Mike_Wicker@fws.gov
04/06/2009 01:36 PM

To Rebecca Fox/R4/USEPA/US@EPA
cc Palmer Hough/DC/USEPA/US@EPA
bcc
Subject Re: DOI elevation deadline

4-9
Fox.Rebecca@epamail.epa.gov

Fox.Rebecca@epamail.epa.gov
04/06/2009 12:29 PM

ToHough.Palmer@epamail.epa.gov
ccMike_Wicker <Mike_Wicker@fws.gov>
SubjectRe: DOI elevation deadline

i thought it was 4-8 but i'm not sure -- better get a definite from
mike...

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

Palmer Hough/DC/USEPA/US
04/06/2009 12:10 PM

To Mike_Wicker <Mike_Wicker@fws.gov>, Rebecca Fox/R4/USEPA/US@EPA

cc

Subject

DOI elevation deadline

Mike/Becky:

What would have been DOI's deadline for elevating PCS to Army,
4/8 or
4/9?

Thanks, Palmer

Palmer F. Hough
US Environmental Protection Agency
Wetlands Division
Room 7231, Mail Code 4502T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Office: 202-566-1374
Cell: 202-657-3114
FAX: 202-566-1375
E-mail: hough.palmer@epa.gov

Street/Courier Address
USEPA
Palmer Hough
EPA West -- Room 7231-L
Mail Code 4502T
1301 Constitution Avenue, NW
Washington, DC 20460

Palmer Hough/DC/USEPA/US
04/06/2009 03:55 PM

To Jefferson.Ryscavage@usace.army.mil, joseph.schroedel@usace.army.mil, Sam_Hamilton@fws.gov, roy.crabtree@noaa.gov,
cc Stan Meiburg/R4/USEPA/US@EPA, Jim Giattina/R4/USEPA/US@EPA, Tom Welborn/R4/USEPA/US@EPA, Jennifer
bcc
Subject EPA concerns regarding proposed Clean Water Act section 404 permit for PCS Phosphates

To:

Mr. Sam Hamilton
Regional Director
US Fish and Wildlife Service, Southeast Region

Dr. Roy Crabtree, Ph.D.
Regional Administrator
NOAA Fisheries, Southeast Region

Brigadier General Joseph Schroedel
Commander
US Army Corps of Engineers
South Atlantic Division

Colonel Jefferson Ryscavage
District Engineer
US Army Corps of Engineers
Wilmington District

Secretary Dee A. Freeman
North Carolina Department of Environment
and Natural Resources

Ms. Coleen Sullins, Director
Division of Water Quality
North Carolina Department of Environment
and Natural Resources

On behalf of Mr. Michael H. Shapiro, the acting US Environmental Protection Agency Assistant Administrator for Water, I would like to share with you a request that EPA transmitted to the Assistant Secretary of the Army - Civil Works (ASA) today. EPA is formally requesting the ASA's review of the Wilmington District's decision to issue a Department of the Army permit for expansion of the PCS Phosphate operation in Beaufort County, NC.

If you have any questions regarding this request, please free to contact me.

Thank you, Palmer Hough

Elevation of Proposal CWA Section 404 Permit PCS.pdf   PCS Elevation to Army_Detailed Comments.pdf

Palmer F. Hough
US Environmental Protection Agency

Wetlands Division
Room 7231, Mail Code 4502T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Office: 202-566-1374
Cell: 202-657-3114
FAX: 202-566-1375
E-mail: hough.palmer@epa.gov

Street/Courier Address
USEPA
Palmer Hough
EPA West -- Room 7231-L
Mail Code 4502T
1301 Constitution Avenue, NW
Washington, DC 20460

"Schafale, Michael" <michael.schafale@ncdenr.gov>

04/06/2009 05:01 PM

To Rebecca Fox/R4/USEPA/US@EPA

cc

bcc

Subject FW: PCS Phosphate Bonnerton Hardwoods

History: This message has been forwarded.

-----Original Message-----
From: Mike Schafale [mailto:michael.schafale@ncmail.net]
Sent: Tuesday, August 26, 2008 2:01 PM
To: Walker, William T SAW
Subject: Re: PCS Phosphate Bonnerton Hardwoods

Hi Tom,

Sorry, I've been away. Answers below. I hope this is in time to help.

Walker, William T SAW wrote:
>
> Mike,
>
> I am trying to gather more info. for the Bonnerton site SNHA
> designation and am hoping you can/will help me with a few things.
>
> 1. According to the Site Survey Report Form and map you supplied
> following your 2005 visits, the Bonnerton site was approximately 203
> ac. (194 primary and 8.9 secondary). According to the January 2008
> publication "Nonriverine wet Hardwood Forests in North Carolina,
> Status and Trends", the Bonnerton site is 198 acres. The information
> supplied by EPA indicates that another 69 acres (45 primary and 24
> secondary) have been added to the site. Could you confirm for me that
> the SNHA is now 271 acres and if so, give some indication of why the
> additional acreage was added after the January 2008 report?
>

I'm sorry this seems like such a moving target. We use whatever information we come up with to update our understanding of things. Since the 2005 report, I've had another visit to the site and have gained access to new aerial photography. There are also two different numbers involved here -- the acreage of the significant natural heritage area (SNHA) and the acreage of Nonriverine Wet Hardwood Forest community. These two aren't the same because the SNHA also contains the headwater stream in the southeast part and the scarp face with its seeps and uplands on the west. It also contains secondary areas that are included in the SNHA as connectors but aren't otherwise in good condition, so you may have seen different acreage figures for primary and secondary SNHA.

I can't remember the details of how and when things have changed. But my most recent visit showed me a new patch of Nonriverine Wet Hardwood Forest, which I added to the SNHA, along with a secondary area to connect it to the other primary areas. I also tweaked the boundaries of the SNHA elsewhere based on aerial photos. Then I mapped the natural natural communities in the SNHA as polygons, and recorded them in our community database. So, the way things stand in our database right now is: the Nonriverine Wet Hardwood Forest community is 198 acres. The SNHA is 271.65 acres, of which 238.85 acres are primary.

And, to make things more complicated, I now have access to 2006 digital aerial photography, which I didn't have when I made the last corrections. And on it, I can see that a portion of the southeastern primary area has recently been clearcut. So, I need to fix the SNHA boundary and community boundary to account for that, but haven't had time to do so yet. That will change both numbers yet again, giving slightly lower acreage figures than the above.

>
> 2. I am still a bit confused regarding the designation process for
> national significance. I think I understand the State significance
> designation to mean that the site is one of the 5 best examples of its
> type in your database. What other states/databases are involved in the
> national ranking process and how is the designation vetted and approved?
>
> I would assume your database has a fairly comprehensive coverage and
> somewhat complete list of all sites in NC (I saw on your website that
> inventories of 80+ counties are either underway or completed). I have
> tried to find information from other states. I could not find that any
> other state had specifically identified Nonriverine Wet Hardwood
> Forest as a community type however, will admit my search was not
> exhaustive. I could not find much available info for NHP in South
> Carolina or Georgia. I did find, I believe, some potential equivalents
> (similar soils, similar species composition) in Virginia and possibly
> Maryland. Based on information from the Virginia NHP website it
> appears that the *Nonriverine wet Hardwood Forest* of NC would
> correspond to the *Non-Riverine Saturated Forests *of VA.* *It did not
> appear that VA had conducted quite as comprehensive a search for this
> community type. From the Maryland NHP website, it appeared that the
> closest match would be the *Liquidambar Styraciflua - (Acer Rubrum)
> Seasonally Flooded Forest Alliance* but I was not able to find much
> info. regarding status and trends. Also, I'm guessing that due to
> differences in climate and geology, one wouldn't really expect to find
> a truly "similar" community in Maryland or further north (?). Would
> these or any other areas be considered equivalent to the Nonriverine
> wet Hardwood Forest and if so, would known occurrences of these forest
> types be included in the national ranking process?
>

Our nationally significant sites are those that we think contain the best examples in the nation (or world really) for one of the elements, in this case Nonriverine Wet Hardwood Forest. It can definitely be harder to distinguish nationally significant sites from state significant, with more limited knowledge of what is going on in other states. In this case, the National Vegetation Classification community that corresponds to our Nonriverine Wet Hardwood Forest ranges from North Carolina only through southeastern Virginia, with most of its occurrences in northeastern North Carolina (north of the Neuse River). Virginia has studied the communities in similar sites north of there, on the eastern shore, and concluded they are a different community type. Virginia has not looked for them as thoroughly as we have, but they have looked for them. When I talked to the ecologist at the Virginia Natural Heritage Program, he indicated that they didn't have any examples known that were both as extensive and as mature as our best examples. Given that we have more than 80% of the global range of the community type, we probably have all of the 5 best examples. But I have been conservative in my analysis and only identified 4 for now. That fact that the Bonnerton site was not discovered in the county inventory and only was found later makes me a bit cautious, but we're running out of places where examples this large could be hiding.

Anyway, at present, national significance designations, like state, are a product of our program's analysis, and are vetted internally by our ongoing analysis, database maintenance, and biennial site significance review process. Other states don't necessarily rate sites using the same concepts, or even rate them at all, so it isn't possible to vet these conclusions with them. But my aerial photo review, analysis, and discussions with Virginia make me more confident about this one than most others.

>

> 3. In a July 9, 2008 e-mail you sent to John Dorney, you indicate that
> the Bonnerton site became nationally significant after other known
> Hardwood Wetland sites were degraded. Were these sites in NC? How were
> these sites degraded? Is there potential for recovery of these sites
> such that they will regain their previous status?
>

There are a large number of sites that have been lost since we started tracking this community type, so it's hard to list them all. One of the most striking losses was the Merritt Hardwoods site in southeastern Pamlico County, which had over 1000 acres of Nonriverine Wet Hardwood Forest into the 1990s. There was another site around 1000 acres in Pamlico County in the 1980s. Though not in one place, over 1000 acres were lost in Currituck County in the 1980s and 1990s, and comparable acreages in several other counties. I didn't track the final fate of these areas closely. Limited acreage was developed or cleared for cultivation. I think most of the acreage was converted to pine plantation. A significant minority was "merely" clearcut and left to regenerate in weedy hardwood or mixed forests. There is possibly some potential for spontaneous recovery in the latter, if any appreciable number of oak seedlings were left. But, given the generation time of trees, such recovery would be measured in centuries. I think it is safe to say none will regain their previous composition, let alone maturity, within our lifetimes, a time in which the remaining mature examples could grow into magnificent old-growth examples if left alone. I have not seen any example that was clearcut and regenerated in anything recognizable as this community type, though parts of the Bonnerton site show that "high grading" can leave enough of the community for reasonable recovery.

It isn't out of the question that these communities could be successfully restored with active effort. I haven't seen it done successfully. Restoration is likely to be most successful on sites where the community occurred until recently, and where it was destroyed by logging but not by mechanical site preparation or clearing. Restoration areas adjacent to existing examples, even if small, are likely to be more successful in that there is a seed source for the smaller plants and animals that aren't deliberately planted. With appropriate planting and sufficient tending, you should be able to establish the appropriate trees. But of course nothing but time can bring maturity or the uneven-aged structure to newly planted restoration sites. And nothing at all can bring the historical continuity that gives one confidence that the most of the smaller organisms are present.

>
> Thanks
>
> Tom
>

--

Michael P. Schafale
Ecologist
North Carolina Natural Heritage Program
Office of Planning and Conservation, Department of Environment and Natural

Resources

1601 Mail Service Center
Raleigh, NC 27699-1601

919-715-8689

michael.schafale@ncmail.net

"Schafale, Michael" <michael.schafale@ncdenr.gov>

04/07/2009 10:16 AM

To Rebecca Fox/R4/USEPA/US@EPA

cc

bcc

Subject RE: PCS question

That is true. Its high significance comes from the community itself, as one of the best examples of a type that has become rare. I don't know that it plays any more role in the aquatic ecosystem than any other of the uncommon naturally-vegetated areas of the watershed. It presumably does supply water by sheet flow to the headwater stream.

-----Original Message-----
From: Fox.Rebecca@epamail.epa.gov [mailto:Fox.Rebecca@epamail.epa.gov]
Sent: Tuesday, April 07, 2009 9:47 AM
To: Schafale, Michael
Subject: RE: PCS question

Mike,

Thanks for sending the email and your clarification on the Bonnerton SNHAs. This is very helpful. One further question -- in the draft ROD the COE characterizes this area this way... it is their understanding that "...NCNHP has designated this site as a SNHA not because of any special value or importance to the aquatic ecosystem, but because it is a terrestrial community that has become increasingly rare in NC". Do you agree with that characterization? Thanks again! b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

"Schafale, Michael" <michael.schafale@ncdenr.gov>

04/06/2009 04:28 PM

To Rebecca Fox/R4/USEPA/US@EPA

cc

Subject RE: PCS question

Do you need to see my email to him? You referenced the date, so I thought you had it. But, it's public information, so it seems like I ought to send it to you if you need it. It was in response to a message from him, which seemed to be based on material he got from John Dorney.

-----Original Message-----
From: Fox.Rebecca@epamail.epa.gov [mailto:Fox.Rebecca@epamail.epa.gov]
Sent: Monday, April 06, 2009 4:25 PM
To: Schafale, Michael
Subject: RE: PCS question

Do you remember if that email discussed the 3 primary areas, especially the northwestern less mature WHF area? Just deciding how to phrase my response. Thanks! b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

"Schafale, Michael" <michael.schafale@ncdenr.gov>		To
	Rebecca Fox/R4/USEPA/US@EPA	cc
04/06/2009 04:19 PM		Subject
	RE: PCS question	

That is the only message I sent to William Walker, and it looks like the only time he emailed me. He did call me and we talked on the phone in April or May of 2008. I can't remember much detail on what we talked about, though it was about this site and the significance of Nonriverine Wet Hardwood Forest. He called me on my cell phone in the field, so I think we couldn't have talked about specific acreages, as I wouldn't have remembered them.

-----Original Message-----
From: Fox.Rebecca@epamail.epa.gov [mailto:Fox.Rebecca@epamail.epa.gov]
Sent: Monday, April 06, 2009 4:11 PM
To: Schafale, Michael
Subject: RE: PCS question

Thanks Mike!

Your characterization below fits precisely with my understanding of this area. I will be responding to the COE's discussion of the SNHA in the draft ROD and was just wondering if you remember if in your August message or if you had any other correspondence with them where you laid out the information of the SNHA as is discussed in your message below? Thanks again for all your help with this project! bf

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

"Schafale, Michael" <michael.schafale@ncdenr.gov>

04/06/2009 03:42 PM

To: Rebecca Fox/R4/USEPA/US@EPA

cc:

Subject: RE: PCS question

Hi Becky,

That's not what I meant to convey in my August message to William Walker. The SNHA has 3 separate primary areas. All have forest mature enough to be highly significant. The northwestern area is the least mature of the three, but it is still mature and highly significant. The secondary areas of the SNHA are younger forests or forests of altered composition. They are included to function as connectors of the primary areas rather than being significant in themselves.

The southwestern primary area has a seepage community on the scarp face, which is not Nonriverine Wet Hardwood Forest. It is not a headwater stream though. The headwater stream is in the southeastern primary area. The northwestern primary area, as far as I know based on the one visit that you were also on, is all Nonriverine Wet Hardwood Forest. I brought up these communities in my August message to explain the discrepancy in acreage between the SNHA and the Nonriverine Wet Hardwood Forest community. They are both wetlands too, but as I understand it, are not proposed to be mined.

I'm not clear what the 73 acres refers to. I did add acreage to the SNHA after our visit in November 2007: roughly 45 acres for the northwestern primary area and 24 acres for a secondary area to connect it to the other primary areas. That is close to 73 acres but not quite.

-----Original Message-----

From: Fox.Rebecca@epamail.epa.gov [mailto:Fox.Rebecca@epamail.epa.gov]
Sent: Monday, April 06, 2009 3:12 PM
To: Schafale, Michael
Subject: Fw: PCS question

Hi Mike,

As you may have heard, EPA is elevating to the Assistant Secretary of the Army (Civil Works) the COE's permit decision for PCS. One of the things we are asking for is full protection of the SNHA including the north west more recently disturbed area. In reading through the COE's draft Record of [illegible]ecision an email correspondence from you is cited and I wanted to check [illegible] see if the context is correct. The topic is the additional 73 [illegible]es that was added to the original SNHA and the COE states that y[illegible] [illegible]y that the additional acreage is a headwater stream on the face of t[illegible] [illegible]ffolk Scarp to the west of the Bonnerton Tract and other
areas that ar[illegible] [illegible]luded as "connectors but aren't otherwise in good condition". [illegible] my understanding that the scarp area was in the original sout[illegible] [illegible]rea that will be protected by the DWQ 401 and that the 73 acres [illegible]es approximately 45 acres of the less mature wet hardwood fore[illegible] the connecting area between this area and the more mature area t[illegible] [illegible]outh. The discussion citing you in the ROD does not mention the l[illegible] [illegible]ure WHF. Just wanted to check to see if this is an [illegible] char[illegible] [illegible]zation of your communication with them. The cite [illegible] [illegible]om 8-26-08. Thanks Mike, Becky

Becky [illegible]
[illegible]on
[illegible]
[illegible]
[illegible] bec

Palmer Hough/DC/USEPA/US
04/07/2009 05:29 PM

To tjregan@potashcorp.com, rsmith@pcsphosphate.com, jfurness@pcsphosphate.com, ghouse@brookspierce.com, liebesman@hklaw.com

cc Stan Meiburg/R4/USEPA/US@EPA, Jim Giattina/R4/USEPA/US@EPA, Tom Welborn/R4/USEPA/US@EPA, Jennifer

bcc

Subject EPA concerns regarding proposed Clean Water Act section 404 permit for PCS Phosphate

History: This message has been forwarded.

To:

Thomas Regan
President, PCS Phosphate and PCS Nitrogen
Suite 500
122 - 1st Avenue, South
Saskatoon, SK Canada S7K783

Ross Smith
Environmental Affairs Manager
PCS Phosphate
1530 NC Highway 306 South
Aurora, NC 27806

Jeff Furness
Senior Environmental Scientist
PCS Phosphate
1530 NC Highway 306 South
Aurora, NC 27806

George House
2000 Renaissance Plaza
230 North Elm Street
Greensboro, NC 27420

Lawrence R. Liebesman
Holland and Knight
2099 Pennsylvania Ave, NW
Suite 100
Washington, DC 20006

On behalf of Mr. Michael H. Shapiro, the acting US Environmental Protection Agency Assistant Administrator for Water, I would like to share with you a request that EPA transmitted to the Assistant Secretary of the Army - Civil Works (ASA) yesterday. EPA is formally requesting the ASA's review of the Wilmington District's decision to issue a Department of the Army permit for expansion of the PCS Phosphate operation in Beaufort County, NC.

If you have any questions regarding this request, please free to contact me.

Thank you, Palmer Hough

Elevation of Proposal CWA Section 404 Permit PCS.pdf PCS Elevation to Army_Detailed Comments.pdf

Palmer F. Hough
US Environmental Protection Agency
Wetlands Division
Room 7231, Mail Code 4502T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Office: 202-566-1374
Cell: 202-657-3114
FAX: 202-566-1375
E-mail: hough.palmer@epa.gov

Street/Courier Address
USEPA
Palmer Hough
EPA West -- Room 7231-L
Mail Code 4502T
1301 Constitution Avenue, NW
Washington, DC 20460

Rebecca Fox /R4/USEPA/US
04/08/2009 02:39 PM

To riverkeeper@ptrf.org
cc
bcc
Subject Fw: EPA concerns regarding proposed Clean Water Act section 404 permit for PCS Phosphate

Hi Heather,

Here is the package we sent out. We had to wait until we had sent to PCS before sharing. Will send letter from Tom Regan later. bf

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov
----- Forwarded by Rebecca Fox/R4/USEPA/US on 04/08/2009 02:30 PM -----

On behalf of Mr. Michael H. Shapiro, the acting US Environmental Protection Agency Assistant Administrator for Water, I would like to share with you a request that EPA transmitted to the Assistant Secretary of the Army - Civil Works (ASA) yesterday. EPA is formally requesting the ASA's review of the Wilmington District's decision to issue a Department of the Army permit for expansion of the PCS Phosphate operation in Beaufort County, NC.

If you have any questions regarding this request, please free to contact me.

Thank you, Palmer Hough

Elevation of Proposal CWA Section 404 Permit PCS.pdf PCS Elevation to Army_Detailed Comments.pdf

Palmer F. Hough
US Environmental Protection Agency
Wetlands Division
Room 7231, Mail Code 4502T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Office: 202-566-1374
Cell: 202-657-3114
FAX: 202-566-1375
E-mail: hough.palmer@epa.gov

Street/Courier Address
USEPA
Palmer Hough
EPA West -- Room 7231-L
Mail Code 4502T
1301 Constitution Avenue, NW
Washington, DC 20460

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

APR 3 - 2009

OFFICE OF WATER

The Honorable John Paul Woodley, Jr.
Assistant Secretary of the Army (Civil Works)
108 Army Pentagon
Room 3E446
Washington, DC 20310-0108

Dear Secretary Woodley:

In accordance with the provisions of the 1992 Memorandum of Agreement (MOA) between the U.S. Environmental Protection Agency (EPA) and the Department of the Army under Section 404(q) of the Clean Water Act (CWA), I am requesting your review of a decision by Colonel Jefferson M. Ryscavage, U.S. Army Corps of Engineers (the Corps), Wilmington District (the District), to issue a Section 404 permit to the Potash Corporation of Saskatchewan Phosphate Division (PCS or the Applicant) to expand an existing phosphate mining operation (Action ID: AID 200110096) in Beaufort County, North Carolina (NC). The 15,100 acre project area is located adjacent to the Pamlico River which is part of the nationally significant Albemarle Pamlico Estuary Complex. The project area contains 6,293 acres of wetlands and 115,843 linear feet of streams that support the Albemarle Pamlico Estuary and collectively constitute aquatic resources of national importance (ARNI). The proposed mine advance involves mining and mining related activities within approximately 11,454 acres, resulting in direct adverse impacts to approximately 3,953 acres of wetlands and 25,727 linear feet of streams. In addition to our concerns regarding the magnitude of the project's adverse impacts to the site's important aquatic resources, we believe there is compelling evidence that additional avoidance, minimization, and compensation are practicable under the CWA Section 404(b)(1) Guidelines (Guidelines). After a thorough review of the available information, I have determined this case warrants elevation to you in accordance with the criteria under Part IV of the MOA, Elevation of Individual Permit Decisions.

This referral meets the criteria in Part IV of the 1992 EPA/Army Section 404(q) MOA. EPA finds that the proposed discharge of fill material into waters of the United States and associated direct and indirect impacts will result in substantial and unacceptable impacts to an aquatic resource of national importance. I want to emphasize, however, our conclusions regarding the current mining proposal do not mean EPA is opposed to additional mining at the site. We believe that a modified mining proposal consistent with the regulations and the CWA could proceed and I am interested in working with you and the mining company to identify an acceptable alternative. However, we do not believe, as currently proposed, the permit complies with the requirements of the Guidelines.

Substantial and Unacceptable Impacts to an ARNI

The 15,100 acre project area is composed of three tracts identified as the NCPC, Bonnerton and South of NC Highway 33 (S33) tracts. There are wetlands on all three tracts that perform important ecological functions that support the Albemarle Pamlico Estuary such as temporary storage of surface water, nutrient cycling, organic carbon export, pollutant filtering/removal, and maintenance of biologically diverse plant and animal habitat. Similarly, there are streams on all three tracts that perform important ecological functions that support the Albemarle Pamlico Estuary such as the transport of water, nutrients and sediment downstream, pollutant processing and removal, and maintenance of biologically diverse plant and animal habitat. We recognize that not all of the approximately 3,953 acres of wetlands and 25,727 linear feet of streams that would be impacted by the proposed project perform all of these respective functions to the same degree (because of their position in the landscape and/or their level of prior disturbance); however, the loss of this entire suite of wetland and stream functions on this scale raises serious ecological concerns.

The proposed permit would represent the single largest wetland impact ever authorized under the CWA in NC and would result in a significant loss of wetlands, streams and other waters of the United States within the nationally significant Albemarle Pamlico Estuary Complex. EPA is particularly concerned with the proposed project's:

- Direct impacts to a 271 acre nonriverine hardwood wetland forest on the Bonnerton tract that has been designated as a Nationally Significant Natural Heritage Area by the NC Natural Heritage Program, and
- Indirect impacts to the site's ten tidal creeks, four of which have been designated as Primary Nursery Areas by the NC Wildlife Resources Commission, associated with the 70 percent reduction in the drainage basins for these creeks.

Nationally Significant Natural Heritage Area: The NC Natural Heritage Program designates areas in the state which it has determined to be important for conservation of the state's biodiversity as Significant Natural Heritage Areas. These areas can be classified as significant by the Natural Heritage Program at the county, regional, state or national level. The fact that the Bonnerton tract's Significant Natural Heritage Area has been classified as nationally significant means the Natural Heritage Program has determined it to be one of the five best examples of this community type in the Nation. This wet hardwood forest community type found on the Bonnerton tract is considered to be among the most threatened and endangered of NC's natural communities. The proposed project would directly impact approximately 97 acres of this ecologically valuable and rare wetland system and would allow mining through the middle of the Significant Natural Heritage Area, bisecting it into two separate and smaller pieces, an eastern and a western piece. This large reduction in size and the fragmentation of the Significant Natural Heritage Area into two separate pieces would undermine some of the key ecological characteristics which make it ecologically valuable and "nationally significant." Although the NC Division of Water Quality's (NCDWQ) CWA Section 401 Water Quality Certification requires the mined out area between the eastern and western pieces to be restored after mining, we believe it will be extremely difficult, based on the current state of the science, to restore this area to its prior condition after mining and this will have a significant detrimental impact to the integrity of this rare and threatened biological community.

Tidal Creeks/Primary Nursery Areas: EPA also has strong concerns with the proposed project's indirect impacts to the project area's ten tidal creeks, four of which have been classified by the NC Wildlife Resource Commission as Primary Nursery Areas. Although the proposed project would not directly impact the perennial reaches of the four Primary Nursery Areas, the headwater drainages of the project site's tidal creeks (including those designated as Primary Nursery Areas) would be reduced by approximately 70 percent. Our concerns regarding the proposed drainage basin reductions are amplified on the NCPC tract since its watersheds have already lost approximately 1,268 acres of wetlands as part of the Applicant's existing mining permit issued by the District in 1997.

Eliminating the headwater streams and wetlands and significantly reducing the drainage areas of the project site's Primary Nursery Areas and other tidal creeks would:

- Reduce flow from ground water and increase variability in surface water flows to the tidal creeks, thereby increasing the frequency and magnitude of short-term salinity fluctuations;
- Reduce filtration of nutrients and other contaminants previously accomplished by the site's streams and wetlands, increasing sedimentation and turbidity in tidal creeks;
- Reduce productivity of native fish and shellfish in the downstream estuary by disrupting the estuarine food web (caused by a reduction of organic materials critical for biological activity in the surface water drainage); and
- Shift downstream estuarine productivity from the benthic community which is dominated by sensitive submerged aquatic vegetation and benthic invertebrate species to tolerant phytoplankton species. This would exacerbate ongoing environmental stress and create an open niche for problematic invasive plant and animal species to colonize and degrade the estuary.

We believe the disruption of these processes and functions in the drainage basin will significantly impact the site's tidal creeks and impair the ability of these systems to function as Primary Nursery Areas.

In summary, EPA believes the impacts to ecological functions at the scale associated with this project, as described above, would cause or contribute to significant degradation [40 CFR 230.10(c)] of the Nation's waters.

Alternatives Analysis

A key provision of the Guidelines requires evaluation of practicable alternatives which satisfy the project's primary purpose. The Guidelines provide that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem" [40

CFR 230.10(a)]. An alternative is practicable if "it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." [40 CFR 230.10(a)(2)].

The proposed project's Final Environmental Impact Statement (FEIS) evaluated eleven alternative mining alignments and a "No-Action" alternative. During the review process, EPA Region 4 has consistently expressed concerns regarding the economic analysis conducted in support of the District's alternatives review. The Guidelines also require selection of the least environmentally damaging practicable alternative (LEDPA). I understand, however, the "LEDPA" identified by the District in the FEIS has since been replaced with a less-damaging alternative required by the NCDWQ's CWA Section 401 Water Quality Certification. Our review indicates that the new "LEDPA" may still not be the least damaging alternative, as required by the Guidelines.

Minimizing and Compensating for Adverse Impacts

The Guidelines require that adverse environmental impacts associated with the proposed discharge of fill material to waters of the United States first be avoided to the maximum extent practicable and then minimized to the extent appropriate and practicable. For unavoidable impacts which remain, compensatory mitigation is required to offset wetland and other aquatic resource losses. In addition to the need to further avoid impacts to the site's high value aquatic resources, we also believe that additional measures can be taken to minimize the impact of the mining project on avoided aquatic resources by improving the quality of the reclamation area (i.e., re-using top soil and re-vegetating with target plant species). Further, we recommend that all avoided aquatic resources be provided permanent protection from future mining with appropriate binding real estate instruments such as conservation easements.

We also have concerns regarding the adequacy of the proposed compensatory mitigation to offset authorized impacts to mature forested wetlands. In light of the very unique and rare qualities of the Nationally Significant Natural Heritage Area, it is not clear that its attributes could be replaced by compensatory mitigation, raising concerns regarding significant degradation [40 CFR 230.10(c)]. Additionally, for impacts to other mature forested wetlands, not located in the Nationally Significant Natural Heritage Area, we continue to have concerns that the proposed compensatory mitigation will not adequately offset impacts to these systems. Even if proposed efforts to replace mature forested wetlands with immature restored or created wetlands are successful, the replacement wetlands will not provide the same level of physical, chemical, and biological processes and functions as the impacted forested wetland systems for a very long time (e.g., 60 to 80 years). The current plan requires 2:1 compensation ratios for these impacts. We continue to believe that compensation ratios of 3:1 would better address the temporal losses associated with the replacement of this wetland type.

EPA/FWS/NMFS Recommended Alternative

Although the formal permit elevation process was initiated with the District's February 24, 2009, Notice of Intent (NOI) letter, EPA has continued to coordinate with the District and the Applicant in an effort to resolve our concerns regarding the proposed project. To this end, on March 24, 2009, representatives from EPA, the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) met with the District and the Applicant to discuss our continued concerns with the proposed project. At that meeting EPA and the Services presented a potential alternative plan for mining the site that would address the concerns raised by the agencies by avoiding and minimizing impacts to the aquatic ecosystem, consistent with the Guidelines. The EPA/FWS/NMFS proposal would provide:

- Additional avoidance designed to reduce the direct and indirect impacts of the mining project on the site's Nationally Significant Natural Heritage Area as well as the site's tidal creeks, including those identified as Primary Nursery Areas;
- Measures to ensure that avoided aquatic resources are provided permanent protections from future mining with appropriate binding real estate instruments such as conservation easements;
- Measures to be taken to minimize the impact of the mining project on avoided aquatic resources by improving the quality of the reclamation areas (i.e., re-using top soil and re-vegetating with target plant species); and
- Measures to be taken to improve the monitoring and adaptive management of both the mining and mitigation sites.

EPA believes that this alternative, if practicable, would also address the primary concerns of those who are challenging the NCDWQ's CWA Section 401 certification of the project, and threatening potential litigation. The Applicant expressed a desire to review the new alternative and noted that its evaluation could take a month or longer. We believe that we cannot conclude that this alternative proposal, or a modified version of it, is not practicable until we have heard back from the Applicant.

Conclusions and Recommendations

In summary, we believe that the permit, as proposed, would fail to comply with the Guidelines for the following reasons:

1. There are less environmentally damaging practicable alternatives that meet the project purpose [40 CFR 230.10(a)];
2. The project's direct and indirect impacts to high value wetland and stream systems including areas designated as Nationally Significant Natural Heritage Areas and Primary Nursery Areas would cause or contribute to significant degradation of the Nation's waters [40 CFR 230.10(c)]; and
3. All appropriate and practicable steps have not been taken to minimize and compensate for the project's adverse impacts to waters of the United States [40 CFR 230.10(d)].

I request, therefore, that your office coordinate with the District to: 1) in coordination with the Applicant, withdraw the NOI letter and initiate further analysis of the new proposed alternative to determine whether such alternative, or a modification of it, would be practicable, and thus the "LEDPA"; **or** 2) revise the proposed permit consistent with the following: a) revise its alternatives analysis for the proposed project to address inconsistencies that bias identification of the LEDPA, b) in development of the LEDPA, avoid direct impacts to the Nationally Significant Natural Heritage Area and indirect impacts to the site's tidal creeks, including those identified as Primary Nursery Areas, to the maximum extent practicable, c) incorporate all appropriate and practicable measures to minimize the impact of the mining project on avoided aquatic resources by improving the quality of the reclamation areas (i.e., re-using top soil and re-vegetating with target plant species), d) ensure that all avoided aquatic resources are provided permanent protection from future mining with the appropriate binding real estate instruments such as conservation easements, e) revise the compensatory mitigation plan to effectively offset impacts to mature forested wetlands and f) include measures to ensure effective monitoring and adaptive management of both the mining and mitigation sites.

EPA has attempted to reach resolution of our concerns with the District and the Applicant. We believe your support for continuation of these discussions would provide the opportunity for successful resolution, and obviate the need to complete this elevation. I appreciate your personal attention to this important matter.

My request for your review of the District's permit decision is based on information provided to EPA in the District's NOI letter. I am concerned that we continue to receive a significant amount of new information regarding the project from the District even as recently as this afternoon. We look forward to working with you in the context of this elevation to consider this new information.

Should you have any questions or concerns regarding this matter, please contact me or have your staff contact Palmer Hough of my staff at (202) 566-1374.

Sincerely,

Michael H. Shapiro
Acting Assistant Administrator

Enclosure

Cc: Colonel Jefferson M. Ryscavage, U.S. Army Corps of Engineers, Vicksburg District
Brigadier General Joseph Schroedel, South Atlantic Division, U.S. Army Corps of Engineers
Sam Hamilton, U.S. Fish and Wildlife Service
Dee Freeman, NC Department of Environment and Natural Resources
Coleen H. Sullins, NC Department of Environment and Natural Resources, Division of Water Quality
A. Stanley Meiburg, EPA
James D. Giattina, EPA

Enclosure

Detailed Comments on Proposed PCS Phosphate Mine Expansion Section 404 Permit

I. Introduction

This referral meets the criteria in Part IV of the 1992 EPA/Army Section 404(q) Memorandum of Agreement (1992 MOA). EPA finds that the proposed discharge would result in substantial and unacceptable impacts to waters of the United States, including wetlands, in the Albemarle Pamlico River estuary system, aquatic resources of national importance (ARNI). On February 24, 2009, the District Engineer for the U.S. Army Corps of Engineers Wilmington District (the Corps) issued a Notice of Intent to issue a Clean Water Act (CWA) Section 404 permit to the Potash Corporation of Saskatchewan Phosphate Division (PCS or the Applicant) to expand an existing phosphate mining operation (Action ID: AID 200110096). Pursuant to the Corps' authority under CWA Section 404, this permit would authorize the discharge of dredged and fill material to waters of the United States associated with a mine advance into the approximately 15,100 acre project area surrounding PCS's current mining operation adjacent to the Pamlico River, north of Aurora, Beaufort County, North Carolina (NC).

The proposed mine advance will involve mining and mining related activities within approximately 11,454 acres, resulting in direct adverse impacts to approximately 3,953 acres of wetlands and 25,727 linear feet of stream. The mining and mining related impacts would take place in three tracts identified as the NCPC, Bonnerton and South of NC Highway 33 (S33) tracts (see Figure 1).

EPA is very concerned with the magnitude of the direct and indirect impacts to wetlands and other waters which support the nationally significant Albemarle Pamlico Estuary System. Of particular concern are portions of a nonriverine wetland hardwood forest that have been designated as a Nationally Significant Natural Heritage Area by the NC Natural Heritage Program and would be directly impacted by the proposed project. The project would also result in the loss of approximately 70 percent of the watersheds of the project area streams which drain to estuaries of the Pamlico River resulting in indirect impacts to these important estuary systems. EPA also has specific concerns regarding the proposed project's indirect impacts to these estuary systems, four of which have been designated as Primary Nursery Areas by the NC Wildlife Resources Commission.

Based on EPA's review of the economic analysis included in the project's Final Environmental Impact Statement (FEIS), we continue to believe that there are less environmentally damaging practicable alternatives for mining the project site that would avoid and minimize impacts to important wetland and stream resources. In addition to the need to further avoid impacts to the site's high value aquatic resources, we also believe that additional measures can be taken to minimize the impact of the mining project on avoided aquatic resources by improving the quality of the reclamation area (i.e., re-using top soil and re-vegetating with target plant species). Further, all avoided aquatic resources should be provided permanent protection from future

Figure 1 illustrates the PCS project boundary. Mining and mining related impacts would take place in three tracts identified as the NCPC, Bonnerton and South of NC Highway 33 (S33) tracts.

mining with appropriate binding real estate instruments such as conservation easements. We also have concerns regarding the adequacy of the proposed compensatory mitigation to offset authorized impacts to mature forested wetlands. Finally, we believe that additional measures are necessary to improve the monitoring and adaptive management of both the mining and mitigation sites.

Based on our review of the proposed project, we believe it fails to comply with the Section 404(b)(1) Guidelines (the Guidelines) for the following reasons:

1. There are less environmentally damaging practicable alternatives that meet the project purpose [40 CFR 230.10(a)];
2. The project's direct and indirect impacts to high value wetland and stream systems including areas designated as Nationally Significant Natural Heritage Areas and Primary Nursery Areas would cause or contribute to significant degradation of the Nation's waters [40 CFR 230.10(c)]; and
3. All appropriate and practicable steps have not been taken to minimize and compensate for the project's adverse impacts to waters of the United States [40 CFR 230.10(d)].

II. Project History

In August 1997, the Corps issued PCS a permit to impact approximately 1,268 acres of wetlands in order to mine phosphate next to its phosphate processing plant on the Hickory Point peninsula adjacent to the Pamlico River and South Creek in Beaufort County, NC. On November 2, 2000, PCS applied for a permit from the Corps to continue its phosphate mining operation into a 3,608-acre tract, known as the NCPC tract, situated east of PCS's current mining operation. The Corps issued a public notice describing this application on October 4, 2001. The requested authorization would impact 2,408 acres of wetlands and other waters of the United States, including wetlands that were "avoided" as part of the 1997 permit negotiations because of their high ecological value. In response to this pubic notice, EPA submitted comment letters on October 25, 2001 and November 20, 2001, pursuant to paragraphs 3(a) and (b) of Part IV of the 1992 MOA, stating that we determined that the project, as proposed, will result in substantial and unacceptable impacts to aquatic resources of national importance. We also stressed the need to avoid and minimize impacts to these valuable aquatic resources and highlighted the need to explore less environmentally damaging alternatives for mining the project site.

Based on the comments received in response to the October 2001 public notice, the Corps prepared an Environmental Impact Statement (EIS) and established an interdisciplinary team (Review Team).[1] The Review Team's role was to identify major issues to be addressed in the EIS and assist with the identification of potentially less environmentally damaging alternatives. EPA was an active participant in the Review Team which met over twenty times during the development of the project's EIS.

On October 20, 2006, the Corps released the Draft EIS (DEIS) and, via public notice, requested comments on both the DEIS as well as the proposed action. The DEIS examined mining impacts

[1] The Review Team was comprised of representatives from state and federal regulatory and commenting agencies, environmental advocacy groups, the Applicant and the Applicant's consultant, CZR Incorporated.

on the NCPC Tract and two additional sites known as the Bonnerton tract (2,806 acres) and the S33 tract (8,686 acres). Nine alternative mining alignments and a "No-Action" alternative were identified for further study in the DEIS. The Applicant's Preferred alternative (AP) was to mine solely on the NCPC tract. An additional Expanded Applicant-Preferred alternative (EAP) proposed mining on all three tracts (NCPC, Bonnerton, and S33) and was also considered practicable by PCS.

Following release of the DEIS, EPA provided a memorandum and two formal comment letters to the Corps. EPA's January 17, 2007 memorandum, prepared by Dr. Adam Daigneault, an EPA economist, provided recommendations for improving the presentation of the DEIS's economic analysis. EPA's February 9, 2007, letter from its National Environmental Policy Act (NEPA) Program Office provided additional comments regarding the DEIS's economic analysis and raised additional concerns regarding the adequacy of the DEIS. Specifically, EPA identified significant environmental concerns that were the basis for rating the AP alternative as "EO-2, Environmental Objections, Insufficient Information". The focus of EPA's concern was that, of all the alternatives considered, the AP and the EAP alternative were the most environmentally damaging. The AP alternative would impact approximately 2,408 acres of wetlands and 38,558 linear feet of stream on the NCPC tract, and the EAP alternative would impact approximately 5,667 acres of wetlands and 89,150 linear feet of stream across all three tracts (see Table 1). EPA further concluded that the economic modeling conducted by PCS to determine the fiscal viability of each of the nine mining alternatives failed to demonstrate why the less environmentally damaging Alternatives SCR and SJA were not feasible. EPA's February 9 and March 6, 2007, letters from its Region 4 Water Management Division reiterated concerns regarding the proposed project's direct and indirect adverse impacts on wetlands and other aquatic resources of national importance, the need to avoid and minimize these impacts and the availability of less environmentally damaging alternatives.

Table 1: Wetland and stream impacts for the ten alternatives evaluated in the DEIS

Alternative	*Total Area*	*Total Wetlands*	*Wetlands Impacted*	*% Wetlands Impacted*	*Total Streams*	*Streams Impacted*	*% Streams Impacted*
	acres	acres	acres	%	linear feet	linear feet	%
AP	3412	2500	2408*	96%	55528	38558	69%
EAPA	13961	6404	5667*	88%	115843	89150	77%
EAPB	13961	6404	5667*	88%	115843	89150	77%
No Action	5745	1691	0	0%	43209	0	0%
S33AP	7743	1691	1130	67%	43209	33486	77%
DL1B	9033	6404	2285	36%	115843	13854	12%
SCRA	10659	6404	3506	55%	115843	14360	12%
SCRB	10659	6404	3506	55%	115843	14360	12%
SJAA	12891	6404	5031	79%	115843	2508	2%
SJAB	12891	6404	5031	79%	115843	2508	2%

During the DEIS comment period, the Applicant proposed changes regarding how the cost of mine development activities are averaged, specifically the cost of mine relocation to S33 which is located south of NC Highway 33. The Applicant argued that this change was necessary to facilitate comparison of alternatives to the Applicant's original request for a 15 year mining plan in the NCPC tract (AP alternative) which is located, along with the Bonnerton tract, north of NC Highway 33. After evaluating the PCS proposal, the Corps incorporated the Applicant's argument into the alternatives analysis identifying only those alternatives that provide at least 15 years of mining in the two tracts north of Highway 33 (i.e., NCPC and Bonnerton) as practicable. Then the Corps developed an additional alternative (Alternative L), fully contained within the project boundary, which provides 15 years of mining north of Highway 33. PCS, on its own initiative, submitted a separate additional alternative (Alternative M). Alternatives L and M were evaluated in a Supplemental DEIS (SDEIS) filed on November 16, 2007. The Corps' stated intent for this document was neither to respond to comments received on the DEIS nor to correct any information presented in the DEIS. Hence, the Corps did not address EPA's earlier concerns and requests for additional information, intending instead to address these issues in the FEIS.

On December 28, 2007, EPA provided comments in response to the SDEIS. We reiterated our concerns regarding the proposed project's adverse impacts to aquatic resources of national importance. Consistent with our rating of the AP alternative in the DEIS, EPA rated Alternative L as "EO-2, Environmental Objections, Insufficient Information" because of the magnitude of impacts on wetland resources. We also raised significant concerns regarding the Corps' decision to change a key aspect of the DEIS's economic analysis, specifically introduction of the criterion that only those alternatives that provide at least 15 years of mining in the two tracts north of Highway 33 (i.e., NCPC and Bonnerton) are practicable. This change creates inconsistencies in the FEIS's economic analysis that bias it in favor of the more extractive and environmentally damaging alternatives, by eliminating numerous alternatives in the SDEIS that had been determined to be practicable in the DEIS, alternatives that are much less environmentally damaging than the proposed project.

EPA believes the modification made to the economic analysis in the SDEIS was not appropriate and that the alternatives excluded from the SDEIS were indeed practicable. In an effort to illustrate this point, EPA requested that our National Center for Environmental Economics review the economic analysis included in the SDEIS. EPA's review of the economic analysis included in the SDEIS (discussed below) concluded that there are less environmentally damaging practicable alternatives to the proposed project. EPA met with the Corps on numerous occasions to share the results of its review and discuss our concerns regarding the modifications to the economic analysis in the SDEIS.

The project's FEIS was published on May 23, 2008. The FEIS identified Alterative L, which was introduced in the SDEIS, as the Applicant's proposal. Alternative L would impact approximately 4,115 acres of wetlands and 29,288 linear feet of stream. Although the FEIS acknowledges EPA's concerns with the changes that were made to the economic analysis in the SDEIS, the analysis was nevertheless carried forward in the FEIS.

On July 23, 2008, EPA provided comments on the FEIS. In this letter, we reiterate our continued concerns regarding the project's direct and indirect impacts to aquatic resources of national importance and the continued need to avoid and minimize impacts to these high value aquatic resources. EPA concluded that the proposed project "would have significant and long-term, direct and cumulative impacts to biocommunities in various waters of the United States which support the nationally significant Albemarle Pamlico Estuary System." The letter notes EPA's continued belief that, based on our review of the economic analysis included in the FEIS, that there are less environmentally damaging practicable alternatives for mining the project site. EPA indicated that our remaining concerns regarding the project could be successfully resolved with greater evaluation of Alternative S33 and further modifications to Alternative L.

On January 15, 2009, the North Carolina Division of Water Quality (NCDWQ) issued its CWA Section 401 Water Quality Certification. In doing so it concluded that additional steps needed to be taken to avoid and minimize impacts to high value aquatic resources at the project site. NCDWQ did not issue its certification for Alternative L. Among a number of changes, it required additional avoidance of impacts to high value aquatic resources; specifically it protected a portion of the site's Nationally Significant Natural Heritage Area from mining and required that this avoided area be protected by a conservation easement. The project certified by NCDWQ, identified as Modified Alternative L, would impact approximately 3,953 acres of wetlands and 25,727 linear feet of stream. Thus, although the FEIS concludes that Alternative L is the least environmentally damaging practicable alternative (LEDPA), NCDWQ's certification of a project that further reduces aquatic resource impacts demonstrates that less environmentally damaging practicable alternatives to the project proposed in the FEIS (Alternative L) in fact exist. Although the NCDWQ's Modified Alternative L includes some additional measures designed to avoid and minimize impacts to important aquatic resources, we continue to believe that additional measures are necessary and practicable. Finally, on March 12, 2009, four environmental groups filed a petition challenging NCDWQ's certification citing, among other concerns, that the certification, which allows impacts to nearly 4,000 acres of wetlands, would result in violations of state water quality standards.

On February 24, 2009, the Corps sent EPA a Notice of Intent to issue a CWA Section 404 permit to PCS for the project certified by NCDWQ, Modified Alternative L. On March 17, 2009, EPA notified the Corps that, pursuant to Part IV, paragraph 3(d)(2) of the 1992 MOA, it was requesting review of the proposed permit by the Acting Assistant Administrator of EPA's Office of Water, and recommending that he request review of the permit by the Assistant Secretary of the Army for Civil Works.

Although the formal permit elevation process was initiated with the Corps' February 24, 2009, letter, EPA has continued to coordinate with the Corps and the Applicant in an effort to resolve our concerns regarding the proposed project. To this end, on March 24, 2009, representatives from EPA, the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) met with the Corps and the Applicant to discuss our continued concerns with the proposed project. At that meeting, EPA, FWS and NMFS presented a potential alternative plan for mining the site that would address the concerns raised by the agencies by avoiding and minimizing impacts to the aquatic ecosystem, consistent with the Guidelines. EPA, FWS and NMFS also noted that we had consulted with the environmental groups who are challenging the NCDWQ's CWA Section 401 certification of the project and had attempted to address many of the environmental groups' concerns in the alternative put forward at the March 24, 2009, meeting.

As discussed in more detail below, the EPA/FWS/NMFS proposal would provide:

- Additional avoidance designed to reduce the direct and indirect impacts of the mining project on the site's Nationally Significant Natural Heritage Area as well as the site's tidal creeks, including those identified as Primary Nursery Areas;
- Measures to ensure that avoided aquatic resources are provided permanent protection from future mining with appropriate binding real estate instruments such as conservation easements;
- Measures to be taken to minimize the impact of the mining project on avoided aquatic resources by improving the quality of the reclamation areas (i.e., re-using top soil and re-vegetating with target plant species); and
- Measures to be taken to improve the monitoring and adaptive management of both the mining and mitigation sites.

During the March 24, 2009, meeting, the Applicant requested more details regarding the agencies' proposal so that it could conduct a more thorough evaluation. The agencies agreed to provide the Corps and the Applicant with the Geographic Information System (GIS) coverages for the proposed new mining boundaries on the NCPC and Bonnerton tracts (the mining boundary on the South of 33 tract remained the same as Modified Alternative L). EPA/FWS/NMFS also agreed to provide additional language describing the proposed reclamation provisions and monitoring provisions presented at the meeting. This information was provided to the Corps and the Applicant on March 30, 2009. The Applicant expressed a desire to review the new alternative and noted that its evaluation could take a month or longer. We believe that we cannot conclude that this alternative proposal, or a modified version of it, is not practicable until we have heard back from the Applicant.

While we remain hopeful that there are opportunities to resolve our concerns with the proposal, discussions with the Corps and the Applicant have not yielded such a result. As we continue to have outstanding concerns, the timeframes outlined in our 1992 MOA dictate that we must share these concerns with the Assistant Secretary of the Army for Civil Works by April 6, 2009.

III. Aquatic Resources of National Importance

The 15,100 acre project area is located adjacent to the Pamlico River which is part of the nationally significant Albemarle Pamlico Estuary Complex (see Figure 2). The project area contains 6,293 acres of wetlands and 115,843 linear feet of streams that support the Albemarle Pamlico Estuary and collectively constitute aquatic resources of national importance (ARNI). The Albemarle Pamlico Estuary Complex is the largest lagoonal estuary and second largest estuarine complex in the United States and is itself an ARNI. The fringe marshes, creeks, and beds of submerged aquatic vegetation in the Albemarle Pamlico Estuary Complex provide essential nursery habitat for most commercial and recreational fish and shellfish in the North Carolina coastal area (Street et al., 2005) and important habitat for waterfowl[2], shorebirds and other migratory birds. The importance of wetlands to coastal fish is not unique to North Carolina. Over 95 percent of the finfish and shellfish species commercially harvested in the United States are wetland-dependent (Feierabend and Zelazny, 1987). More than 70 percent of

[2] See FWS waterfowl survey website: http://www.fws.gov/birddata/databases/mwi/mwidb.html

the commercially or recreationally valuable fish species of the Atlantic seaboard rely on the Albemarle-Pamlico system for some portion of their life cycle and more than 90 percent of the fish caught in NC depend on the estuary as a nursery habitat.[3] Further, the Albemarle-Pamlico Estuary Complex was designated as estuaries of "national significance" in 1987 and joined EPA's National Estuary Program. Since 2002, EPA has awarded over $7.7 million to the Albemarle-Pamlico National Estuary Program (APNEP) for wetlands, streams and shellfish area restoration projects, watershed assessment and mapping, and a multitude of other projects. In addition, during 2003-2008, the APNEP used its annual funding from EPA to secure an additional $84 million in leveraged resources from both public and private funders. The resources have been used to help address the priority problems facing the Albemarle-Pamlico Estuary.

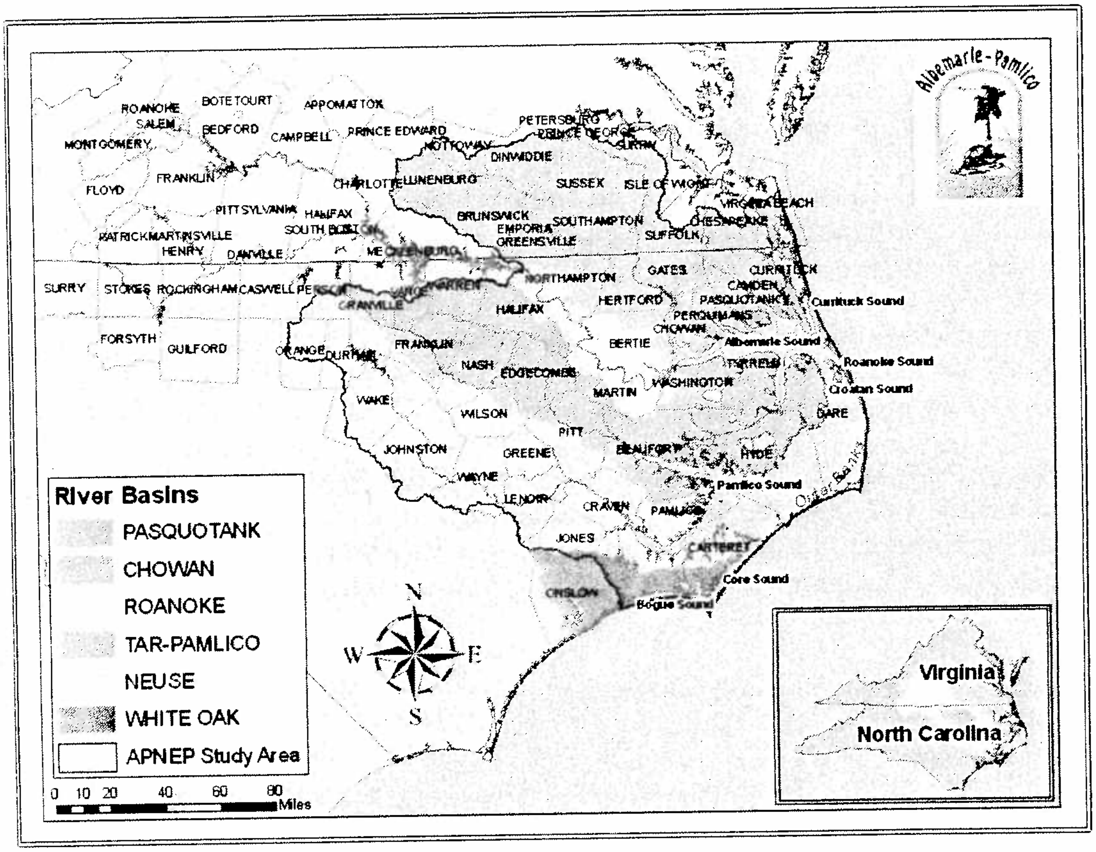


Figure 2 illustrates the boundary of the Albemarle-Pamlico National Estuary Program. The Albemarle-Pamlico estuarine system was designated as estuaries of national significance in 1987 and joined EPA's National Estuary Program.

As discussed earlier, the project site consists of three distinct tracts, NCPC, Bonnerton and S33. The NCPC tract is adjacent to the Pamlico River and South Creek. Seventy-one percent of this tract is designated as wetlands and it contains eight tidal creeks, including three inland Primary

[3] See Association of National Estuary Programs website: http://www.nationalestuaries.org/publications/factcards/albemarle.htm

Nursery Areas (Tooley Creek, Jacobs Creek, and Jacks Creek). The Bonnerton tract is adjacent to the Pamlico River, Durham Creek, and Porter Creek. Seventy-six percent of this tract is designated as wetlands and it contains the headwater drainage to one tidal creek designated as an inland Primary Nursery Area (Porter Creek). The Bonnerton tract also contains an approximately 271 acre nonriverine hardwood forested wetland that has been designated as a Nationally Significant Natural Heritage Area. The S33 tract is farther inland than either the NCPC or Bonnerton tracts and contains the headwaters of three creeks that drain into South Creek, one of which is a tidal creek. Approximately 20 percent of the S33 tract is delineated as wetland.

The Bonnerton and NCPC tracts include tidally influenced forested wetlands, creeks and salt marsh designated as Essential Fish Habitat (EFH) by the South Atlantic Fishery Management Council and Mid-Atlantic Fishery Management Council for federally managed fishery species. A subset of the areas designated as EFH is recognized by the NC Wildlife Resource Commission as inland Primary Nursery Areas and this state designation also makes these areas federally designated Habitat Area of Particular Concern (HAPC), the subset of EFH that warrants the highest protection under the Magnuson-Stevens Fishery Conservation and Management Act. The Primary Nursery Areas within the project area are Tooley Creek, Jacobs Creek, Jacks Creek and Porter Creek.

The FEIS classifies the site's wetlands into ten categories: brackish marsh complex, bottomland hardwood forest, herbaceous assemblage, shrub-scrub assemblage, hardwood forest, mixed pine-hardwood forest, pine forest, pocosin-bay forest, sand ridge forest, and pine plantation. All of the site's wetlands perform important ecological functions that support the Albemarle Pamlico Estuary such as temporary storage of surface water, nutrient cycling, organic carbon export, pollutant filtering/removal, and maintenance of biologically diverse plant and animal habitat. The FEIS classifies the site's stream resources into intermittent streams, perennial streams and pubic trust areas (i.e., navigable/canoeable creeks in coastal counties). All of the site's stream resources perform important ecological functions that support the Albemarle Pamlico Estuary such as the transport of water, nutrients and sediment downstream, pollutant processing and removal, and maintenance of biologically diverse plant and animal habitat. Of particular ecological importance are the wetland areas on the Bonnerton tract designated as a Nationally Significant Natural Heritage Area and the tidal creeks on the NCPC and Bonnerton tracts, four of which have been identified as Primary Nursery Areas.

Nationally Significant Natural Heritage Area

The Bonnerton tract contains an approximately 271 acre wetland area that has been designated by the NC Natural Heritage Program as a Nationally Significant Natural Heritage Area. The Natural Heritage Program designates areas in the state which it has determined to be important for conservation of the state's biodiversity as Significant Natural Heritage Areas. These areas can be classified as significant by the Natural Heritage Program at the county, regional, state or national level. The fact that the Bonnerton tract's Significant Natural Heritage Area has been classified as nationally significant means the Natural Heritage Program has determined it to be one of the five best examples of this community type in the nation. The 271 acre nonriverine

Wet Hardwood Forest (WHF) community type found on the Bonnerton tract is considered to be among the most threatened and endangered of NC's natural communities.

Nonriverine WHF communities are dominated by some of the same trees as wetland bottomland hardwood forests, and especially by several oak species, including swamp chestnut oak (*Quercus michauxii*), laurel oak (*Quercus laurifolia*), cherrybark oak (*Quercus pagoda*) and water oak (*Quercus nigra*). The nonriverine WHF is habitat for many species, including black bear (*Ursus americanus*) and wild turkey (*Meleagris gallopavo*) . The multi-layered structure characteristic of mature WHFs supports high densities and diversities of neotropical migrant birds such as wood thrush (*Hylocichla mustelina*), Swainson's warbler (*Limnothlypsis swainsonii*), worm-eating warbler (*Helmitheros vermivorus*), prothonotary warbler (*Protonotaria citrea*), hooded warbler (*Wilsonia citrina*) and white-breasted nuthatch (*Sitta pusilla*)

Some of the indicators of quality in a WHF are canopy maturity, canopy age structure, extent, and connection to other natural communities. Historically nonriverine WHFs naturally occurred in large patches and it is believed that some aspects of their ecosystem function are dependent on this large extent. The Natural Heritage Program also finds that the rate of loss of this community type is greater than all other community types in the state.

Tidal Creeks/Primary Nursery Areas

There are ten tidal creeks on the project site: Jacks Creek, Jacobs Creek, Drinkwater Creek, Tooley Creek, Huddy Gut, Huddles Cut, Sibyl Creek, Whitehurst Creek, Porter Creek, and Bailey Creek. All ten of these tidal creeks perform similarly critical biological support functions and have thus been a focus of concern throughout our review of the proposed project. Four of these tidal creeks (Jacks Creek, Jacobs Creek, Tooley Creek and Porter Creek) have been specifically designated as Primary Nursery Areas by the NC Wildlife Resources Commission. Primary Nursery Areas are defined as those areas inhabited by the embryonic, larval or juvenile life stages of marine or estuarine fish or crustacean species due to favorable physical, chemical or biological factors. The purpose of inland Primary Nursery Areas are to establish and protect those fragile inland waters which support embryonic, larval or juvenile populations of these species. The critical input to and function of Primary Nursery Areas are not contained just within the public trust waters but also includes the headwater drainages. Wetlands that surround or serve as headwaters for estuarine creeks are essential for the creeks to serve as Primary Nursery Areas.

Estuarine waters occur along three sides of the proposed mining site and support a wide range of fishery resources, including commercially or recreationally important species such as striped bass (*Morone saxatilis*), American shad (*Alosa sapidissima*), Atlantic herring (*Clupea harengus*), summer flounder (*Paralichthys dentatus*), red drum (*Sciaenops ocellatus*), blue crab (*Callinectes sapidus)*, shrimp *(Pennaeidae)* and oysters (*Crassostrea virginica)*. The estuary also provides important habitat for anadromous fish, including the endangered shortnose sturgeon (*Acipenser breviorostrum*). Nursery areas located in the creeks and embayments of the estuarine system, such as those found on the project site, are important to over 75 species of fish and shellfish.[4]

---

[4] See Association of National Estuary Programs website: http://www.nationalestuaries.org/publications/factcards/albemarle.htm

IV. Substantial and Unacceptable Impacts

40 CFR 230.10(c): Significant Degradation

EPA believes that compliance with requirements of Section 230.10(c) of the Guidelines has not been demonstrated. Section 230.10(c) requires that no discharge of dredged or fill material shall be permitted which will cause or contribute to significant degradation of waters of the United States. The Guidelines explicitly require evaluation of all direct, secondary, (i.e., indirect), and cumulative impacts reasonably associated with the proposed discharge in determining compliance with Section 230.10(c). In accordance with the Guidelines, determining significant degradation requires specific consideration of effects on such functions and values as wildlife habitat, aquatic system diversity, stability and productivity, recreation, aesthetic and economic values.

Of the 15,100 acre project area, the proposed mine advance would impact approximately 11,454 total acres and result in direct impacts to approximately 3,953 acres of wetlands, 19 acres of open waters and 25,727 linear feet of streams. This would represent the single largest wetland impact ever authorized under the Clean Water Act in NC and would result in a significant loss of wetlands, streams and other waters of the United States within the nationally significant Albemarle Pamlico Estuary Complex.

As previously noted, all of the site's wetlands perform important ecological functions that support the Albemarle Pamlico Estuary such as temporary storage of surface water, nutrient cycling, organic carbon export, pollutant filtering/removal, and maintenance of biologically diverse plant and animal habitat. Also as previously noted, all of the site's stream resources perform important ecological functions that support the Albemarle Pamlico Estuary such as the transport of water, nutrients and sediment downstream, pollutant processing and removal, and maintenance of biologically diverse plant and animal habitat. We recognize that not all of the approximately 3,953 acres of wetlands and 25,727 linear feet of streams that would be impacted by the proposed project perform all of these respective functions to the same degree (because of their position in the landscape and/or their level of prior disturbance), however, the complete loss of this entire suite of wetland and stream functions on this scale raises serious ecological concerns.

The habitat functions provided by wetlands and streams that would be lost are particularly important in light of the ecological and economic value of the Albemarle Pamlico Estuary's commercial and recreational fishery/shellfish resources. Also, the state has designated the entire Tar-Pamlico River Basin as Nutrient Sensitive Waters because of problems associated with excessive levels of nutrients in the river such as harmful algal blooms, low oxygen levels, increased fish kills, and other symptoms of stress and diseases in the aquatic biota. The state developed a strategy to reduce nutrient inputs from around the basin to the estuary that is yielding improvements to water quality. Nonetheless, we are very concerned that loss of the water quality enhancement functions provided by the approximately 3,953 acres of wetlands and 25,727 linear feet of streams that would be completely eliminated by the proposed project could exacerbate existing water quality problems in the Tar-Pamlico River and hamper the state's ongoing efforts to improve the river's water quality.

Direct Impacts to Nationally Significant Natural Heritage Area

EPA is concerned with the proposed project's direct impacts to the wetland area on the Bonnerton tract that has been designated by the NC Natural Heritage Program as a Nationally Significant Natural Heritage Area. As previously noted, the 271 acre nonriverine WHF found on the Bonnerton tract is an extremely unique and rare community type, one that has experienced a rate of loss higher than all other community types in the state. The fact that the Bonnerton tract's Significant Natural Heritage Area has been classified as nationally significant means the Natural Heritage Program has determined it to be one of the five best examples of this community type in the Nation.

As previously noted, some of the indicators of quality in a nonriverine WHF are canopy maturity, canopy age structure, extent, and connection to other natural communities. Historically, nonriverine WHFs naturally occurred in large patches and it is believed that some aspects of their ecosystem function are dependent on this large extent. The proposed project would directly impact approximately 97 acres[5] of this ecologically valuable and rare wetland system and would allow mining through the middle of the 271 acre area, bisecting it into two separate and smaller pieces, an eastern and a western piece. This large reduction in size and the fragmentation of the tract into two separate pieces would undermine some of the key ecological characteristics which make it ecologically valuable and "nationally significant." Although the NCDWQ's CWA Section 401 Water Quality Certification requires the mined out area between the eastern and western pieces to be restored after mining, we believe it will be extremely difficult, based on the current state of the science, to restore this area to its prior condition after mining and this will have a significant detrimental impact to the integrity of this rare and threatened biological community. In addition to reducing the size of the area and fragmenting it into two pieces, the large scale disturbances associated with allowing phosphate mining through the middle of the area (land clearing, groundwater extraction, pit excavation, road and support infrastructure construction, etc.) will further lower the ecological value of the remaining eastern and western pieces of the area.

Given the unique and valuable nature of this nationally significant resource, it is EPA's determination that the direct impacts of mining the 271 acre Significant Natural Heritage Area on the Bonnerton tract does not comply with Subparts C-F of the Guidelines, specifically Subpart C – Impacts on physical characteristics of the aquatic ecosystem, Subpart D – Impacts on the biological characteristic of the aquatic ecosystem, Subpart E – Impacts to special aquatic sites and Subpart F – Effects on human use characteristics (SNHA designation).

Indirect Impacts to Tidal Creeks/Primary Nursery Areas

EPA is also concerned with the proposed project's indirect impacts to the project area's ten tidal creeks, four of which have been classified by the NC Wildlife Resource Commission as Primary Nursery Areas. Although the proposed project would not directly impact the perennial reaches

[5] Based on the February 24, 2009, Notice of Intent letter from the Wilmington District Corps, page 6.

of the four Primary Nursery Areas, the headwater drainages of the project site's tidal creeks, including those designated as Primary Nursery Areas, would be reduced by approximately 70 percent. Our concerns regarding the proposed drainage basin reductions are amplified on the NCPC tract since its watersheds have already lost approximately 1,268 acres of wetlands as part of the Applicant's 1997 mining permit.

Eliminating the headwater streams and wetlands and significantly reducing the drainage areas of the project site's Primary Nursery Areas and other tidal creeks would:

- Reduce flow from ground water and increase variability in surface water flows to the tidal creeks, thereby increasing the frequency and magnitude of short-term salinity fluctuations;
- Reduce filtration of nutrients and other contaminants previously accomplished by the site's streams and wetlands, increasing sedimentation and turbidity in tidal creeks;
- Reduce productivity of native fish and shellfish in the downstream estuary by disrupting the estuarine food web (caused by a reduction of organic materials critical for biological activity in the surface water drainage); and
- Shift downstream estuarine productivity from the benthic community which is dominated by sensitive submerged aquatic vegetation and benthic invertebrate species to tolerant phytoplankton species. This would exacerbate ongoing environmental stress and create an open niche for problematic invasive plant and animal species to colonize and degrade the estuary.

We believe the disruption of these processes and functions in the drainage basin will significantly impact the site's tidal creeks and impair the ability of these systems to function as Primary Nursery Areas.

Estuarine animals exist in a community assemblage and the influence of a factor, such as salinity, on one species may be extended either directly or indirectly to affect other species. The cumulative effects of even small changes in an estuary may have a total systemic effect on the marine resources and the economic activities that depend on them. We believe the potential effect of Drainage Basin Reduction (DBR) on the production of marine fisheries resources is significant.

Besides its effect on fish production, DBR will likely result in increased sedimentation and turbidity, which are significant contributors to declines in populations of aquatic organisms. The direct effects of sedimentation and turbidity at various trophic levels are mortality, reduced physiologic functions and avoidance. Sedimentation can clog the gills of fish, reducing respiratory abilities. This stress may reduce tolerance levels to disease and toxicants and to changes in dissolved oxygen concentrations and salinity, compromising the health of local fisheries resources. Decreases in primary production are associated with increases in sedimentation and turbidity and produce negative cumulative effects through depleted food availability to zooplankton, insects, freshwater mollusks and fish. Decreases in available food at various trophic levels also results in depressed rates of growth, reproduction and recruitment. These effects lead to alterations in community density, diversity and structure.

Mining will directly affect the rate at which water is routed through the watershed. DBR will reduce contiguous sheet flow and as the mine expansion progresses there is an ever increasing trend of diverting surface water drainage which once promoted estuarine productivity into National Pollutant Discharge Elimination System (NPDES) channels, pipes and outfalls. This redirection of surface flows contributes to estuarine degradation because it removes natural watershed drainage patterns that 1) promote infiltration and trapping of sediments and other pollutants, and 2) provide a beneficial diffuse source of water to the estuary and subsequently decreases the buffering capacity of the system. These changes will likely increase the amount of sediment, nutrients and toxics entering the system. Nitrogen and phosphorus can accelerate eutrophication resulting in algal blooms, reduced water clarity, shifts in algal and fish populations and fish kills. Currently South Creek, which is stressed with water quality problems including algal blooms and increases in suspended solids, is designated as a Nutrient Sensitive Water (NSW) by the state, as is the entire Tar-Pamlico River Basin. We believe the reduction of the South Creek's buffering capacity associated with the large scale removal of wetlands and streams from the watersheds draining to the creek will likely exacerbate its existing water quality problems by removing the system's nutrient uptake capability. Hypoxic conditions caused by excess nutrients can result in reduced commercial and recreational fisheries production.

EPA believes the proposed mining operations will negatively impact estuarine trophic structure through disruption of substrate inputs crucial to primary producers; reduction of energy sources that fuel estuarine productivity; and degradation of the nutrient sequestration capacity of the estuarine system. Estuary productivity is dependent on the complex interactions among the various components of the aquatic food web; with epiphytes (attached to wetland macrophytes) and submerged aquatic vegetation (SAV) forming the foundation of the estuarine food web. SAV populations have recently declined by as much as 50 percent, possibly because of anthropogenic impacts. As a result, detritus supplied by wetland macrophytes has become more important as an epiphytic substrate. While phytoplankton are also important for productivity, the role of wetland plants and SAV detritus is of greater importance to the overall stability of shallow aquatic food webs. It is our belief that the proposed mining operations will negatively impact both types of epiphytic substrates.

Also of importance to estuarine food webs is the gradual and episodic release of Dissolved Organic Matter (DOM) from the contributing basins and wetlands immediately adjacent to the Albemarle Pamlico Estuary Complex. This energy source fuels bacterial communities that, through mineralization, provide inorganic nitrogen, phosphorous and carbon, supporting productivity. In addition, DOM supported bacteria are an important component of the "microbial loop." This part of aquatic food web links DOM (of autochthonous and/or allochthonous origin) to higher trophic levels, via bacteria-protist-metazoan-zooplankton interactions. The impacts associated with the proposed project would decrease the quantity and quality of allochthonous DOM supplied to the estuary because of the close proximity of PCS's proposed mining operations.

Most of the drainage basin wetlands that would be subjected to impacts are wet forests, including bottomland hardwood forests. These areas are subjected to repeated periods of inundation and desiccation. This is important from a biogeochemical perspective as it allows for the accumulation of particulate organic matter and its subsequent processing (dissolution and mineralization). This leads to episodic exports of dissolved organic materials to the estuary. Wetlands impacted by the proposed project also retain nutrient loads carried by high flow events, which are later sequestered into forest biomass. Wet forests are also important for denitrification and these areas also provide refugia and nursery habitat for aquatic organisms during high flow periods.

The Applicant provided a December 2007 report prepared for PCS by Entrix, on *Potential Effects of Watershed Reduction on Tidal Creeks – An Assessment.* EPA believes that, while the report clarifies currently known characteristics of the South Creek tributaries, it does not support the conclusion that current and future DBRs from mining activities would have no significant effect on downstream ecosystems. Data collected by NC Wildlife Resource Commission in November 2006 to determine species present in Jacks, Jacobs and South Creeks does not support that fish production originates from downstream estuarine environments. The Applicant's report does not address freshwater species nor did it establish a connection between biota and previous mining impacts in the area including watershed reduction and ground water draw down. The report used "baseline" data for Jacks Creek collected after the watershed had already been reduced by almost 20 percent. Small reductions in watershed area may have large biotic impacts and, therefore, it is problematic using these data as a baseline to determine DBR impacts. The Applicant's report also makes a troubling extrapolation that since past smaller DBRs did not adversely impact the tidal creeks, the much larger DBRs associated with the proposed project (i.e., 70 to 80 percent DBRs) also would not adversely impact the tidal creeks. However, data do not exist to draw this conclusion.

The Entrix report and the Corps' February 24, 2009, Notice of Intent letter both present the success of the PA II man-made marsh on the PCS project area to hypothesize that the DBRs will not cause significant loss of habitat value and nursery functions of the tidal creeks. The West (2000) study evaluating PA II is frequently cited in these discussions and is used by the Entrix report to argue broad scale functional equivalency of PA II to local tidal creeks. EPA does not believe it is valid to use the West study to make these inferences. The study's objective was to assess how well PA II could provide suitable habitat for fish, benthic and plant species and not to evaluate the effects of DBR on these populations. The data were collected from the lower reaches of the stream channel and did not fully assess the upper channel's biota. These results support the potential for species repopulation in the lower reaches of the creeks but do not support the proposition that DBR will not impact the upper channel's biota. The report does not provide data on the functional equivalence of factors, such as stream substrate, biogeochemical processes, wetland plants, etc. and in fact, there was no evidence of accretion of natural sediment structure (woody detrital covering, large peat component, etc) or organic carbon in the 10 years of the study. EPA believes the data presented do not overcome the large body of scientific information showing that mining through the headwaters of estuarine streams and their riverine habitat will have a significant negative impact on the functioning and structure of the creeks impacted by the proposed mining activities. There is, however, a large amount of scientific data supporting the importance of headwater streams and wetlands on downstream water quality (Meyer and Wallace, 2001; Gomi *et al.,* 2002; Alexander *et al.*, 2007; Meyer *et al.,* 2007; and Wipfli *et al.*, 2007).

Summary of Impacts

In summary, the proposed project would eliminate critical ecological functions provided by approximately 3,953 acres of wetlands and 25,727 linear feet of streams within the nationally significant Albemarle Pamlico Estuary. Wetland functions include temporary storage of surface water, nutrient cycling, organic carbon export, pollutant filtering/removal, and maintenance of biologically diverse plant and animal habitat. Stream functions include transport of water, nutrients and sediment downstream, pollutant processing and removal, and maintenance of biologically diverse plant and animal habitat. Of particular concern are the proposed projects:

- Direct impacts to portions of a nonriverine hardwood wetland forest that has been designated as a Nationally Significant Natural Heritage Area by the NC Natural Heritage Program, and
- Indirect impacts to the site's tidal creeks, four of which have been designated as Primary Nursery Areas by the NC Wildlife Resources Commission, associated with the 70 percent reduction in the drainage basins for these creeks.

EPA believes that impacts to these ecological functions at the scale associated with this project would cause or contribute to significant degradation [40 CFR 230.10(c)] of the Nation's waters. Further, as discussed below, we do not believe the proposed compensatory mitigation would reduce these adverse impacts to an acceptable level.

V. Alternatives Analysis

40 CFR 230.10(a): Alternatives Analysis

A key provision of the Guidelines is the practicable alternatives test which provides that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem" [40 CFR 230.10(a)]. An alternative is practicable if "it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes."[6] [40 CFR 230.10(a)(2)].

The FEIS evaluated eleven alternative mining alignments and a "No-Action" alternative. A central component of the FEIS's alternatives analysis was the evaluation of each alternative to determine if it was practicable in light of its costs. Though the Guidelines do not consider cost in terms of economics, here, the evaluation looked at the alternatives in terms of their economic viability. Throughout our review of the DEIS, SDEIS, and FEIS, EPA has consistently cited concerns regarding the economic analysis. The concerns became heightened after aspects of the economic analysis were modified in the SDEIS and FEIS, changes that we believe inappropriately bias the economic analysis in favor of more extractive and more environmentally damaging mining alternatives and effectively obscure identification of the least environmentally damaging practicable alternative (LEPDA) as required by the Guidelines.

FEIS Economic Analysis

Our primary concern with the FEIS's economic analysis is its inconsistent treatment of the practicability of mining the southern portion of the S33 tract. The development of the long-term

---

[6] The CWA Section 404(b)(1) Guidelines use the term "basic purpose" and "overall project purposes" interchangeably. For a detailed discussion of this issue see EPA's Final Determination Pursuant to Section 404(c) of the CWA Concerning the Two Forks Water Supply Impoundments, Jefferson and Douglas Counties, Colorado.

alternatives that have been evaluated in the DEIS, SDEIS, and FEIS relied on an assumption that mining in the southern portion of S33 would become practicable while the FEIS's economic analysis relies on a contradictory assumption regarding those same mining costs. Although not currently practicable from a cost standpoint, mining the southern portion of S33 was included in the mine alternatives evaluated in the FEIS because mining these areas would become practicable. Specifically, the FEIS states that "[t]he applicant has also indicated that it believes the market will eventually become favorable; a reasonable position based on [U.S. Geological Survey] USGS information regarding the rate of depletion of domestic production capacity and the applicant's future shift to higher margin products. The Corps has determined that it is therefore appropriate to include this area [the lower portion of S33] in the evaluation" (FEIS at 2-26). Similarly, the FEIS states that the Applicant has indicated that while it does not find the cost associated with mining the southern portions of S33 practicable now, "it expects they will become practicable at some point in the future" (FEIS at 2-29). Thus, mining alternatives that include mining in the southern portion of S33 were included for evaluation throughout the EIS process based on the expectation affirmed by the Applicant, agreed to by the Corps, and supported by USGS information that changes in market conditions and product shifts would make mining these areas practicable.

Perplexingly, the FEIS reverses this fundamental assumption for the alternatives when it eliminates all alternatives that provide less than 15 years of mining in the NCPC and Bonnerton tracts, leaving only the AP, EAP, SJAA, M and L alternatives for consideration. To be practicable, the FEIS states that an alternative must "provide the applicant with the certainty of practicable costs for at least 15 years" (FEIS at 2-29). According to the FEIS, the SCRA, SCRB and SJAB alternatives do not experience "high cost" (presumably this means impracticable costs) "until at or after 15 years" (FEIS at 2-30). If the assumption, discussed above, that the southern portions of S33 will become practicable were consistently applied, there would be no basis for the determination that these alternatives are impracticable since they all provide at least 15 years of practicable mining costs. However, the FEIS rejects these alternatives when it concludes that "SCRA, SCRB and SJAB are not practicable due to the required commitment to the higher mining costs within the initial 10-12 years of the plan without the expectation of fully recovering these development costs" (FEIS at 2-30). This determination contradicts the fundamental assumption used to include the southern portion of S33 in each of the mining alternatives. The southern portion of S33 was included specifically because the Applicant, the Corps and USGS expect that those predicted higher costs will be practicable in the future and the Applicant will fully recover the development costs associated with opening S33 to mining. EPA believes it is inappropriate that the FEIS assumes that mining S33 is practicable for the proposed alternatives yet this same assumption does not apply to its economic analysis.

Practicable Alternatives

EPA was very concerned when these inconsistencies first appeared in the SDEIS. EPA stated that such inconsistencies were not appropriate and that the alternatives excluded from the SDEIS were indeed practicable. In an effort to illustrate this point, EPA requested that our National Center for Environmental Economics review the economic analysis included in the SDEIS. EPA met with the Corps on numerous occasions to share the results of its review and discuss our concerns regarding the modifications to the economic analysis in the SDEIS. Despite these efforts, no substantive changes were made to the economic analysis included in the FEIS. EPA's review of the economic analysis included in the SDEIS and the FEIS concludes that there are less environmentally damaging practicable alternatives to the proposed project (See Appendix 1).

EPA's review of the FEIS's cost practicability analysis used expected cost and value data from the FEIS to calculate the expected profit per year for every year of every alternative. EPA then calculated the Net Present Value (NPV) of the stream of annual profits for each alternative. This allows for the comparison of projects of differing lengths in equal terms (current year dollars). An alternative with a positive NPV will add positive value to the Applicant if undertaken and therefore demonstrates at least a minimum level of cost practicability.

A NPV analysis assumes that a dollar in the future is worth less than a dollar today due to the time value of money and investment risk (among other things). The amount that the value of a future dollar is discounted is given by the discount rate. The NPV of an alternative is the value of the stream of future profits in today's dollars.

$$NPV = \sum_{t}^{T} \frac{profit_t}{(1+r)^t}$$

where t (t=1 .... T) indexes the years of an alternative and r is the discount rate. Following White House Office of Management and Budget (OMB) guidance we have used a 3% and 7% discount rate

Our NPV analysis utilized the:

- 1991 to 2007 USGS adjusted price per ton estimates from Table 2-7 on page 6-12 of Volume 1 of the FEIS
- Cost per ton estimates for each year for each alternative from Table 2-6 on page 6-11 of the FEIS
- Expected tons extracted from each alternative for each year from the tables in Appendix D of the FEIS.

As the first step in the NPV procedure, a time trend was regressed on 1991 to 2007 USGS adjusted price per ton estimates to predict expected future prices per ton for the next 50+ years. Next, estimated cost per ton for each alternative for each year was subtracted from the estimated expected price per ton to give expected profit per ton per year for each alternative (i.e., price per ton - cost per ton = profit per ton). Then, expected profit per ton per year for each alternative was multiplied by the number of expected tons mined per year for each alternative to get total expected profit per year for each alternative (i.e., profit per ton * number of tons per year = total annual expected profits). Finally, using both a 3% and 7% discount rate, annual total profits for each year for each alternative are discounted back to their 2008 value. The NPV of each alternative is then the sum of its discounted annual total profits.

The results of the NPV analysis, presented in Table 2, highlight that contrary to the conclusions drawn in the FEIS, many of the alternatives evaluated in the FEIS are indeed economically viable and should not have been eliminated from further consideration. According to the FEIS, an alternative is reasonable if it provides "the applicant with the certainty of practicable costs for at least 15 years" (FEIS at 2-29). Assuming this criterion is appropriate for use in a practicability determination made under the Guidelines, only the "No Action" and the S33AP and DL1B alternatives should have been eliminated from further consideration since they are the only three alternatives that do not provide at least 15 years of economically viable mining. If the 15 year criterion is not relevant for purposes of evaluating alternatives under the Guidelines and is not used, even the S33AP and DL1B options have a positive net present value and would be a better use of the land for the Applicant than letting it remain unused.

A number of the alternatives that are economically viable, based on the NPV analysis, involve far fewer impacts to aquatic resources than the FEIS's Alternative L or the proposed project (Modified Alternative L). EPA finds that the inconsistencies in the FEIS's economic analysis coupled with the results of the NPV evaluation strongly indicate that the proposed project is not the least environmentally damaging practicable alternative.

Table 2. Net Present Value evaluation for the twelve alternatives evaluated in the FEIS

PCS Phosphate Mine Economics Evaluation			
NET PRESENT VALUE OF EACH ALTERNATIVE			
Mine Alternatives	3% Discount Rate	7% Discount Rate	# Years of Profitable Mining
AP	$364,300,909.71	$277,903,276.63	15
EAPA	$524,097,625.97	$352,411,515.70	35
EAPB	$480,656,851.35	$328,416,387.22	27
SCRA	$322,546,488.93	$253,026,944.10	19
SCRB	$293,339,783.09	$231,303,419.79	15
ALT L	$358,954,836.17	$271,764,925.74	23
ALT M	$445,195,180.08	$321,454,432.72	26
SJAA	$346,132,934.40	$266,988,898.53	23
SJAB	$353,940,971.53	$247,989,896.39	20
S33AP	$121,250,674.62	$122,320,107.39	12
No Action	($15,417,603.86)	$7,000,403.73	5
DL1B	$211,886,850.05	$154,818,541.01	10

VI. Minimizing and Compensating for Adverse Impacts

40 CFR 230.10(d): Minimizing and Compensating for Adverse Impacts

The Guidelines require that adverse environmental impacts associated with the proposed discharge of fill material to waters of the United States first be avoided to the maximum extent practicable and then minimized to the extent appropriate and practicable. For unavoidable impacts which remain, compensatory mitigation is required to offset wetland and other aquatic resource losses. EPA and other agencies, most notably the FWS, have recommended additional measures that should be taken to minimize the impact of the mining project on avoided aquatic resources by improving the quality of the reclamation area.

EPA recommends that a topsoil cover be added to the reclaimed areas utilizing, to the extent appropriate and practicable, the topsoil removed prior to site mining. Reuse of on-site topsoil takes advantage of the soil structure, organic matter, nutrients, and seed sources available in that material (i.e., the A Horizon) which is removed as mining operations advance. According to FWS, there is support for such an approach in the published literature (Farmer and Blue, 1978; Schuman and Power, 1981) and addition of topsoil to phosphate reclamation sites in Florida has yielded better environmental results than traditional methods. Adding approximately one foot of topsoil on average (no less than six inches) would allow the site to recover at a greatly accelerated pace in contrast to not having topsoil and would make the reclaimed area suitable for a broader array of tree species. While EPA recognizes that adequate amounts of topsoil will likely not be available to re-cover the entire reclamation area because of losses during removal and site preparation, reasonable targets for the percent of the reclamation site amended with topsoil should be established.

EPA also recommend that upland portions of the reclamation area be replanted, to the extent appropriate and practicable, in longleaf pine (*Pinus palustris)* and wetland areas be replanted in bald cypress *(Taxodium distichum)* and/or Atlantic white cedar *(Chamaecyparis thyoides)* if Atlantic white cedar is shown to do well on the reclamation sites. All three of these species will grow on low fertility sites and longleaf pine and bald cypress are long lived species that despite slow growth rates can be expected to live long enough to eventually establish moderate stand coverage even on sterile sites. These species will also produce decay resistant litter that over the very long term will rebuild soil. All of these species provide wildlife habitat and all occur naturally in monotypic stands. Reasonable targets for the percent of the reclamation site replanted with these species should be established. It should be noted that these improvements would be in addition to the already agreed-upon 3-foot site cap needed to address the cadmium risk assessment recommendations. Finally, we recommend that all avoided aquatic resources be provided permanent protection from future mining with appropriate binding real estate instruments such as conservation easements.

EPA appreciates the work that the Applicant has put into the proposed compensatory mitigation plan and the steps taken to address concerns raised by EPA during the review of the DEIS, SDEIS and FEIS. However, we continue to have a number of concerns regarding the compensatory mitigation and whether it can effectively offset the proposed impacts. We have previously described our concerns regarding the project's direct impacts to the Nationally Significant Natural Heritage Area. As previously noted, this area was designated by the NC Natural Heritage Program as "nationally significant" which means that it is one of the five best examples of this community type in the nation. In light of the very unique and rare qualities of this area, it is not clear that its attributes could be replaced by compensatory mitigation, raising concerns regarding significant degradation [40 CFR 230.10(c)].

Additionally, for impacts to other mature forested wetlands, not located in the Nationally Significant Natural Heritage Area, we continue to have concerns that the proposed compensatory mitigation will not adequately offset impacts to these systems. Plant communities drive many physical, chemical, and biological processes within wetlands such as 1) sedimentation, and, because of adsorption, nutrient retention; 2) transpiration through hydrological demand; 3) nutrient (inorganic nitrogen and phosphorous) cycling; 4) denitrification, by providing the soil conditions for the appropriate microbial communities; and 5) flood mitigation because mature communities are stable sources of hydraulic roughness. Even if proposed efforts to replace mature forested wetlands with immature restored or created wetlands are successful, the replacement wetlands will not provide the same level of physical, chemical, and biological processes and functions as the impacted forested wetland systems for a very long time (e.g., 60 to 80 years). Offsets for impacts to mature forested wetlands through the proposed compensatory mitigation are not adequate to maintain wetland functions within the watershed. The current plan requires 2:1 compensation ratios for these impacts. EPA believes that impacts to mature forested wetlands should be offset at compensation ratios of 3:1 to better address the temporal losses associated with the replacement of this wetland type.

VII. EPA/FWS/NMFS Recommended Alternative

Although the formal permit elevation process was initiated with the Corps' February 24, 2009, letter, EPA has continued to coordinate with the Corps and the Applicant in an effort to resolve our concerns regarding the proposed project. To this end, on March 24, 2009, representatives from EPA, FWS and NMFS met with the Corps and the Applicant to discuss our continued concerns with the proposed project. At that meeting, EPA, FWS and NMFS presented a potential alternative plan for mining the site that would address the concerns raised by the agencies by avoiding and minimizing impacts to the aquatic ecosystem, consistent with the Guidelines.

Key Components of the EPA/FWS/NMFS Alternative

The EPA/FWS/NMFS proposal includes four key components:

1) Additional Aquatic Resource Avoidance: The alternative reduces impacts to wetlands from the approximately 3,953 acres of impacts associated with the proposed project down to approximately 2,787 acres of impacts.[7] As previously discussed, EPA has significant concerns regarding the proposed project's direct and indirect adverse impacts to the site's high value aquatic resources, specifically the site's Nationally Significant Natural Heritage Area as well as the site's estuaries, including those identified as Primary Nursery Areas. The additional avoidance was designed to reduce the project's direct and indirect impacts to these resources down to an acceptable level and avoid causing or contributing to significant degradation [40 CFR 230.10(c)]. It should be noted that this alternative which would allow impacts to approximately 2,787 acres of wetlands continues to be extraordinarily large, and would represent the single largest wetland fill authorized to date in the state of NC, amplifying the need to pay very close attention to the execution, monitoring and adaptive management of the project's compensatory mitigation so that the Nation's waters are not significantly degraded.

2) Protection of Avoided Aquatic Resources: The alternative provides permanent protection from mining to the site's avoided areas through the use of appropriate binding real estate instruments such as conservation easements. We are open to discussion regarding compensatory mitigation credit for the permanent protection of these avoided areas. We also note that many of the aquatic resource areas avoided under this alternative provide restoration and enhancement opportunities. We are open to discuss the Applicant's

[7] This alternative would also involve approximately 7.4 acres of impacts to other waters of the United States.

recommendations regarding the appropriate level of compensation credit for the preservation, enhancement, and/or restoration of avoided aquatic resources.

3) Improvements to Site Reclamation: The alternative includes additional measures, consistent with 40 CFR 230.10(d), to minimize the impact of the mining project on avoided aquatic resources by improving the quality of the reclamation areas. Specifically, these measures include the reuse of topsoil from mined areas to re-cover reclaimed areas to the extent appropriate and practicable and the replanting of reclaimed areas with target tree species (longleaf pine, bald cypress and/or Atlantic white cedar) that are expected to improve soil quality and habitat over the long-term (see also Section VI).

4) Improvements to Monitoring and Adaptive Management Plan: The alternative includes additional measures to improve the monitoring and adaptive management of both the mining and mitigation sites. While the footprint of the mining alternative does not extend into the Primary Nursery Areas, we are concerned that the extensive mining of wetlands and streams that serve as the headwaters of these creeks may impair the function of these Primary Nursery Areas. Accordingly, a monitoring program coupled with an adaptive management process is proposed to gauge the impacts to the Primary Nursery Areas from the mining so that appropriate adjustments can be made to mine operations. The monitoring provisions also require the establishment of an independent panel of scientists and engineers to annually evaluate whether direct and indirect impacts from mining and benefits from the compensatory mitigation are in accordance with expectations at the time of permitting.

Development of the EPA/FWS/NMFS Alternative

In the development of this alternative, we assumed that pursuant to evaluation of alternatives under the Guidelines, the basic project purpose, in this instance, is to continue mining at the Applicant's existing mining operation. Practicable alternatives are those which could meet this basic purpose and are available and capable of being done after taking into consideration cost, existing technology, and logistics.

The FEIS argues that 15 years represents an adequate planning horizon for this phosphate mining project and that an alternative is reasonable if it provides "the applicant with the certainty of practicable costs for at least 15 years" (FEIS at 2-29). From the standpoint of logistics, it would seem appropriate to limit the evaluation of alternatives pursuant to the Guidelines to those which provide at least 15 years of economically viable mining. Based on EPA's NPV analysis (see Table 2), the AP, EAPA, EAPB, SCRA, SCRB, ALT L, ALT M, SJAA, and SJAB alternatives would be considered practicable. Of these the SCRA and SCRB alternatives, which involve the same level of aquatic resource impacts, would be considered the least environmentally damaging practicable alternatives.

EPA/FWS/NMFS, however, continue to be concerned that the level of impacts associated with the SCRA and SCRB alternatives would allow an unacceptable level of 1) direct impacts to the site's Nationally Significant Natural Heritage Area and 2) indirect impacts to the site's tidal creeks, including those identified as Primary Nursery Areas. Thus, the agencies developed a mining alternative, within the boundaries of the existing array of alternatives evaluated in the FEIS, that attempts to maximize protection of these ecologically valuable areas while continuing to ensure 15 years of economically viable mining. While we do not have precise economic data for the mining boundary proposed, since it was not specifically evaluated in the FEIS, our proposed boundary was developed based on comparing it to the economic data generated for those alternative mine plans that involved both greater and lesser mining impacts on each of the three tracts. Based on our best professional judgment, we estimate that our proposed alternative maximizes protections for high value aquatic resources, to a greater extent than either the SCRA or SCRB alternatives, while continuing to provide at least 15 years of economically viable mining, making it the apparent LEDPA.

GIS coverages illustrating our proposed mining boundaries for the NCPC and Bonnerton tracts have been provided to the Corps and the Applicant so that a detailed economic analysis can be developed. Our alternative does not alter the proposed mining boundary on the S33 tract; it continues to be the boundary associated with the Modified L Alternative.

EPA believes that this alternative, if practicable, would also address the primary concerns of those who are challenging the NCDWQ's CWA Section 401 certification of the project, and threatening litigation. The Applicant expressed a desire to review the new alternative and noted that its evaluation could take a month or longer. We believe that we cannot conclude that this alternative proposal, or a modified version of it, is not practicable until we have heard back from the Applicant.

VIII. Conclusions and Recommendations

In summary, we believe that the permit, as proposed, would fail to comply with the Guidelines for the following reasons:

1. There are less environmentally damaging practicable alternatives that meet the project purpose [40 CFR 230.10(a)];
2. The project's direct and indirect impacts to high value wetland and stream systems including areas designated as Nationally Significant Natural Heritage Areas and Primary Nursery Areas would cause or contribute to significant degradation of the Nation's waters [40 CFR 230.10(c)]; and
3. All appropriate and practicable steps have not been taken to minimize and compensate for the project's adverse impacts to waters of the United States [40 CFR 230.10(d)].

Therefore, EPA requests that the ASA (Civil Works) direct the Wilmington District to do the following: 1) in coordination with the Applicant, withdraw the NOI letter and initiate further analysis of the new proposed alternative to determine whether such alternative or a modification of it, would be practicable, and thus the "LEDPA"; **or** 2) revise the proposed permit consistent with the following: a) revise its alternatives analysis for the proposed project to address inconsistencies that bias identification of the LEDPA, b) in development of the LEDPA, avoid direct impacts to the Nationally Significant Natural Heritage Area and indirect impacts to the site's tidal creeks, including those identified as Primary Nursery Areas, to the maximum extent practicable, c) incorporate all appropriate and practicable measures to minimize the impact of the mining project on avoided aquatic resources by improving the quality of the reclamation areas (i.e., re-using top soil and re-vegetating with target plant species), d) ensure that all avoided aquatic resources are provided permanent protection from future mining with the appropriate binding real estate instruments such as conservation easements, e) revise the compensatory mitigation plan to effectively offset impacts to mature forested wetlands and f) include measures to ensure effective monitoring and adaptive management of both the mining and mitigation sites.

Citations

Alexander, R.B., Boyer, E.W., Smith, R.A., Schwartz, G.E., and R.B. Moore. 2007. The role of headwater streams in downstream water quality. Jounral of the American Water Resources Association 43(1): 41-59.

Farmer, E.E. and W.G. Blue. 1978. Reclamation of lands mined for phosphate. Pages 585-608 In: F.W. Schaller and P. Sutton (eds.). Reclamation of Drastically Disturbed Lands. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, Madison, WI.

Gomi, T., Sidle, R.C., and J.S. Richardson. 2002. Understanding processes and downstream linkages of headwater systems. BioScience 52(10): 905-916.

Meyer J.L. and J.B. Wallace. 2001. Lost linkages and lotic ecology: Rediscovering small streams. In: *Ecology: Achievement and Challenge*, M.C. Press, N.J. Huntly, and S.Levin (Editors). Blackwell Science, Malden, Massachusetts, pp 295-317.

Meyer, J.L., Strayer, D.L., Wallace, B., Eggert, S.L., Helfman, G.S., and N.E. Leonard. 2007. The contribution of headwater streams to biodiversity in river networks. Journal of the American Water Resources Association 43(1): 86-103.

Feierabend, S.J. and J.M. Zelazny. 1987. Status report on our nation's wetlands. National Wildlife Federation, Washington, D.C., 50pp.

Schuman, G.E. and J.F. Power. 1981. Topsoil management of mined soils. Journal of Soil and Water Conservation 36: 77-78.

Street, M.W., A.S. Deaton, W.S. Chappell, and P.D. Mooreside. 2005. North Carolina Coastal Habitat Protection Plan. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries. Morehead City. 630 pp.

West, T.L., Clough, L.M., Ambrose Jr, W.G. 2000. Assessment of function in an oligohaline environment: Lessons learned by comparing created and natural habitats. Ecological Engineering 15: 303-321.

Wipfli, M.S., Richardson, J.S., and R.J. Naiman. 2007. Ecological linkages between headwaters and downstream ecosystems: Transport of organic matter, invertebrates, and wood down headwater channels. Journal of the American Water Resources Association 43(1): 72-85.

Appendix 1: EPA's Analysis of the FEIS Economic Evaluation

This appendix contains three sections. The first briefly details the U.S. Environmental Protection Agency's (EPA) primary concerns with the U.S. Army Corps of Engineers, Wilmington District's (the Corps) Economic Evaluation included in the Final Environmental Impact Statement (FEIS) for the proposed Section 404 permit to the Potash Corporation of Saskatchewan Phosphate Division (PCS or the Applicant) to expand an existing phosphate mining operation (Action ID: AID 200110096) in Beaufort County, NC. It should be noted that the Preamble (Federal Register Vol. 45 No. 249, page 85339, dated December 24, 1980) for the Clean Water Act (CWA) Section 404(b)(1) Guidelines (the Guidelines) addresses the issue of cost and economics. The Preamble makes it clear that the cost factor for purposes of practicability is in terms of what is reasonable in light of overall scope/cost of the proposed project and that it is not to be construed as an economics factor which would consider such matters as the applicant's financial standing, or investment, or market share. However, matters such as economic viability may be considered in the question of whether or not the project is available and logistically practicable. The second section describes the alternative evaluation method suggested by EPA and its results. The final section addresses the Corps' comments regarding EPA's method from its February 24, 2009, Notice of Intent (NOI) letter.

I. Concerns Regarding the Corps' FEIS Economic Evaluation

The FEIS evaluated eleven alternative mining alignments and a "No-Action" alternative. A central component of the FEIS's alternatives analysis was the evaluation of each alternative to determine if it was reasonable and feasible in light of its costs (i.e., economically viable). One of EPA's primary concerns regarding the Corps' FEIS Economic Evaluation is that the Corps intends to decide economic viability based solely on cost estimates without any consideration of the revenues the operation will bring in while incurring the costs. EPA does not contest the validity of the cost estimates produced by the Marston Cost Model (in fact all cost estimates used in the analysis done by EPA come directly from the Marston Cost Model), however consideration of expected costs without considering the accompanying expected revenue provides limited information on economic viability. For example, one cannot make any judgment on economic viability if all we know is that costs of an alternative is $1,000,000. However, we can make an informed decision if we compare the expected costs to expected revenues (i.e., revenues of less than $1,000,000 would mean the project is clearly not economically viable while revenues greater than $1,000,000 would suggest the project at least passes an initial hurdle of practicability under the Guidelines). EPA agrees with the Corps' assessment that "no or negative cash flow" is not practicable (FEIS Section 2.7.4. pg 2-22). The expected level of costs that would cause the applicant to break even would effectively set the upper cost bound for economic viability (i.e., the highest level of costs a firm could potentially endure).

As is pointed out numerous times in the FEIS, phosphate prices are determined by the (global and national) market and not influenced by the applicant's production levels. Comparing costs (which the applicant can control) to expected prices (which the firm does not control) simply adds context to the cost numbers and allows for better decision making.

A second major issue with the FEIS Economics Evaluation concerns the Corps' use of a 15 year time frame for alternative evaluation. If a project is expected to last longer than 15 years, then the entire length of the project should be included in the evaluation. No convincing reason has yet been given as to why a 37 year permit should be awarded based on evaluation of only the first 15 years of a potential project. Calculating the net present value (NPV) of each alternatives stream of future profits allows the equal comparison of different length alternatives. Evaluating only the first 15 years of a 15+ year project ignores the effects of those later years and weights the decision criteria in favor of those alternatives with the most profitable early years. In many cases, potential alternatives include higher cost mining areas in later years where they are not subject to evaluation. Their inclusion as part of the alternatives clearly signals that mining those areas is in the applicant's plans and therefore should be evaluated as part of the value of the alternative.

It is also important to note that the cost estimates presented in the FEIS do not account for any impacts the alternatives may have on recreational opportunities (hunting, fishing, bird watching, hiking, etc), unique cultural and environmental resources, and other environmental quality issues (like water quality). Degradation or loss of these types of resources has real effects on peoples' well being that have been estimated extensively in the economic literature. These losses may be partially or fully offset by mitigation undertaken, but they (as well as accounting production costs) should be considered and quantified when possible when evaluating alternatives.

II. Explanation of EPA's Analysis

The most straight forward and theoretically correct way to evaluate the economic viability of multiple alternatives of different lengths is to compare the discounted NPV of each alternative's stream of expected profits. By calculating the NPV of each alternative it is possible to compare the total value of each project in equal terms (current year dollars). An alternative with a positive NPV will add positive value to the applicant's company if undertaken and therefore demonstrates at least a minimum level of economic viability. EPA's review of the FEIS's Economic Evaluation uses expected cost and value data from the FEIS to calculate both the total NPV and the expected profit per year for every year of every alternative.

NPV analysis works by discounting future profits or losses back to the current (or any assumed baseline) year value and then summing the discounted years values to get the total current value. Discounting assumes that a dollar in the future is worth less than a dollar today due to the time value of money and investment risk (among other things). The amount that the value of a future dollar is discounted is given by the discount rate.

Each step used in calculating the NPV of alternatives is described below.

1. Using 1991 to 2007 USGS adjusted price per ton estimates from Table 2-7 on page 6-12 of Volume 1 of the FEIS (and reproduced on pages 8 and 9 of this appendix), future value per ton is predicted using an ordinary least squares regression.

Table A1: Predicted Adjusted Price Per Ton

	Year	Intercept
Coefficient Estimate	-0.0063	27.90081
Standard error	0.12767	1.308226

The fitted line predicts that prices will be relatively constant in the future (declining less than one cent per year). The estimated price intercept and year slope term are then used to predict the adjusted price per ton out into the future for the years the alternatives are assumed to be in operation. The estimate is likely conservative based on the recent increases in prices. The predictions assume that sales from this operation do not affect the overall market price. A graphic depiction of the historic prices and fitted line is given in Figure A1.

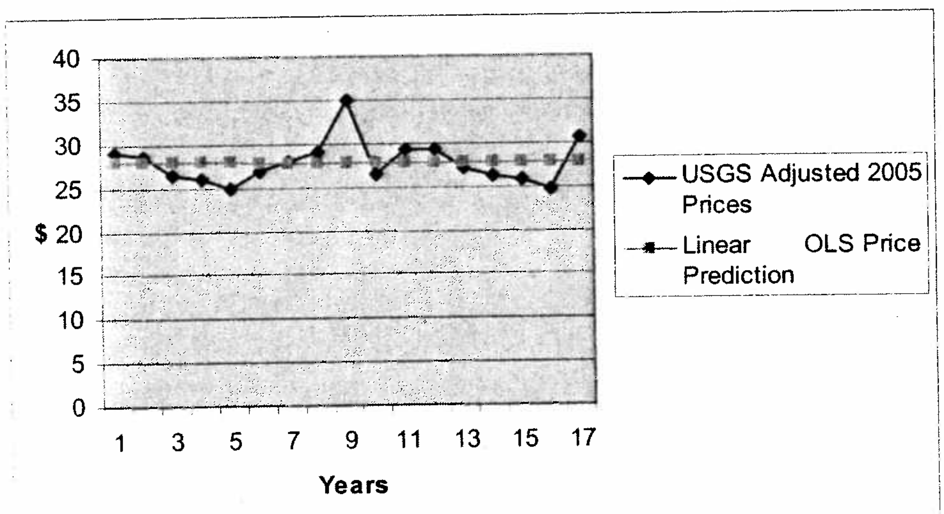


Figure A1: Historic and Predicted USGS Adjusted Prices

2. Next, the profit per ton per year for each alternative is computed. Cost per ton estimates for each year for each alternative from Table 2-6 on page 6-11 of the FEIS (and reproduced on pages 11 and 12 of this appendix) are subtracted from the value per ton per year estimates (from step 1) to get estimates of the profit per ton per year for each year for all alternatives. (Price per ton – cost per ton = profit per ton). Profit

per ton results for all years for all alternatives are presented on pages 15 and 16 of this appendix.

3. Then, total profit per year for each alternative is computed. Estimates of expected concentrated tons extracted from each alternative for each year from the tables in Appendix D of the FEIS (and reproduced on pages 13 and 14 of this appendix) are multiplied by the corresponding profit per concentrated ton for each year for each alternative (from step 2) to get estimates of total profit per year for each year for each alternative. (Profit per ton in a year * number of tons extracted in that year = total profit that year). Profit per year estimates for each alternative are presented on pages 17 and 18 of this appendix. The profit per year estimates for each alterative can also be used to understand the timing of annual profits for each alternative.

4. The net present value of the stream of annual profits over the life of each alternative is then calculated for each option. NPV is calculated

$$NPV = \sum_{t}^{T} \frac{profit_t}{(1+r)^t}$$

where t (t=1 .... T) indexes the years of an alternative, $profit_t$ is profit in year t (from step 3), and r is the discount rate. Following White House Office of Management and Budget (OMB) guidance we have used both a 3% and 7% discount rate. The NPV results are presented in Table A2.

Table A2. Net Present Value evaluation for the twelve alternatives evaluated in the FEIS

PCS Phosphate Mine Economics Evaluation			
NET PRESENT VALUE OF EACH ALTERNATIVE			
Mine Alternatives	3% Discount Rate	7% Discount Rate	# Years of Profitable Mining
AP	$364,300,909.71	$277,903,276.63	15
EAPA	$524,097,625.97	$352,411,515.70	35
EAPB	$480,656,851.35	$328,416,387.22	27
SCRA	$322,546,488.93	$253,026,944.10	19
SCRB	$293,339,783.09	$231,303,419.79	15
ALT L	$358,954,836.17	$271,764,925.74	23
ALT M	$445,195,180.08	$321,454,432.72	26
SJAA	$346,132,934.40	$266,988,898.53	23
SJAB	$353,940,971.53	$247,989,896.39	20
S33AP	$121,250,674.62	$122,320,107.39	12
No Action	($15,417,603.86)	$7,000,403.73	5
DL1B	$211,886,850.05	$154,818,541.01	10

The results of the NPV analysis, presented in Table A2, highlight that contrary to the conclusions drawn in the FEIS, many of the alternatives evaluated in the FEIS are indeed economically viable and should not have been eliminated from further consideration.

According to the FEIS, an alternative is reasonable if it provides "the applicant with the certainty of practicable costs for at least 15 years" (FEIS 2-29). Assuming this criterion is appropriate for use in determining whether an alternative is available and logistically practicable under the Guidelines, only the "No Action" and the S33AP and DL1B alternatives should have been eliminated from further consideration since they are the only three alternatives that do not provide at least 15 years of economically viable mining. If the 15 year criterion is not relevant for purposes of evaluating alternatives under the Guidelines and is not used, even the S33AP and DL1B options have a positive net present value and would be a better use of the land for the applicant than letting it remain unused. Discounted annual profit estimates for each alternative are presented on pages 20 through 23 of this appendix.

A number of the alternatives that are economically viable, based on the NPV analysis, involve far fewer impacts to aquatic resources than the FEIS's Alternative L or the proposed project (Modified Alternative L). EPA finds that the inconsistencies in the FEIS's economic analysis coupled with the results of the NPV evaluation strongly indicate that the proposed project is not the least environmentally damaging practicable alternative.

In order to check the sensitivity of results to the price estimate, the NPV of all alternatives was also calculated assuming both a 10% increase and decrease in predicted prices every year.[1] When predicted prices are assumed to decrease by 10% every year the S33AP, DL1B, and No Action alternatives do have negative NPV's, however all the other remaining alternatives do have positive NPV's signaling that even with depressed prices and profits a number of alternatives with fewer impacts to aquatic resources than the FEIS's Alternative L are still economically viable. If prices are assumed to increase 10% over predicted prices for all years then all alternatives have positive NPV's. The sensitivity results are presented below in Table A3.

[1] The 1991 to 2007 USGS adjusted price data used to estimate future prices had a standard deviation of roughly $2.50 or 10% of the sample's mean value.

Table A3. Net Present Value Sensativity to Price Estimation Analysis

PCS Phosphate Mine Economics Evaluation				
NET PRESENT VALUE OF EACH ALTERNATIVE				
	10% Decrease in Mean Predicted USGS Prices		10% Increase in Mean Predicted USGS Prices	
Mine Alternatives	3% Discount Rate	7% Discount Rate	3% Discount Rate	7% Discount Rate
AP	$199,692,806	$152,096,957	$528,909,013	$403,709,596
EAPA	$172,703,927	$161,903,126	$875,491,325	$542,919,905
EAPB	$129,263,152	$137,907,998	$832,050,551	$518,924,777
SCRA	$41,554,309	$78,150,857	$603,538,668	$427,903,032
SCRB	$12,347,604	$56,427,332	$574,331,963	$406,179,507
ALT L	$53,061,028	$90,235,035	$664,848,644	$453,294,816
ALT M	$125,184,502	$136,707,141	$765,205,858	$506,201,725
SJAA	$11,528,380	$79,332,534	$680,737,489	$454,645,263
SJAB	$19,334,672	$60,332,773	$688,547,271	$435,647,019
S33AP	($119,099,609)	($38,885,328)	$361,600,958	$283,525,543
No Action	($173,111,811)	($114,811,873)	$142,276,603	$128,812,681
DL1B	($148,326,103)	($10,593,356)	$572,099,803	$320,230,438

III. Responses to the Corps NOI letter:

- **The Corps**: "The Corps has also concluded that comparison of these cost estimates to an independently generated industry estimate of product value (the USGS value) is the most appropriate gauge available for determining cost practicability."

  Response: EPA analysis does compare the Marston Cost model estimates to USGS value estimates. Costs are predicted by the Marston Model and historic USGS estimates are used to extrapolate future values. EPA analysis then looks at the difference between expected costs and revenues to give a measure of economic viability. To our knowledge, the Corps and/or Applicant's analysis have never directly compared costs to product value.

- **The Corps**: "Finally, the Corps has determined that alternatives that give the applicant approximately 15 years of operation within the less costly Tracts (NCPC and Bonnerton) are practicable while alternatives that would require mining within the S33 Tract within the initial approximately 15 years are not practicable."

  Response: It is still unclear (and unjustified) why the Corps has determined that a 15 year time frame should be used in aspects of the decision making. EPA's NPV analysis demonstrates that a number of alternatives that do not provide 15 years of operation in NCPC and Bonnerton and require mining within S33 are economically viable and practicable, including SCRA and SCRB. Further, if a project is expected to last longer than 15 years, then the entire length of the project should be included in the evaluation. For all mining alternatives except AP, SCRB, S33AP and DL1B, roughly the first 20 years have positive expected profits. In the case of S33AP the first 12 years have positive expected profits and in the case of the DL1B the first 10 years have positive profits. Net present value methods allow comparison of projects of different lengths in equal terms (current year dollars) and therefore would allow full evaluation of alternatives.

- **The Corps**: "The NPV arguments presented to the USACE were largely cash flow analyses (i.e., sales less cost) and should not be confused with final income statements or profits."

  Response: Sales price less cost (on a per unit basis or in terms of totals) equals profit. EPA only used terms like sales minus costs because the Corps was resistant to the word profit. Further, two sentences later the Corps states: "Using this total NPV for each alternative suggests that practically all of the alternatives can yield profitable results over the period of the life of the mine." This sentence seems to admit/agree that the NPV analysis looks at profitability which contradicts the Corps' earlier statement.

- **The Corps**: "The problem with this approach is that it obviously does not allow consideration of costs on an annual basis. In this case we are considering a private enterprise, costs extended over very long periods of time, and costs which fluctuate substantially over the years. Regardless of the analysis used, it is clear that while many years of mining are likely to be profitable under most of the alternatives, there are also many consecutive years in which mining is likely not to be cost effective."

  Response: One of the strengths of the EPA approach is that is does allow consideration of costs on a yearly basis. Annual costs, expected revenues, and profits are all calculated as part of the analysis. The summed value of annual discounted profit estimates (the NPV) gives an overall value of an alternative, but simply looking at the discounted yearly estimates (before summing) shows how costs and revenues are fluctuating each year.

  The timing and sequence of profits is something that should be considered in evaluation options. As stated earlier, the first 15 to 20 years of all mining alternatives except the S33AP and DL1B have positive profits (S33AP has positive profits for the first 12 and DL1B has positive profits for the first 10 years).

PREDICTED VALUE PER TON: (USGS adjusted price per ton estimates from Table 2-7 on page 6-12 of Volume 1 of the FEIS):

YEAR	USGS Adjusted 2005 Prices	Renumbered Years	Linear OLS Price Prediction
1991	29.16	1	27.8945098
1992	28.56	2	27.88821078
1993	26.49	3	27.88191176
1994	26.03	4	27.87561275
1995	24.83	5	27.86931373
1996	26.91	6	27.86301471
1997	28.08	7	27.85671569
1998	29.02	8	27.85041667
1999	34.91	9	27.84411765
2000	26.38	10	27.83781863
2001	29.24	11	27.83151961
2002	29.21	12	27.82522059
2003	27.16	13	27.81892157
2004	26.26	14	27.81262255
2005	25.88	15	27.80632353
2006	24.6	16	27.80002451
2007	30.63	17	27.79372549
2008		18	27.78742647
2009		19	27.78112745
2010		20	27.77482843
2011		21	27.76852941
2012		22	27.76223039
2013		23	27.75593137
2014		24	27.74963235
2015		25	27.74333333
2016		26	27.73703431
2017		27	27.73073529
2018		28	27.72443627
2019		29	27.71813725
2020		30	27.71183824
2021		31	27.70553922
2022		32	27.6992402
2023		33	27.69294118
2024		34	27.68664216
2025		35	27.68034314
2026		36	27.67404412
2027		37	27.6677451
2028		38	27.66144608
2029		39	27.65514706
2030		40	27.64884804
2031		41	27.64254902
2032		42	27.63625
2033		43	27.62995098
2034		44	27.62365196

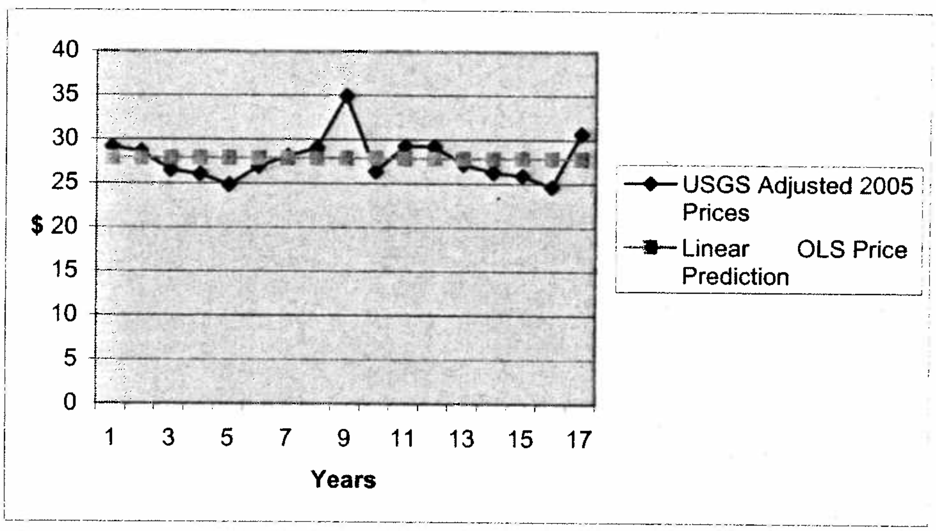
2035	45	27.61735294
2036	46	27.61105392
2037	47	27.6047549
2038	48	27.59845588
2039	49	27.59215686
2040	50	27.58585784
2041	51	27.57955882
2042	52	27.5732598
2043	53	27.56696078
2044	54	27.56066176
2045	55	27.55436275
2046	56	27.54806373
2047	57	27.54176471
2048	58	27.53546569
2049	59	27.52916667
2050	60	27.52286765
2051	61	27.51656863
2052	62	27.51026961
2053	63	27.50397059
2054	64	27.49767157
2055	65	27.49137255
2056	66	27.48507353
2057	67	27.47877451
2058	68	27.47247549
2059	69	27.46617647
2060	70	27.45987745
2061	71	27.45357843
2062	72	27.44727941
2063	73	27.44098039
2064	74	27.43468137
2065	75	27.42838235

OLS REGRESSION RESULTS: (Using USGS adjusted 2005 prices and Year from Predicted value per ton pages)

Linear

	Year	Intercept
Coefficient Estimate	-0.0063	27.90081
Standard error	0.12767	1.308226
	0.000162	2.578804
	0.002434	15
	0.016188	99.75342

*** Based on the data from 1991 through 2007, I have used a simple trend to predict future USGS Adjusted Prices into the future through the year 2065. These are likely conservative estimates since the recent phosphate prices seem to be rising.**



PREDICTED COST PER TON: (from Table 2-6 on page 6-11 of the FEIS)

YEAR	AP	EAPA	EAPB	SCRA	SCRB	ALT L	ALT M	SJAA
1	19.83	19.83	19.83	22.11	22.11	22.11	20.78	21.97
2	22.06	22.06	22.06	21.53	21.53	21.53	20.83	22.75
3	22.58	22.58	22.58	22.15	22.15	22.15	21.18	22.79
4	22.44	22.44	22.44	23.7	23.7	23.7	22.84	23.93
5	21.42	21.42	21.42	20.73	20.73	20.73	23.03	21.89
6	22.65	22.65	22.65	21.32	21.32	21.32	20.96	21.86
7	21.95	21.95	21.95	22.12	22.03	22.23	21.46	21.95
8	22	22	22	22.75	22.86	22.28	21.3	21.79
9	22.07	22.07	22.07	21.86	22.02	21.14	20.88	20.69
10	20.98	20.98	20.98	22.86	22	21.88	21.81	21.75
11	20.83	20.83	20.83	24.65	22.28	23.22	20.96	22.28
12	20.94	20.94	20.94	24.78	24.31	26.25	22.57	23.63
13	21	21	21	22.28	23.71	24.71	21.29	24.32
14	21.17	21.43	21.39	22.65	23.5	23.43	22.2	25.17
15	21.96	21.67	21.37	22.46	26.99	23.72	23.83	24.35
16		22.67	23.43	24.36	30.32	23.13	26.13	22.57
17		21.66	22.18	23.3	27.06	22.8	25.07	23.42
18		22.4	22.33	23.16	27.45	22.69	22.96	22.58
19		22.17	22.96	25.04	28.58	23.8	23.73	22.59
20		24.85	23.79	29.25	28.85	24.96	23.16	24.48
21		24.37	23.3	29.09	29.1	23.61	22.82	23.51
22		24.28	23.46	27.65	29.15	23.25	22.63	23.75
23		22.6	24.98	27.85	28.13	27.44	23.91	23.76
24		24.06	27.4	28.9	29.51	29.62	24.94	28.75
25		22.3	27.36	28.39	28.19	27.52	23.46	27.82
26		22.64	26.81	28.71	29.29	27.78	24.01	27.73
27		23.06	26.75	29.85	29.44	26.14	27.82	27.41
28		24.09	28.91	29.09	26.94	30.34	29.28	29.76
29		23.77	29.48	28.04	23.98	29.2	27.59	29.46
30		23.19	28.61	29.32	24.18	28.63	27.63	28.78
31		24.53	28.32	28.86	25.03	30.21	26.51	30.58
32		26.41	28.28	31.38	26.9	29.47	30.68	30.02
33		27.25	29.31			28.88	28.88	28.98
34		26.18	28.55			28.2	28.91	27.67
35		26.79	29.91			29.35	30.48	29.37
36		27.63	28.96			28.46	28.83	29.51
37		28.77	28.1			30.43	28.92	31.04
38		30.05	28.97				28.12	28.68
39		28.5	29.51				29.31	28.91
40		28.52	29.04				28.64	27.6
41		28.33	24.53				30.92	29.3
42		29.88	23.37					29.44
43		28.45	23.58					30.97
44		30.13	23.74					28.61
45		28.23	23.59					
46		28.62	24.63					
47		28.8	24.94					
48		30.49	23.67					
49		28.72	23.33					
50								

YEAR	SJAB	S33AP	No Action	DL1B
1	21.97	22.02	23.63	22.62
2	22.75	22.21	23.43	22.02
3	22.79	22.11	23.83	22.23
4	23.93	23.87	26.8	22.91
5	21.89	23.24	27.67	22.07
6	21.86	22.5	29.22	22.56
7	21.95	23.98	28.18	23.41
8	21.79	25.98	29.87	24
9	20.6	26.96	30.16	23.25
10	22.21	26.63	29.36	27.47
11	22.29	26.78	29.36	29.58
12	23.25	27.2	29.45	28.24
13	23.42	28.62	31.3	27.7
14	23.17	29.67	32.96	28.64
15	23.63	28.82	35.15	27.95
16	25.01	29.41		30.05
17	28.04	27.88		29.27
18	27.36	29.78		28.11
19	27.65	28.32		28.81
20	27.02	30.81		29.09
21	29.22	28.17		29.17
22	29.28	28.5		29.62
23	29	28.89		25.47
24	31.49	30.44		24.6
25	28.73	29.08		23.84
26	28.9			25.37
27	27.84			25.47
28	30.04			
29	29.13			
30	30.46			
31	26.77			
32	23.93			
33	24.37			
34	24.25			
35	24.65			
36	25.81			
37	24.01			
38	23.77			
39	23.87			
40	23.75			
41	24.15			
42	25.31			
43	23.51			
44	23.27			
45				
46				
47				
48				
49				
50				

EXTRACTED CONCENTRATE TONS PER YEAR: (from the tables in Appendix D of the FEIS)

YEAR	AP	EAPA	EAPB	SCRA	SCRB	ALT L	ALT M	SJAA
1	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
2	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
3	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
4	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
5	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
6	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
7	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
8	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
9	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
10	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
11	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
12	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
13	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
14	5000000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
15	4431000	5000000	5000000	5000000	5000000	5000000	5000000	5000000
16		5000000	5000000	5000000	5000000	5000000	5000000	5000000
17		5000000	5000000	5000000	5000000	5000000	5000000	5000000
18		5000000	5000000	5000000	5000000	5000000	5000000	5000000
19		5000000	5000000	5000000	5000000	5000000	5000000	5000000
20		5000000	5000000	5000000	5000000	5000000	5000000	5000000
21		5000000	5000000	5000000	5000000	5000000	5000000	5000000
22		5000000	5000000	5000000	5000000	5000000	5000000	5000000
23		5000000	5000000	5000000	5000000	5000000	5000000	5000000
24		5000000	5000000	5000000	5000000	5000000	5000000	5000000
25		5000000	5000000	5000000	5000000	5000000	5000000	5000000
26		5000000	5000000	5000000	5000000	5000000	5000000	5000000
27		5000000	5000000	5000000	5000000	5000000	5000000	5000000
28		5000000	5000000	5000000	5000000	5000000	5000000	5000000
29		5000000	5000000	5000000	5000000	5000000	5000000	5000000
30		5000000	5000000	5000000	5000000	5000000	5000000	5000000
31		5000000	5000000	5000000	5000000	5000000	5000000	5000000
32		5000000	5000000	3649000	3649000	5000000	5000000	5000000
33		5000000	5000000			5000000	5000000	5000000
34		5000000	5000000			5000000	5000000	5000000
35		5000000	5000000			5000000	5000000	5000000
36		5000000	5000000			5000000	5000000	5000000
37		5000000	5000000			3846000	5000000	5000000
38		5000000	5000000				5000000	5000000
39		5000000	5000000				5000000	5000000
40		5000000	5000000				5000000	5000000
41		5000000	5000000				2902000	5000000
42		5000000	5000000					5000000
43		5000000	5000000					4923000
44		5000000	5000000					3626000
45		5000000	5000000					
46		5000000	5000000					
47		5000000	5000000					
48		5000000	5000000					
49		2754000	2754000					
50								

YEAR	SJAB	S33AP	No Action	DL1B
1	5000000	5000000	5000000	5000000
2	5000000	5000000	5000000	5000000
3	5000000	5000000	5000000	5000000
4	5000000	5000000	5000000	5000000
5	5000000	5000000	5000000	5000000
6	5000000	5000000	5000000	5000000
7	5000000	5000000	5000000	5000000
8	5000000	5000000	5000000	5000000
9	5000000	5000000	5000000	5000000
10	5000000	5000000	5000000	5000000
11	5000000	5000000	5000000	5000000
12	5000000	5000000	5000000	5000000
13	5000000	5000000	4578000	5000000
14	5000000	5000000	3648000	5000000
15	5000000	5000000	2383000	5000000
16	5000000	5000000		5000000
17	5000000	5000000		5000000
18	5000000	5000000		5000000
19	5000000	5000000		5000000
20	5000000	5000000		5000000
21	5000000	5000000		5000000
22	5000000	5000000		5000000
23	5000000	5000000		5000000
24	5000000	5000000		5000000
25	5000000	4236000		5000000
26	5000000			5000000
27	5000000			3236000
28	5000000			
29	5000000			
30	5000000			
31	5000000			
32	5000000			
33	5000000			
34	5000000			
35	5000000			
36	5000000			
37	5000000			
38	5000000			
39	5000000			
40	5000000			
41	5000000			
42	5000000			
43	5000000			
44	3549000			
45				
46				
47				
48				
49				
50				

Total Tons Removed	
AP	74431000
EAPA	242754000
EAPB	242754000
SCRA	158649000
SCRB	158649000
ALT L	183846000
ALT M	202902000
SJAA	218549000
SJAB	218549000
S33AP	124236000
No Action	70609000
DL1B	133236000

PROFIT PER TON: (Expected Price Per Ton – Predicted Cost Per Ton for every year for every alternative)

YEAR	AP	EAPA	EAPB	SCRA	SCRB	ALT L	ALT M
1	7.957426	7.957426	7.957426	5.677426	5.677426	5.677426	7.007426
2	5.721127	5.721127	5.721127	6.251127	6.251127	6.251127	6.951127
3	5.194828	5.194828	5.194828	5.624828	5.624828	5.624828	6.594828
4	5.328529	5.328529	5.328529	4.068529	4.068529	4.068529	4.928529
5	6.34223	6.34223	6.34223	7.03223	7.03223	7.03223	4.73223
6	5.105931	5.105931	5.105931	6.435931	6.435931	6.435931	6.795931
7	5.799632	5.799632	5.799632	5.629632	5.719632	5.519632	6.289632
8	5.743333	5.743333	5.743333	4.993333	4.883333	5.463333	6.443333
9	5.667034	5.667034	5.667034	5.877034	5.717034	6.597034	6.857034
10	6.750735	6.750735	6.750735	4.870735	5.730735	5.850735	5.920735
11	6.894436	6.894436	6.894436	3.074436	5.444436	4.504436	6.764436
12	6.778137	6.778137	6.778137	2.938137	3.408137	1.468137	5.148137
13	6.711838	6.711838	6.711838	5.431838	4.001838	3.001838	6.421838
14	6.535539	6.275539	6.315539	5.055539	4.205539	4.275539	5.505539
15	5.73924	6.02924	6.32924	5.23924	0.70924	3.97924	3.86924
16		5.022941	4.262941	3.332941	-2.62706	4.562941	1.562941
17		6.026642	5.506642	4.386642	0.626642	4.886642	2.616642
18		5.280343	5.350343	4.520343	0.230343	4.990343	4.720343
19		5.504044	4.714044	2.634044	-0.90596	3.874044	3.944044
20		2.817745	3.877745	-1.58225	-1.18225	2.707745	4.507745
21		3.291446	4.361446	-1.42855	-1.43855	4.051446	4.841446
22		3.375147	4.195147	0.005147	-1.49485	4.405147	5.025147
23		5.048848	2.668848	-0.20115	-0.48115	0.208848	3.738848
24		3.582549	0.242549	-1.25745	-1.86745	-1.97745	2.702549
25		5.33625	0.27625	-0.75375	-0.55375	0.11625	4.17625
26		4.989951	0.819951	-1.08005	-1.66005	-0.15005	3.619951
27		4.563652	0.873652	-2.22635	-1.81635	1.483652	-0.19635
28		3.527353	-1.29265	-1.47265	0.677353	-2.72265	-1.66265
29		3.841054	-1.86895	-0.42895	3.631054	-1.58895	0.021054
30		4.414755	-1.00525	-1.71525	3.424755	-1.02525	-0.02525
31		3.068456	-0.72154	-1.26154	2.568456	-2.61154	1.088456
32		1.182157	-0.68784	-3.78784	0.692157	-1.87784	-3.08784
33		0.335858	-1.72414			-1.29414	-1.29414
34		1.399559	-0.97044			-0.62044	-1.33044
35		0.78326	-2.33674			-1.77674	-2.90674
36		-0.06304	-1.39304			-0.89304	-1.26304
37		-1.20934	-0.53934			-2.86934	-1.35934
38		-2.49564	-1.41564				-0.56564
39		-0.95194	-1.96194				-1.76194
40		-0.97824	-1.49824				-1.09824
41		-0.79453	3.005466				-3.38453
42		-2.35083	4.159167				
43		-0.92713	3.942868				
44		-2.61343	3.776569				
45		-0.71973	3.92027				
46		-1.11603	2.873971				
47		-1.30233	2.557672				
48		-2.99863	3.821373				
49		-1.23493	4.155074				
50							

YEAR	SJAA	SJAB	S33AP	No Action	DL1B
1	5.817426	5.817426	5.767426	4.157426	5.167426
2	5.031127	5.031127	5.571127	4.351127	5.761127
3	4.984828	4.984828	5.664828	3.944828	5.544828
4	3.838529	3.838529	3.898529	0.968529	4.858529
5	5.87223	5.87223	4.52223	0.09223	5.69223
6	5.895931	5.895931	5.255931	-1.46407	5.195931
7	5.799632	5.799632	3.769632	-0.43037	4.339632
8	5.953333	5.953333	1.763333	-2.12667	3.743333
9	7.047034	7.137034	0.777034	-2.42297	4.487034
10	5.980735	5.520735	1.100735	-1.62926	0.260735
11	5.444436	5.434436	0.944436	-1.63556	-1.85556
12	4.088137	4.468137	0.518137	-1.73186	-0.52186
13	3.391838	4.291838	-0.90816	-3.58816	0.011838
14	2.535539	4.535539	-1.96446	-5.25446	-0.93446
15	3.34924	4.06924	-1.12076	-7.45076	-0.25076
16	5.122941	2.682941	-1.71706		-2.35706
17	4.266642	-0.35336	-0.19336		-1.58336
18	5.100343	0.320343	-2.09966		-0.42966
19	5.084044	0.024044	-0.64596		-1.13596
20	3.187745	0.647745	-3.14225		-1.42225
21	4.151446	-1.55855	-0.50855		-1.50855
22	3.905147	-1.62485	-0.84485		-1.96485
23	3.888848	-1.35115	-1.24115		2.178848
24	-1.10745	-3.84745	-2.79745		3.042549
25	-0.18375	-1.09375	-1.44375		3.79625
26	-0.10005	-1.27005			2.259951
27	0.213652	-0.21635			2.153652
28	-2.14265	-2.42265			
29	-1.84895	-1.51895			
30	-1.17525	-2.85525			
31	-2.98154	0.828456			
32	-2.42784	3.662157			
33	-1.39414	3.215858			
34	-0.09044	3.329559			
35	-1.79674	2.92326			
36	-1.94304	1.756961			
37	-3.47934	3.550662			
38	-1.12564	3.784363			
39	-1.36194	3.678064			
40	-0.05824	3.791765			
41	-1.76453	3.385466			
42	-1.91083	2.219167			
43	-3.44713	4.012868			
44	-1.09343	4.246569			
45					
46					
47					
48					
49					
50					

PROFIT PER YEAR: (Profit Per Ton multiplied by Extracted Concentrate Tons Per Year for every year for every alternative)

YEAR	AP	EAPA	EAPB	SCRA	SCRB	ALT L
1	39787132.35	39787132.35	39787132.35	28387132.35	28387132.35	28387132.35
2	28605637.25	28605637.25	28605637.25	31255637.25	31255637.25	31255637.25
3	25974142.16	25974142.16	25974142.16	28124142.16	28124142.16	28124142.16
4	26642647.06	26642647.06	26642647.06	20342647.06	20342647.06	20342647.06
5	31711151.96	31711151.96	31711151.96	35161151.96	35161151.96	35161151.96
6	25529656.86	25529656.86	25529656.86	32179656.86	32179656.86	32179656.86
7	28998161.76	28998161.76	28998161.76	28148161.76	28598161.76	27598161.76
8	28716666.67	28716666.67	28716666.67	24966666.67	24416666.67	27316666.67
9	28335171.57	28335171.57	28335171.57	29385171.57	28585171.57	32985171.57
10	33753676.47	33753676.47	33753676.47	24353676.47	28653676.47	29253676.47
11	34472181.37	34472181.37	34472181.37	15372181.37	27222181.37	22522181.37
12	33890686.27	33890686.27	33890686.27	14690686.27	17040686.27	7340686.27
13	33559191.18	33559191.18	33559191.18	27159191.18	20009191.18	15009191.18
14	32677696.08	31377696.08	31577696.08	25277696.08	21027696.08	21377696.08
15	25430573.31	30146200.98	31646200.98	26196200.98	3546200.98	19896200.98
16		25114705.88	21314705.88	16664705.88	-13135294.12	22814705.88
17		30133210.78	27533210.78	21933210.78	3133210.78	24433210.78
18		26401715.69	26751715.69	22601715.69	1151715.69	24951715.69
19		27520220.59	23570220.59	13170220.59	-4529779.41	19370220.59
20		14088725.49	19388725.49	-7911274.51	-5911274.51	13538725.49
21		16457230.39	21807230.39	-7142769.61	-7192769.61	20257230.39
22		16875735.29	20975735.29	25735.29	-7474264.71	22025735.29
23		25244240.20	13344240.20	-1005759.80	-2405759.80	1044240.20
24		17912745.10	1212745.10	-6287254.90	-9337254.90	-9887254.90
25		26681250.00	1381250.00	-3768750.00	-2768750.00	581250.00
26		24949754.90	4099754.90	-5400245.10	-8300245.10	-750245.10
27		22818259.80	4368259.80	-11131740.20	-9081740.20	7418259.80
28		17636764.71	-6463235.29	-7363235.29	3386764.71	-13613235.29
29		19205269.61	-9344730.39	-2144730.39	18155269.61	-7944730.39
30		22073774.51	-5026225.49	-8576225.49	17123774.51	-5126225.49
31		15342279.41	-3607720.59	-6307720.59	12842279.41	-13057720.59
32		5910784.31	-3439215.69	-13821839.61	2525680.39	-9389215.69
33		1679289.22	-8620710.78			-6470710.78
34		6997794.12	-4852205.88			-3102205.88
35		3916299.02	-11683700.98			-8883700.98
36		-315196.08	-6965196.08			-4465196.08
37		-6046691.18	-2696691.18			-11035474.85
38		-12478186.27	-7078186.27			
39		-4759681.37	-9809681.37			
40		-4891176.47	-7491176.47			
41		-3972671.57	15027328.43			
42		-11754166.67	20795833.33			
43		-4635661.76	19714338.24			
44		-13067156.86	18882843.14			
45		-3598651.96	19601348.04			
46		-5580147.06	14369852.94			
47		-6511642.16	12788357.84			
48		-14993137.25	19106862.75			
49		-3400987.50	11443072.50			
50						

YEAR	ALT M	SJAA	SJAB	S33AP	No Action	DL1B
1	35037132.35	29087132.35	29087132.35	28837132.35	20787132.35	25837132.35
2	34755637.25	25155637.25	25155637.25	27855637.25	21755637.25	28805637.25
3	32974142.16	24924142.16	24924142.16	28324142.16	19724142.16	27724142.16
4	24642647.06	19192647.06	19192647.06	19492647.06	4842647.06	24292647.06
5	23661151.96	29361151.96	29361151.96	22611151.96	461151.96	28461151.96
6	33979656.86	29479656.86	29479656.86	26279656.86	-7320343.14	25979656.86
7	31448161.76	28998161.76	28998161.76	18848161.76	-2151838.24	21698161.76
8	32216666.67	29766666.67	29766666.67	8816666.67	-10633333.33	18716666.67
9	34285171.57	35235171.57	35685171.57	3885171.57	-12114828.43	22435171.57
10	29603676.47	29903676.47	27603676.47	5503676.47	-8146323.53	1303676.47
11	33822181.37	27222181.37	27172181.37	4722181.37	-8177818.63	-9277818.63
12	25740686.27	20440686.27	22340686.27	2590686.27	-8659313.73	-2609313.73
13	32109191.18	16959191.18	21459191.18	-4540808.82	-16426604.56	59191.18
14	27527696.08	12677696.08	22677696.08	-9822303.92	-19168272.94	-4672303.92
15	19346200.98	16746200.98	20346200.98	-5603799.02	-17755160.61	-1253799.02
16	7814705.88	25614705.88	13414705.88	-8585294.12		-11785294.12
17	13083210.78	21333210.78	-1766789.22	-966789.22		-7916789.22
18	23601715.69	25501715.69	1601715.69	-10498284.31		-2148284.31
19	19720220.59	25420220.59	120220.59	-3229779.41		-5679779.41
20	22538725.49	15938725.49	3238725.49	-15711274.51		-7111274.51
21	24207230.39	20757230.39	-7792769.61	-2542769.61		-7542769.61
22	25125735.29	19525735.29	-8124264.71	-4224264.71		-9824264.71
23	18694240.20	19444240.20	-6755759.80	-6205759.80		10894240.20
24	13512745.10	-5537254.90	-19237254.90	-13987254.90		15212745.10
25	20881250.00	-918750.00	-5468750.00	-6115725.00		18981250.00
26	18099754.90	-500245.10	-6350245.10			11299754.90
27	-981740.20	1068259.80	-1081740.20			6969217.75
28	-8313235.29	-10713235.29	-12113235.29			
29	105269.61	-9244730.39	-7594730.39			
30	-126225.49	-5876225.49	-14276225.49			
31	5442279.41	-14907720.59	4142279.41			
32	-15439215.69	-12139215.69	18310784.31			
33	-6470710.78	-6970710.78	16079289.22			
34	-6652205.88	-452205.88	16647794.12			
35	-14533700.98	-8983700.98	14616299.02			
36	-6315196.08	-9715196.08	8784803.92			
37	-6796691.18	-17396691.18	17753308.82			
38	-2828186.27	-5628186.27	18921813.73			
39	-8809681.37	-6809681.37	18390318.63			
40	-5491176.47	-291176.47	18958823.53			
41	-9821918.58	-8822671.57	16927328.43			
42		-9554166.67	11095833.33			
43		-16970232.57	20064338.24			
44		-3964782.16	15071072.06			
45						
46						
47						
48						
49						
50						

DISCOUNTED RATES AND TOTAL NET PRESENT VALUE OF ALTERNATIVES:

YEAR	3% Discount rate	7% Discount Rate
1	0.97087379	0.93457944
2	0.94259591	0.87343873
3	0.91514166	0.81629788
4	0.88848705	0.76289521
5	0.86260878	0.71298618
6	0.83748426	0.66634222
7	0.81309151	0.62274974
8	0.78940923	0.5820091
9	0.76641673	0.54393374
10	0.74409391	0.50834929
11	0.72242128	0.4750928
12	0.70137988	0.44401196
13	0.68095134	0.41496445
14	0.66111781	0.38781724
15	0.64186195	0.36244602
16	0.62316694	0.3387346
17	0.60501645	0.31657439
18	0.58739461	0.29586392
19	0.57028603	0.27650833
20	0.55367575	0.258419
21	0.53754928	0.24151309
22	0.5218925	0.22571317
23	0.50669175	0.21094688
24	0.49193374	0.19714662
25	0.47760557	0.18424918
26	0.46369473	0.17219549
27	0.45018906	0.16093037
28	0.43707675	0.15040221
29	0.42434636	0.14056282
30	0.41198676	0.13136712
31	0.39998715	0.12277301
32	0.38833703	0.11474113
33	0.37702625	0.1072347
34	0.3660449	0.10021934
35	0.3553834	0.09366294
36	0.34503243	0.08753546
37	0.33498294	0.08180884
38	0.32522615	0.07645686
39	0.31575355	0.07145501
40	0.30655684	0.06678038
41	0.297628	0.06241157
42	0.28895922	0.05832857
43	0.28054294	0.05451268
44	0.27237178	0.05094643
45	0.26443862	0.04761349
46	0.25673653	0.04449859
47	0.24925876	0.04158747
48	0.2419988	0.03886679
49	0.23495029	0.0363241
50	0.22810708	0.03394776

NET PRESENT VALUE OF EACH ALT

	3%	7%
AP	$364,300,910	$277,903,277
EAPA	$524,097,626	$352,411,516
EAPB	$480,656,851	$328,416,387
SCRA	$322,546,489	$253,026,944
SCRB	$293,339,783	$231,303,420
ALT L	$358,954,836	$271,764,926
ALT M	$445,195,180	$321,454,433
SJAA	$346,132,934	$266,988,899
SJAB	$353,940,972	$247,989,896
S33AP	$121,250,675	$122,320,107
No Action	($15,417,604)	$7,000,404
DL1B	$211,886,850	$154,818,541

RANKED NET PRESENT VALUE OF EACH ALT

	3%	7%
EAPA	$524,097,626	$352,411,516
EAPB	$480,656,851	$328,416,387
ALT M	$445,195,180	$321,454,433
AP	$364,300,910	$277,903,277
ALT L	$358,954,836	$271,764,926
SJAB	$353,940,972	$247,989,896
SJAA	$346,132,934	$266,988,899
SCRA	$322,546,489	$253,026,944
SCRB	$293,339,783	$231,303,420
DL1B	$211,886,850	$154,818,541
S33AP	$121,250,675	$122,320,107
No Action	-$15,417,604	$7,000,404

DISCOUNTED ANNUAL PROFITS FOR EACH ALTERNATIVE

YEAR	AP -- 3%	AP -- 7%	EAPA -- 3%	EAPA -- 7%	EAPB -- 3%	EAPB -- 7%	SCRA -- 3%
1	38628283.84	37184235.84	38628283.84	37184235.84	38628283.84	37184235.84	27560322.67
2	26963556.65	24985271.43	26963556.65	24985271.43	26963556.65	24985271.43	29461435.81
3	23770019.55	21202637.1	23770019.55	21202637.1	23770019.55	21202637.1	25737574.12
4	23671646.83	20325547.88	23671646.83	20325547.88	23671646.83	20325547.88	18074178.43
5	27354318.24	22609613.08	27354318.24	22609613.08	27354318.24	22609613.08	30330318.55
6	21380685.7	17011488.33	21380685.7	17011488.33	21380685.7	17011488.33	26949956.01
7	23578159.18	18058597.75	23578159.18	18058597.75	23578159.18	18058597.75	22887031.39
8	22669201.85	16713361.45	22669201.85	16713361.45	22669201.85	16713361.45	19708917.22
9	21716549.6	15412455.92	21716549.6	15412455.92	21716549.6	15412455.92	22521287.17
10	25115905.27	17158657.54	25115905.27	17158657.54	25115905.27	17158657.54	18121422.47
11	24903437.27	16377485.05	24903437.27	16377485.05	24903437.27	16377485.05	11105190.89
12	23770245.48	15047870.01	23770245.48	15047870.01	23770245.48	15047870.01	10303751.78
13	22852176.2	13925871.24	22852176.2	13925871.24	22852176.2	13925871.24	18494087.62
14	21603806.73	12672973.94	20744353.58	12168811.52	20876577.14	12246374.97	16711534.97
15	16322917.31	9217210.073	19349699.27	10926370.55	20312492.19	11470039.58	16814344.58
16			15650654.39	8507219.796	13282620.03	7220028.324	10384893.76
17			18231088.09	9539402.837	16658045.33	8716309.422	13269953.23
18			15508225.43	7811315.001	15713813.54	7914867.371	13276125.92
19			15694397.26	7609570.319	13441767.45	6517362.404	7510792.772
20			7800585.711	3640794.392	10735067.21	5010415.107	-4380280.881
21			8846572.281	3974636.511	11722460.91	5266731.525	-3839590.631
22			8807319.697	3809075.628	10947078.95	4734499.605	13431.05701
23			12791048.2	5325193.792	6761416.396	2814925.88	-509610.1935
24			8811883.624	3531437.15	596590.2273	239088.5969	-3092912.795
25			12743113.59	4915998.368	659692.6925	254494.1765	-1799975.989
26			11569069.8	4296235.346	1901034.732	705959.3166	-2504065.179
27			10272530.84	3672150.931	1966542.756	702985.6547	-5011387.608
28			7708619.854	2652608.432	-2824929.897	-972084.8877	-3218298.975
29			8149686.295	2699546.766	-3965402.349	-1313521.613	-910108.54
30			9094102.831	2899768.122	-2070738.352	-660280.7528	-3533291.349
31			6136714.542	1883617.773	-1443041.859	-442930.7039	-2523007.151
32			2295376.45	678210.058	-1335574.819	-394619.4864	-5367532.2
33			633136.1102	180078.0733	-3250234.231	-924439.3246	
34			2561506.846	701314.3408	-1776125.216	-486284.8939	
35			1391787.652	366812.0761	-4152193.353	-1094329.772	
36			-108752.8673	-27590.83276	-2403218.494	-609701.6217	
37			-2025538.369	-494672.7807	-903345.5303	-220613.1724	
38			-4058232.511	-954042.9189	-2302011.288	-541175.8845	
39			-1502886.271	-340103.0691	-3097441.678	-700950.8579	
40			-1499423.606	-326634.6283	-2296471.393	-500263.619	
41			-1182378.297	-247940.6738	4472553.718	937879.176	
42			-3396474.879	-685603.7458	6009147.863	1212991.242	
43			-1300502.162	-252702.3614	5530718.329	1074681.476	
44			-3559124.807	-665725.0308	5143153.644	962013.5015	
45			-951622.5719	-171344.3746	5183353.499	933288.5639	
46			-1432627.581	-248308.6627	3689266.151	639438.1598	
47			-1623083.882	-270802.6906	3187610.282	531835.3847	
48			-3628321.238	-582735.1135	4623837.874	742622.4172	
49			-799063.0068	-123537.8188	2688553.227	415659.3393	
50							

YEAR	SCRA -- 7%	SCRB -- 3%	SCRB -- 7%	ALT L -- 3%	ALT L -- 7%	ALT M -- 3%
1	26530030.24	27560322.67	26530030.24	27560322.67	26530030.24	34016633.35
2	27299884.06	29461435.81	27299884.06	29461435.81	27299884.06	32760521.5
3	22957677.53	25737574.12	22957677.53	25737574.12	22957677.53	30176011.17
4	15519308.04	18074178.43	15519308.04	18074178.43	15519308.04	21894672.74
5	25069415.4	30330318.55	25069415.4	30330318.55	25069415.4	20410317.53
6	21442664.12	26949956.01	21442664.12	26949956.01	21442664.12	28457427.67
7	17529260.47	23252922.57	17809497.86	22439831.06	17186748.12	25570233.38
8	14530827.31	19274742.14	14210722.3	21564028.92	15898548.71	25432134.17
9	15983586.35	21908153.79	15548439.35	25280387.41	17941747.82	26276729.16
10	12380174.19	21321026.3	14566076.15	21767482.65	14871085.73	22027915.52
11	7303212.635	19665883.02	12933062.27	16270503.02	10700126.13	24433863.44
12	6522840.395	11951994.5	7566268.5	5148609.66	3259352.495	18053999.46
13	11270098.77	13625285.54	8303102.969	10220528.84	6228280.73	21864796.76
14	9803126.352	13901784.29	8154903.078	14133175.52	8290639.112	18199050.03
15	9494708.775	2276171.467	1285306.43	12770614.31	7211298.851	12417590.24
16	5644912.444	-8185481.031	-4449378.57	14217370.43	7728130.221	4869866.346
17	6943492.835	1895644.053	991894.2942	14782494.35	7734928.811	7915557.689
18	6687032.119	676511.5836	340751.1134	14656503.24	7382312.322	13863520.52
19	3641675.74	-2583269.903	-1252521.754	11046566.14	5356027.405	11246166.25
20	-2044423.67	-3272929.372	-1527585.664	7496064.047	3498663.941	12479145.83
21	-1725072.336	-3866468.094	-1737147.99	10889259.53	4892386.241	13012579.17
22	5808.794692	-3900762.7	-1687039.944	11495066.08	4971498.429	13112932.83
23	-212161.896	-1218978.641	-507487.5327	529107.8907	220279.2148	9472217.251
24	-1239511.053	-4593310.691	-1840808.244	-4863874.246	-1949238.884	6647375.184
25	-694389.0878	-1322370.42	-510139.9103	277608.2371	107094.8344	9973001.293
26	-929897.867	-3848779.888	-1429264.797	-347884.6962	-129188.8245	8392760.916
27	-1791435.038	-4088500.044	-1461527.785	3339619.377	1193823.275	-441968.6919
28	-1107446.879	1480276.121	509376.9047	-5950028.682	-2047460.707	-3633521.891
29	-301469.3421	7704122.615	2551955.81	-3371317.441	-1116733.671	44670.77515
30	-1126634.019	7054768.371	2249500.892	-2111937.028	-673417.4645	-52003.23067
31	-774417.822	5136746.679	1576685.256	-5222920.38	-1603135.617	2176841.805
32	-1585933.464	980815.2327	289799.4165	-3646180.172	-1077329.196	-5995619.229
33				-2439627.801	-693884.7221	-2439627.801
34				-1135546.641	-310901.0406	-2435006.035
35				-3157119.84	-832073.5428	-5165036.037
36				-1540637.431	-390862.9792	-2178947.418
37				-3696695.777	-902799.3778	-2276775.572
38						-919800.1403
39						-2781688.132
40						-1683357.711
41						-2923277.99
42						
43						
44						
45						
46						
47						
48						
49						
50						

YEAR	ALT M -- 7%	SJAA -- 3%	SJAA -- 7%	SJAB -- 3%	SJAB -- 7%	S33AP -- 3%
1	32744983.51	28239934.32	27184235.84	28239934.32	27184235.84	27997215.88
2	30356919.6	23711600.77	21971907.81	23711600.77	21971907.81	26256609.72
3	26916722.23	22809120.81	20345524.33	22809120.81	20345524.33	25920602.45
4	18799757.45	17052418.33	14641978.55	17052418.33	14641978.55	17318964.44
5	16870074.34	25327187.6	20934095.56	25327187.6	20934095.56	19504578.31
6	22642080.12	24688748.51	19643540.11	24688748.51	19643540.11	22008798.89
7	19584334.62	23578159.18	18058597.75	23578159.18	18058597.75	15325280.34
8	18750393.32	23498081.54	17324471.01	23498081.54	17324471.01	6959958.083
9	18648861.69	27004825.06	19165598.74	27349712.59	19410368.93	2977660.498
10	15049007.98	22251143.69	15201512.77	20539727.69	14032309.39	4095252.171
11	16068674.73	19665883.02	12933062.27	19629761.96	12909307.63	3411404.295
12	11429172.54	14336686.09	9075909.161	15669307.86	9919531.884	1817055.229
13	13324172.79	11548383.96	7037461.403	14612664.99	8904801.419	-3092069.853
14	10675715.14	8381450.614	4916629.116	14992628.67	8794801.526	-6493700.017
15	7011953.541	10748749.17	6069593.889	13059452.18	7374399.56	-3596865.352
16	2647111.254	15962237.86	8676587.095	8359601.205	4544025.002	-5350071.458
17	4141809.479	12906943.37	6753548.201	-1068936.532	-559320.219	-584923.3752
18	6982896.035	14979570.28	7545037.476	940839.1571	473889.8758	-6166635.595
19	5452805.321	14496796.6	7028902.82	68560.12161	33241.99445	-1841898.068
20	5824434.966	8824885.857	4118869.547	1793203.778	836948.2116	-8698951.763
21	5846362.933	11158034.17	5013142.784	-4188997.66	-1882055.842	-1366863.961
22	5671209.241	10190334.82	4407215.516	-4239992.825	-1833753.502	-2204612.072
23	3943491.706	9852236.062	4101701.868	-3423087.747	-1425106.475	-3144407.285
24	2663992.022	-2723962.493	-1091651.088	-9463454.681	-3792559.781	-6880802.565
25	3847353.138	-438800.1168	-169278.9318	-2611905.457	-1007612.69	-2920904.32
26	3116696.219	-231961.0144	-86139.95128	-2944575.17	-1093483.585	
27	-157991.8103	480918.8724	171915.4426	-486987.5975	-174084.8471	
28	-1250328.981	-4682506.098	-1611294.291	-5294413.553	-1821857.388	
29	14796.99245	-3922967.712	-1299465.331	-3222796.215	-1067536.686	
30	-16581.87876	-2420927.098	-771942.8024	-5881615.878	-1875426.586	
31	668165.0066	-5962896.599	-1830265.679	1656858.516	508560.0979	
32	-1771513.019	-4714107.016	-1392867.298	7110755.673	2101000.042	
33	-693884.7221	-2628140.924	-747502.0716	6062314.063	1724257.736	
34	-666679.7143	-165527.6569	-45319.7772	6093840.129	1668431.017	
35	-1361269.148	-3192658.179	-841439.8366	5194390.009	1369005.523	
36	-552803.5747	-3352057.663	-850424.1284	3031042.201	768981.8258	
37	-556029.4094	-5827594.703	-1423203.095	5947055.53	1452377.571	
38	-216234.237	-1830433.367	-430313.4401	6153868.674	1446702.429	
39	-629495.8502	-2150181.04	-486585.8348	5806808.319	1314080.359	
40	-366702.8569	-89262.13893	-19444.87565	5811957.046	1266077.459	
41	-613001.3691	-2625874.1	-550636.7934	5038046.919	1056461.161	
42		-2760764.586	-557280.8894	3206243.39	647204.1031	
43		-4760878.87	-925092.9128	5628908.356	1093760.915	
44		-1079894.783	-201991.5083	4104934.761	767817.3619	
45						
46						
47						
48						
49						
50						

YEAR	S33AP -- 7%	No Action -- 3%	No Action -- 7%	DL1B -- 3%	DL1B -- 7%
1	26950590.98	20181681.9	19427226.5	25837132.35	24146852.67
2	24330192.38	20506774.68	19002216.14	28805637.25	25159959.17
3	23120937.11	18050384.18	16100775.37	27724142.16	22631158.38
4	14870847.11	4302629.189	3694432.255	24292647.06	18532744.13
5	16121438.85	397793.7323	328794.9747	28461151.96	20292408
6	17511245	-6130672.131	-4877853.725	25979656.86	17311342.33
7	11737687.87	-1749641.403	-1340056.706	21698161.76	13512524.64
8	5131380.272	-8394051.525	-6188696.812	18716666.67	10893270.41
9	2113275.912	-9285007.219	-6589663.969	22435171.57	12203246.84
10	2797790.038	-6061629.767	-4141177.8	1303676.47	662723.011
11	2243474.353	-5907830.173	-3885222.72	-9277818.63	-4407824.796
12	1150295.689	-6073468.423	-3844838.853	-2609313.73	-1158566.5
13	-1884274.226	-11185718.39	-6816456.891	59191.18	24562.23386
14	-3809258.807	-12672486.55	-7433786.727	-4672303.92	-1812000.016
15	-2031074.65	-11396361.97	-6435287.292	-1253799.02	-454434.4641
16	-2908136.15			-11785294.12	-3992086.863
17	-306060.7067			-7916789.22	-2506252.72
18	-3106063.512			-2148284.31	-635599.8104
19	-893060.9211			-5679779.41	-1570506.337
20	-4060091.892			-7111274.51	-1837688.468
21	-614112.1369			-7542769.61	-1821677.571
22	-953472.1573			-9824264.71	-2217465.882
23	-1309085.689			10894240.20	2298106.016
24	-2757540.026			15212745.10	2999141.276
25	-1126817.301			18981250.00	3497279.701
26				11299754.90	1945766.866
27				7315.739412	1121558.772
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					

"Schafale, Michael" <michael.schafale@ncdenr.gov>

04/08/2009 03:13 PM

To Rebecca Fox/R4/USEPA/US@EPA

cc

bcc

Subject RE: PCS question

Exemption 6 Personal Privacy

I can talk. I'm working at home today. You can reach me here at
I'll be unavailable tomorrow and Friday, and tied up in meetings much of
Monday.

-----Original Message-----
From: Fox.Rebecca@epamail.epa.gov [mailto:Fox.Rebecca@epamail.epa.gov]
Sent: Wednesday, April 08, 2009 2:08 PM
To: Schafale, Michael
Subject: RE: PCS question

Mike,

Do you have a few minutes to chat? If so, could you send me your phone #? Just have a few questions.... b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

"Schafale, Michael" <michael.schafale@ncdenr.gov>

04/08/2009 01:34 PM

To Rebecca Fox/R4/USEPA/US@EPA

cc

Subject RE: PCS question

Sparrow Road is way south, just 2 miles north of the Pamlico County line. Here is a screen shot. It is the yellow filled in site. The other orange lines are other SNHAs. The collection near it, the southwestern most in the view, is our Suffolk Scarp Bogs and Western Gum Swamp sites. My understanding is that they intend to eventually mine all the way down to there and mine the Sparrow Road site.

Of the northern SNHAs, Bonnerton is the western one, the eastern one is Drinkwater Creek, a regionally significant SNHA that has younger Nonriverine Wet Hardwood Forest. It is about half in the mining area and half in the mine buffer and exclusion for a creek. The green hatched areas are state game lands. I can send a shapefile if you wish.

But, given the complications involved, I don't push bringing Sparrow Road in. It looks hard enough to work for the Bonnerton site.

-----Original Message-----
From: Fox.Rebecca@epamail.epa.gov [mailto:Fox.Rebecca@epamail.epa.gov]
Sent: Wednesday, April 08, 2009 12:55 PM
To: Schafale, Michael
Subject: RE: PCS question

Yep, I know all the push back DWQ ran into and had to modify original 401. We are going to get a lot of resistance too and it is being handled at the highest levels now we will see where we end up. Where exactly is the Sparrow Road site? b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

"Schafale, Michael" <michael.schafale@ncdenr.gov>
04/08/2009 12:49 PM

To: Rebecca Fox/R4/USEPA/US@EPA
cc:
Subject: RE: PCS question

Here is the timeline.

I understand that the state tried to get a non-mining move from north to south and ran into a lot of opposition from PCS. I don't know how hard they tried to get no mining of the northwest area. There is also the Sparrow Road site, which looks like about half is slated to be mined, which I don't know that anybody tried to get eliminated from mining. It's good, but the Bonnerton site is definitely better.

One of the awkward things about this all is that it's so easy to destroy these communities. Clearcutting this site would pretty well eliminate its significance, and would be perfectly legal. This site became nationally significant because other private land owners degraded some of the better examples. It was state significant when it was first discovered in 2005. And in 1960 we probably wouldn't have thought it worth worrying about.

-----Original Message-----
From: Fox.Rebecca@epamail.epa.gov [mailto:Fox.Rebecca@epamail.epa.gov]
Sent: Wednesday, April 08, 2009 12:20 PM
To: Schafale, Michael
Subject: RE: PCS question

Mike,

Ok, thanks! Was going to send this afternoon. The time line would be helpful. Just for your information, the boundary we are trying to get on Bonnerton would add the northwestern area and extend to the western boundary to include the wetland mixed pine hardwood forest and wet pine plantation just west of that NW area. We are also asking for a non mining, non impacting way to proceed from N to S in Bonnerton so to leave the connecting area as it is. Course we do not know how this will all turn out but that is what we are shooting for. b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

"Schafale, Michael" <michael.schafale@ncdenr.gov>
04/08/2009 11:41 AM

To: Rebecca Fox/R4/USEPA/US@EPA
cc:
Subject: RE: PCS question

Hi Becky,

Linda tells me that she got the information she needs on the elevation package from Colleen Sullins, so we don't need you to send it. Thanks for checking on it for us.

Do you have the time line I did of NHP actions on the Bonnerton site? Would that be of use to you?

-----Original Message-----
From: Fox.Rebecca@epamail.epa.gov [mailto:Fox.Rebecca@epamail.epa.gov]
Sent: Tuesday, April 07, 2009 5:39 PM
To: Schafale, Michael
Subject: RE: PCS question

just got teh ok to share the elevation package tomorrow -- have to wait for it to be received by PCS. i can send tomorrow -- do you want the cover letter and the detailed comments? I assume you probably do not want to see the economic appendix? b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

"Schafale, Michael" <michael.schafale@ncdenr.gov>
04/07/2009 04:18 PM

To: Rebecca Fox/R4/USEPA/US@EPA
cc:
Subject: RE: PCS question

Hi Becky,

Can you share the EPA letter to the Corps with me?

-----Original Message-----
From: Fox.Rebecca@epamail.epa.gov [mailto:Fox.Rebecca@epamail.epa.gov]
Sent: Monday, April 06, 2009 3:12 PM
To: Schafale, Michael
Subject: Fw: PCS question

Hi Mike,

As you may have heard, EPA is elevating to the Assistant Secretary of the Army (Civil Works) the COE's permit decision for PCS. One of the things we are asking for is full protection of the SNHA including the north west more recently disturbed area. In reading through the COE's draft Record of Decision an email correspondence from you is cited and I wanted to check to see if the context is correct. The topic is the additional 73 acres that was added to the original SNHA and the COE states that you say that the additional acreage is a headwater stream on the face of the Suffolk Scarp comprised of a headwater stream on the face of the Suffolk Scarp to the west of the Bonnerton Tract and other areas that are included as "connectors but aren't otherwise in good condition". It is my understanding that the scarp area was in the original southern area that will be protected by the DWQ 401 and that the 73 acres includes approximately 45 acres of the less mature wet hardwood forest and the connecting area between this area and the more mature area to the south. The discussion citing you in the ROD does not mention the less mature WHF. Just wanted to check to see if this is an accurate characterization of your communication with them. The cite they made from you was an email from 8-26-08. Thanks Mike, Becky

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

(See attached file: PCStimeline.doc)
[attachment "sparrowroad.doc" deleted by Rebecca Fox/R4/USEPA/US]

Rebecca Fox /R4/USEPA/US
04/09/2009 10:19 AM

To Palmer Hough/DC/USEPA/US@EPA
cc Mike_Wicker@fws.gov, Ron Sechler <ron.sechler@noaa.gov>
bcc
Subject Re: Fw: Onsite ASA(CW) Meeting 17 April 2009

Palmer,

I would definitely say Ross Smith should be your first contact at PCS. He is their environmental manager. I can't find my sign up list from the mtg at this moment -- wonder why... i actually had 2 of them but they are somewhere in this mass of papers strewn about my office :) But I do have a number for Ross = 252.322.8270. b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov
Palmer Hough/DC/USEPA/US

Palmer Hough/DC/USEPA/US
04/09/2009 10:13 AM

To Rebecca Fox/R4/USEPA/US@EPA
cc Mike_Wicker@fws.gov, Ron Sechler <ron.sechler@noaa.gov>
Subject Re: Fw: Onsite ASA(CW) Meeting 17 April 2009

Becky/Mike/Ron:

Can one of you send me the sign up sheet from the 3/24 meeting. As Becky's email notes we are going to reach out to PCS directly to set up a site visit on 4/27 and I need the phone numbers of the PCS folks who attended that meeting so that I can start the ball rolling on that.

Also, of the four folks who attended the 3/24 meeting, who do you think would be the best person to reach out to first to set this site visit up?

Thanks, Palmer

Palmer F. Hough
US Environmental Protection Agency
Wetlands Division
Room 7231, Mail Code 4502T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Office: 202-566-1374
Cell: 202-657-3114
FAX: 202-566-1375
E-mail: hough.palmer@epa.gov

Street/Courier Address
USEPA

Palmer Hough
EPA West -- Room 7231-L
Mail Code 4502T
1301 Constitution Avenue, NW
Washington, DC 20460

Rebecca Fox Mike/Ron, Just to keep you all in the loop on all t... 04/09/2009 10:07:16 AM

From: Rebecca Fox/R4/USEPA/US
To: Mike_Wicker@fws.gov
Cc: Ron Sechler <ron.sechler@noaa.gov>, Palmer Hough/DC/USEPA/US@EPA
Date: 04/09/2009 10:07 AM
Subject: Re: Fw: Onsite ASA(CW) Meeting 17 April 2009

Mike/Ron,

Just to keep you all in the loop on all this, EPA had asked for a site visit on 4-27 in our email that went out to all attendees from our Raleigh mtg. The Army set up this 4-17 mtg and are inflexible about the date. Our managers from DC to RA in Atlanta can not make this date so we are still planning on the 4-27 date. Just to let you know that it looks like there will be two onsite meetings.

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

Mike_Wicker@fws.gov

Mike_Wicker@fws.gov
04/09/2009 09:58 AM

To Ron Sechler <ron.sechler@noaa.gov>, Rebecca Fox/R4/USEPA/US@EPA
cc
Subject Fw: Onsite ASA(CW) Meeting 17 April 2009

----- Forwarded by Mike Wicker/R4/FWS/DOI on 04/09/2009 09:57 AM -----

Mike Wicker/R4/FWS/DOI

To "Jolly, Samuel K SAW" <Samuel.K.Jolly@usace.army.mil>
cc "Moyer, Jennifer A HQ02" <Jennifer.A.Moyer@usace.army.mil>, "Gaffney-Smith, Margaret E" <Meg.E.Gaffney-Smith@usace.army.mil>, pete_benjamin@fws.gov, "Smith, Chip R HQDA" <SmithCR@HQDA.Army.Mil>, "Walker, William T SAW" <William.T.Walker@usace.army.mil>
Subject Re: Onsite ASA(CW) Meeting 17 April 2009

I

0
4/
0
9/
2
0
0
9
0
9:
5
2
A
M

Ken,

Do you have any information as to the response to our request for an extension as it will have a bearing on what we do? Please let us know as soon as possible because our deadline for elevation is today (April 9) so that we will have time to make arrangements.

(See attached file: 040617 FINAL signed 20 day extenson to review ROD.pdf)

Thanks,

Mike

"Jolly, Samuel K SAW" <Samuel.K.Jolly@usace.army.mil>

"
J
ol
ly
,
S
a
m
u
el
K
S
A
W
"
<
S
a
m

To<pete_benjamin@fws.gov>, <mike_wicker@fws.gov>

cc"Walker, William T SAW" <William.T.Walker@usace.army.mil>,
"Moyer, Jennifer A HQ02" <Jennifer.A.Moyer@usace.army.mil>,
"Smith, Chip R HQDA" <SmithCR@HQDA.Army.Mil>,
"Gaffney-Smith, Margaret E" <Meg.E.Gaffney-Smith@usace.army.mil>

SubjectOnsite ASA(CW) Meeting 17 April 2009 uel.K.Jolly@usace.army.mil>

04/09/2009 09:18 AM

Pete/Mike,

As per the below email, Chip Smith (ASA(CW)) has scheduled his 404(q) site visit to PCS on 17 April 2009. Should USFWS elevate the decision to ASA this Friday, please accept this email as your agency's invitation to attend and notify your Region and HQ personnel accordingly. Thanks.

Ken Jolly
Chief, Regulatory Division
Wilmington District

From: Smith, Chip R Mr CIV USA ASA CW
To: Peck.Gregory@epamail.epa.gov
Cc: evans.david@epa.gov ; Chubb, Suzanne L Ms CIV USA ASA CW ; James, William L LRN; Gaffney-Smith, Margaret E; Pfenning, Michael COL HQDA

Sent: Wed Apr 08 15:44:28 2009

Subject: PCS Phosphate Site Visit

As stated previously I have scheduled the 404q site visit for April 17th. This is firm. I will meet with the applicant and agency representatives that day. This site visit will cover EPA and FWS should they request higher level review. If NMFS requests ASA review we will address that separately, with a separate site visit and separate documentation.

Chip

Sent from my BlackBerry Wireless Device [attachment "040617 FINAL signed 20 day extenson to review ROD.pdf" deleted by Palmer Hough/DC/USEPA/US]

Tom Welborn/R4/USEPA/US
04/13/2009 12:24 PM

To Suzanne Schwartz/DC/USEPA/US@EPA, Palmer Hough/DC/USEPA/US@EPA, Rebecca Fox/R4/USEPA/US@EPA, Jennifer
cc
bcc
Subject PCS articles.

[1 Attachment]
Sent by EPA Wireless E-Mail Services

----- Original Message -----
From: ust-waste
Sent: 04/13/2009 12:17 PM GMT
To: Tom Welborn; Angela Ellis
Subject: Scan from a Xerox WorkCentre Pro

Please open the attached document. It was scanned and sent to you using a Xerox WorkCentre Pro.

Sent by: Guest [ust-waste@epa.gov]
Number of Images: 6
Attachment File Type: PDF

WorkCentre Pro Location: machine location not set
Device Name: XRX-WATER-16SW

For more information on Xerox products and solutions, please visit http://www.xerox.com

THE NEWS&OBSERVER
newsobserver.com

Published: Apr 11, 2009 02:00 AM
Modified: Apr 11, 2009 03:46 AM

Mine ties layoffs to permit problems

PCS Phosphate has sought expansion, but EPA wants a review of wetlands, river impact.

BY WADE RAWLINS, Staff Writer
Comment on this story

PCS Phosphate announced Friday that it planned to eliminate 12 contractor jobs and reassign 12 other workers involved in mining and blamed delays in getting a federal permit to expand its mining operation in Beaufort County. Environmental advocates said the company has itself to blame.

The company said it plans to idle one of two excavation teams that strip off the top 100-foot layer of soil and rock to prepare the site for mining of phosphate ore. Actual mining will continue.

"Our mining operations are quickly approaching the end of our existing permit boundary," said Steve Beckel, general manager of the PCS Phosphate's Aurora facility. "We began the permitting process more than eight years ago in hopes of avoiding this situation."

PCS's announcement comes after leaders of the U.S. Environmental Protection Agency last week asked the assistant secretary of the Army to intervene in the permit review and require changes to the mining expansion plan drafted by the Corps of Engineers office in Wilmington. EPA says the environmental harm the expansion would entail is unacceptable to the Pamlico River and wetlands.

The mining expansion would allow the company to mine about 11,000 acres adjacent to its current open-pit mine, including impacts to nearly 4,000 acres of wetlands and about five miles of streams. The expansion would cause the largest permitted destruction of streams and wetlands in North Carolina.

The rich deposit of black phosphate rock has been extracted from the site by various companies for about 40 years. PCS Phosphate, part of an international company based in Canada, has worked the mine since 1995. It is the largest employer in Beaufort County, with 1,100 full-time workers and hundreds of contract workers.

The company's permit allows it to mine the site until 2017, but it may exhaust the available phosphate before then. As part of its long-range plans, the company is seeking a permit to expand its mining operations at the site for another 35 years.

The EPA said PCS's mining expansion plan is unacceptable because of the magnitude of harm it would cause to the Pamlico River estuary and to tidal creeks and wetlands.

The agency said it was particularly concerned about a "nationally significant" 271-acre hardwood swamp forest that would be destroyed under the existing expansion plan. Another big concern was the mining of the drainages of 10 tidal creeks, many of which provide important nursery areas for young fish and marine life.

The assistant secretary of the Army has until early May to decide whether to order changes to the mining permit or approve it as proposed. EPA officials can veto the permit if they still find the permit objectionable.

With the economic slowdown reducing demand for phosphate, the company announced in January that it planned to reduce production at its Aurora facility at least through the first quarter. But on Friday it blamed the layoffs on delays in obtaining a permit.

"The global market for phosphate has followed the economic situation in the world," said Ross Smith, environmental manager for PCS Phosphate. "This idling doesn't have anything to do with market conditions. It's solely due to not receiving permits for our mine continuation."

David Emmerling, executive director of Pamlico Tar River Foundation, an advocacy group for the Pamlico and Tar rivers, said the group deeply regretted that 24 employees' jobs have been affected. But Emmerling faulted the company for being unwilling to compromise during permit negotiations.

"I find it regrettable that PCS employees and contractors have to bear the consequences of the hardball strategy that PCS has used in the permitting process," Emmerling said. "The layoff is a direct result of their unwillingness to compromise and instead to try to use this strategy to create pressure with this 11th-hour maneuvering."

"They have advanced a mining expansion alternative that they were told at the very beginning of the process was not going to be allowed," Emmerling said.

The company first applied to expand its mine in 2000. It sought to mine through wetlands, salt marsh, headwaters of a number of creeks and navigable waters -- a plan state regulators said violated state law, causing the issue to be tied up in court until 2006.

Since then, the company has offered a different plan, and the permitting process has moved forward.

wade.rawlins@newsobserver.com or 919-829-4528

Related Content

Pulitzer Prize Winning

WASHINGTON DAILY NEWS

The Voice of the Pamlico

MONDAY, APRIL 13, 2009

Local News

PCS cuts 12, blames permitting delays

PTRF head: PCS to blame, not EPA

By TED STRONG

Staff Writer

PCS Phosphate announced Friday it will cut 12 contractor positions at its Aurora facility. The company blamed the move, which will take effect April 20, on permitting delays, but environmentalists said the company is to blame.

The cuts stem from PCS Phosphate's decision to idle one of its bucket-wheel excavators, giant machines that scoop away upper layers of earth to make it easier for mining machines to access the phosphate ore below.

"We've only got room for one to be able to operate,' said Ross Smith, PCS Phosphate's manager of environmental affairs. Twelve PCS Phosphate employees affected by the cuts were reassigned to other duties at the facility.

He said the mine is nearing the edge of its permitted area.

"Everyone deeply regrets the impact this is having on these families," said David Emmerling, executive director of the Pamlico-Tar River Foundation in an e-mail. "This occurred because PCS ignored the concerns state and federal agencies presented from the beginning of the 8 year process."

He added later in the e-mail, "The company steadfastly refused to compromise and it is their decisions that create the present situation."

Environmentalists have been under fire lately for their opposition to some of PCS Phosphate's proposed expansion. The Beaufort County Board of Commissioners recently decided to begin lobbying on PCS Phosphate's behalf, and two commissioners condemned "long-haired" environmentalists at a recent meeting.

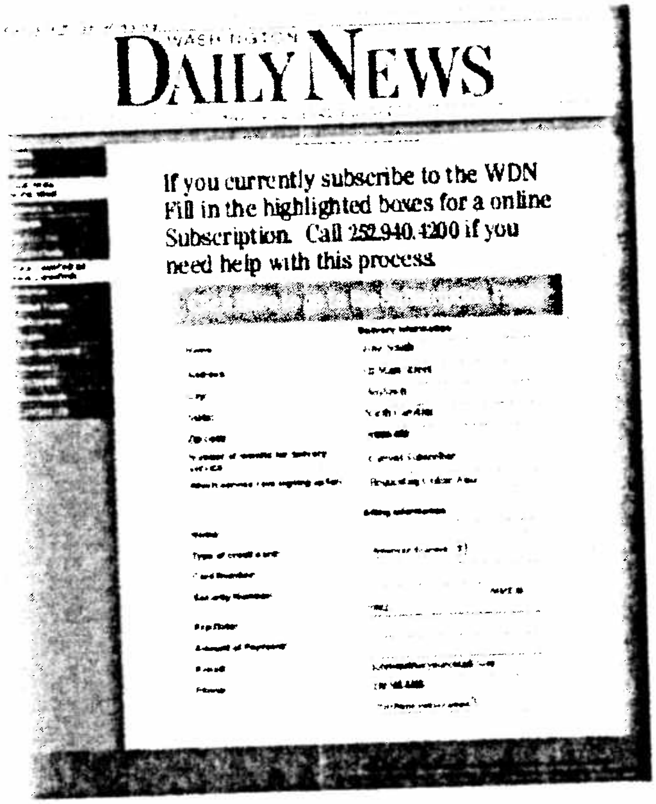
The latest setback to PCS Phosphate's pursuit of its permit was a decision this week by the Environmental Protection Agency to ask for a second review of PCS Phosphate's permit application by the U.S. Army Corps of Engineers' office in Washington, D.C. The review will take a maximum of 30 days, and it comes on the heels of a more-than-eight-year process of review at the Corps of Engineers' office in Wilmington.

Smith said he's not sure if more cuts could be coming, saying the permit-approval path from this point forward is uncertain. The Corps of Engineers' Washington, D.C., office likely will either order its Wilmington office to approve the permit or reconsider the permit application. If the Corps of Engineers swiftly approves PCS Phosphate's expansion, the Environmental Protection Agency has veto power over the permit.

"I believe if a viable and practical permit is issued that we would restart everything," said Smith. "The unknown is what the actual permit boundary and restrictions would be, given the EPA's recent action."

The EPA contends the proposed expansion would adversely affect nearby waterways and the aquatic life within them. The objections mirror protests raised by environmentalists over a water-quality certification issued by the N.C. Division of Water Quality for the project. Smith said the DWQ certification adequately addressed many such worries.

Related photo: PCS Phosphate has idled one of its two bucket-wheel excavators. One of the company's excavators clears earth in this June 2008 photograph. (WDN File Photo/Ted Strong)



Print Article

Print This Story

Phosphate mine blames NC layoffs on permit delay

By The Associated Press

A phosphate mining company is blaming layoffs at a North Carolina facility on delays in getting permits to expand its operation.
PCS Phosphate announced Friday it planned to eliminate 12 contractor jobs and reassign 12 other workers.
PCS Phosphate wants federal permits to continue mining phosphate ore on the Pamlico River in Beaufort County for 30 more years.
The U.S. Environmental Protection Agency has expressed concern about effects the project may have on wetlands and streams.
PCS Phosphate is part of a company based in Canada and has mined phosphate since 1995 for fertilizer and other uses. The company is Beaufort County's largest employer with 1,100 workers.

Mike_Wicker@fws.gov
04/13/2009 03:20 PM

To Rebecca Fox/R4/USEPA/US@EPA, Ron Sechler <ron.sechler@noaa.gov>
cc
bcc
Subject Fw: draft PCS letter with attachments

(See attached file: 20090413_PCS_404qf1.doc)(See attached file: 20090413_PCS_NCMFC.pdf)(See attached file: 20090413_PCS_ncwrc.pdf)(See attached file: 20090413_PCS_NMFS.doc)

Dear:

This letter is provided under Part IV, paragraph 3(f)(1), of the 1992 Memorandum of Agreement (MOA) between the Department of the Interior and the Department of Army, under Clean Water Act (CWA) Section 404(q). The U.S. Fish and Wildlife Service (Service) has decided not to seek higher level review of the proposed decision by the Army Corps of Engineers' Wilmington District to issue a CWA Section 404 permit to the Potash Corporation of Saskatchewan, Phosphate Division, Aurora Operation. Nonetheless, the Service has substantial unresolved concerns regarding the proposed project and our decision to not seek higher level review is not an indication that these concerns have been resolved. To the contrary, the Service fully concurs with the views expressed by the U.S. Environmental Protection Agency in their letter to the Assistant Secretary of the Army (Civil Works) dated April 6, 2009.

The Wilmington District issued a Notice of Intent to Proceed letter regarding this permit under paragraph 3(c)(3) of the MOA on March 2, 2009; this letter was received by our Southeast Regional Office on March 5, 2009. The proposed project is an expansion of the mine's 1997 CWA permit. The expansion, as currently proposed, will impact 3,953 acres of wetlands and 25,727 linear feet of streams, including a portion of a Significant Natural Heritage Area designated as "nationally significant." In addition, the project is adjacent to the Pamlico River and will result in a loss of approximately 70 percent of the watersheds of the project area streams which drain to the Albemarle-Pamlico Estuary Complex.

The March 2, 2009, Notice of Intent to Proceed included some provisions to minimize impacts through minor project reduction and compensatory mitigation. The Wilmington District concluded that these steps would adequately address our concerns for the project. Both the Service's Raleigh, North Carolina Field Office and Southeast Regional Office staff carefully considered these measures, and responded on March 20, 2009, pursuant to Part IV, paragraph 3(d)(2) of the 1992 MOA. That response stated that the Service does not concur that our concerns have been adequately addressed.

Pursuant to Part IV, paragraph 3(f) of the 1992 MOA, the Department of the Interior had until April 9, 2009, to notify the ASA (CW) that Interior was requesting higher level review. On April 3, 2009, the District provided the Service with an 80-page draft Record of Decision containing information not previously reviewed by the Service. In response the Service requested, via a letter dated April 8, 2009, an extension of the MOA timeframe in order to allow a review of the new information. The Corps denied that request, and the Service was unable to complete its review within the timeframe prescribed by the MOA.

Throughout the permit review process, the Service has consistently stated our concerns regarding the effects of the proposed project on the nationally significant fish and wildlife resources of the Albemarle-Pamlico Estuary System, of which the project site is apart. The proposed project would eliminate critical ecological functions provided by approximately 3,953 acres of wetlands and 25,727 linear feet of streams within the nationally significant Albemarle Pamlico Estuary. Wetland functions include temporary storage of surface water, nutrient cycling, organic carbon export, pollutant filtering/removal, and maintenance of biologically diverse plant and animal habitat. Stream functions include transport of water, nutrients and sediment downstream, pollutant processing and removal, and maintenance of biologically diverse plant and animal habitat. Of particular concern are the proposed projects:

- Direct impacts to portions of a nonriverine hardwood wetland forest that has been designated as a Nationally Significant Natural Heritage Area by the NC Natural Heritage Program; and,
- Indirect impacts to the site's tidal creeks, four of which have been designated as Primary Nursery Areas by the NC Wildlife Resources Commission, associated with the 70 percent reduction in the drainage basins for these creeks.

The Service believes that impacts to these ecological functions at the scale associated with this project would cause substantial and unacceptable adverse impacts to these aquatic resources of national importance and that the concerns expressed by the Service throughout the permit review process have not been adequately addressed. Eliminating the headwater streams and wetlands and significantly reducing the drainage areas of the project site's Primary Nursery Areas and other tidal creeks would:

- Reduce flow from ground water and increase variability in surface water flows to the tidal creeks, thereby increasing the frequency and magnitude of short-term salinity fluctuations;
- Reduce filtration of nutrients and other contaminants previously accomplished by the site's streams and wetlands, increasing sedimentation and turbidity in tidal creeks;
- Reduce productivity of native fish and shellfish in the downstream estuary by disrupting the estuarine food web (caused by a reduction of organic materials critical for biological activity in the surface water drainage); and
- Shift downstream estuarine productivity from the benthic community which is dominated by sensitive submerged aquatic vegetation and benthic invertebrate species to tolerant phytoplankton species. This would exacerbate ongoing environmental stress and create an open niche for problematic invasive plant and animal species to colonize and degrade the estuary.

We believe the disruption of these processes and functions in the drainage basin will significantly impact the site's tidal creeks and impair the ability of these systems to function as Primary Nursery Areas. Further, we agree with the EPA that the adverse impacts to these resources have not been avoided and minimized to the extent possible and the proposed compensatory mitigation would not reduce these adverse impacts to an acceptable level.

Since the formal permit elevation process was initiated with the Corps' March 2, 2009, letter, the Service has continued to coordinate with the Corps, Applicant, and others in an effort to resolve our concerns regarding the proposed project. To this end, on March 24, 2009, representatives from the Service, Environmental Protection Agency (EPA), and National Marine Fisheries Service (NMFS) met with the Corps and the Applicant to discuss our continued concerns with the proposed project. At that meeting, the Service, EPA, and NMFS presented a potential alternative plan for mining the site that would address the concerns raised by the agencies by avoiding and minimizing impacts to the aquatic ecosystem. Details regarding the development of the EPA/FWS/NMFS alternative are provided in the April 6, 2009, letter from the EPA and are incorporated herein by reference.

To summarize, the EPA/FWS/NMFS proposal includes four key components:

1) Additional Aquatic Resource Avoidance: The alternative reduces impacts to wetlands from the approximately 3,953 acres of impacts associated with the proposed project down to approximately 2,787 acres of impacts. As previously discussed, the Service has significant concerns regarding the proposed project's direct and indirect adverse impacts to the site's high value aquatic resources, specifically the site's Nationally Significant Natural Heritage Area as well as the site's estuaries, including those identified as Primary Nursery Areas. The additional avoidance was designed to reduce the project's direct and indirect impacts to these resources down to an acceptable level. It should be noted that this alternative which would allow impacts to approximately 2,787 acres of wetlands continues to be extraordinarily large, and would continue to represent the single largest wetland fill authorized to date in the state of North Carolina, amplifying the need to pay very close attention to the execution, monitoring and adaptive management of the project's compensatory mitigation so that the Nation's waters are not significantly degraded.

2) Protection of Avoided Aquatic Resources: The alternative provides permanent protection from mining to the site's avoided areas through the use of appropriate binding real estate instruments such as conservation easements. We are open to discussion regarding compensatory mitigation credit for the permanent protection of these avoided areas. We also note that many of the aquatic resource areas avoided under this alternative provide restoration and enhancement opportunities. We are open to discuss the Applicant's recommendations regarding the appropriate level of compensation credit for the preservation, enhancement, and/or restoration of avoided aquatic resources.

3) Improvements to Site Reclamation: The alternative includes additional measures to minimize the impact of the mining project on avoided aquatic resources by improving the quality of the reclamation areas. Specifically, these measures include the reuse of topsoil from mined areas to re-cover reclaimed areas to the extent appropriate and practicable and the replanting of reclaimed areas with target tree species (longleaf pine, bald cypress and/or Atlantic white cedar) that are expected to improve soil quality and habitat over the long-term.

4) Improvements to Monitoring and Adaptive Management Plan: The alternative includes additional measures to improve the monitoring and adaptive management of both the mining and mitigation sites. While the footprint of the mining alternative does not extend into the Primary Nursery Areas, we are concerned that the extensive mining of wetlands and streams that serve as the headwaters of these creeks may impair the function of these Primary Nursery Areas. Accordingly, a monitoring program coupled with an adaptive management process is proposed to gauge the impacts to the Primary Nursery Areas from the mining so that appropriate adjustments can be made to mine operations. The monitoring provisions also require the establishment of an independent panel of scientists and engineers to annually evaluate whether direct and indirect impacts from mining and

benefits from the compensatory mitigation are in accordance with expectations at the time of permitting.

The Service has conducted an expedited review of the draft Record of Decision provided by the Corps on April 3. It appears as though the Corps has included permit conditions intended to address our recommendations related to site reclamation and monitoring. The monitoring protocols represent an improvement; however, the conditions regarding site reclamation provide no standards or performance measures, and appear to the Service to be unenforceable, and hence ineffective.

The draft Record of Decision also contains the same flaws the Service and others have previously noted in the Final Environmental Impact Statement (FEIS). Specifically, in addition to comments of the EPA referenced above regarding the availability of less environmentally damaging practicable alternatives, it is also our view that the Corps has consistently drawn inappropriate conclusions from limited data that are contrary to, and not supported, by the vast body of knowledge regarding the functioning of estuarine systems.

The FEIS, the March 2, 2009, Notice of Intent to Proceed letter, and the draft Record of Decision rely heavily on monitoring data and studies of local estuaries to support the conclusion that project-related reductions of approximately 70 percent of the watersheds of project area streams would not substantially impair the functioning of those stream or their associated estuaries. The Service and other agencies have consistently noted the limitations of these analyses.

To summarize, it has been pointed out by the Service and others that these studies are of insufficient scope, duration, and design to provide a basis for determining the effects of project-related drainage basin reduction on the creeks and estuaries of the project area. The Corps appears to acknowledge this in the FEIS with statements such as those appearing on page 4-14 of the FEIS: "...although a definitive conclusion cannot be made because the pre-drainage basin reduction monitoring data on flow and salinity for this creek covers less than a year." The FEIS further states (page 4-16) "it is difficult to draw any definite conclusions because there was no control site for Stanley's 1990 statistical study and there was only one year of baseline water quality and flow data for Jacks Creek." Also in Appendix J.II-7 of the FEIS it is stated in reference (in part) to a report by Entrix: "Although the Corps does not endorse or agree with all of the conclusions and statements found in either of these reports, both have been included in Appendix F in their entirety and the relevant information from these reports has been used as appropriate in the discussion of potential impacts found in Section 4.0 of the FEIS. Additionally, the Entrix report was supplied to the Review Team and their comments have been considered." We note that this is apparently in response (at least in part) to a critique of the Entrix study provided by NMFS following the February 12, 2008, interagency meeting (see attached). We concur completely with the NMFS comments, and note that although the Corps states that these comments were "considered" we can find no specific evidence of such consideration in the FEIS or draft Record of Decision.

Despite acknowledgement of the limitations of these studies, the Corps consistently overlooks these limitations and draws definitive conclusions that the project will not result in substantial adverse impacts to the Albemarle-Pamlico Estuary. We view this as an inappropriate use of the available information. We point again to the comments submitted throughout the process by the

State and federal agencies responsible for the management and conservation of the Albemarle-Pamlico Estuary including the Service, NMFS, EPA, NC Wildlife Resources Commission, and NC Division of Marine Fisheries (see attached comments of the NC WRC and NC DMF) that have noted the limitations of these studies, and drawing on their accumulated expertise and the vast body of available scientific information have concluded that one cannot deprive a stream of 70 percent of its watershed and expect it to function normally.

We remain committed to working with the Corps of effectively address our concerns. We are hopeful that a reasonable outcome can be achieved that satisfies the economic interests of the applicant while sustaining the ecologically and economically vital resources of the Albemarle-Pamlico Estuary. Thank you for your consideration in this matter. Should you have any questions regarding these comments or wish to discuss this matter further please contact Pete Benjamin, Supervisor of the Raleigh Field Office, at (919) 856-4520 extension 11.

Sincerely,

Sam D. Hamilton
Regional Director

Attachments

RECEIVED

JUL 0 3 2008

NORTH CAROLINA MARINE FISHERIES COMMISSION
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

COMMISSIONERS

MICHAEL F. EASLEY
Governor

WILLIAM G. ROSS JR.
Secretary

MAC CURRIN
Chairman

DAVID BERESOFF
Bolivia
WILLIAM R. BIZZELL
Kinston
B.J. COPELAND
Pittsboro
MIKEY DANIELS
Wanchese

JESS HAWKINS
Morehead City
RUSTY RUSS
Shallotte
BRADLEY STYRON
Cedar Island

JUL 1 4 2008

June 26, 2008

US Army Corps of Engineers
Wilmington District
Regulatory Division
69 Darlington Ave.
Wilmington, NC 28403

To Whom It May Concern:

We appreciate the opportunity to review and comment on the Final Environmental Impact Statement (FEIS) for The Potash Corporation of Saskatchewan Phosphate Division (PCS), Aurora Operation. PCS has applied for a Department of the Army authorization to continue its phosphate mining operation on the Hickory Point peninsula adjacent the Pamlico River and South Creek, north of Aurora, in Beaufort County. Our understanding is that the preferred mining option is Alternative L. We address Alternative L in our comments below.

We recognize the economic benefits that will likely result from continued extraction of phosphate ore and in particular expanded opportunities resulting from Alternative L. However, this option will result in unacceptable tradeoffs as a result of negative impacts to habitats supporting important estuarine, marine, and coastal species. Many of these species are fishery resources that significantly contribute to the economies of the region and the state of North Carolina.

The N.C.Marine Fisheries Commission is statutorily responsible for management of our state's coastal fisheries and the habitats that support those fisheries. Headwater drainages, riparian wetlands and coastal marshes associated with estuarine nursery areas serve as the backbone for our coastal fisheries. Any loss of function of these critical fish habitats seriously threatens the productivity of our fisheries.

The loss of wetlands eliminates their filtering effect that would otherwise maintain water quality at a high level critical to the propagation and productivity of estuarine organisms. Loss and degradation of wetlands compromises the integrity of downstream Primary Nursery Areas and essential fish habitat. We are losing Primary Nursery Area function throughout the coastal areas of the state. Destruction and impairment of headwater drainages, riparian wetlands, and coastal marshes lead to the accumulation of negative impacts on recreational and commercial fisheries. This results in environmental impacts that will have significant and negative economic effects for the state. The proposed activities will lead to predictable hydrological changes in addition to impacts that cannot be predicted because of the large spatial scale and the long time scale at which proposed mining activities occur. Heavy metals and other contaminants resulting from the mobilization of overburden and the handling of ore will reduce water quality and degrade bottom habitat of adjacent nursery areas. While mitigation of these impacts is theoretically possible, no available alternatives to offset these effects are available locally. We see no convincing evidence that impacts to Primary Nursery Areas can be mitigated.

We urge you to seek alternatives that will avoid and minimize impacts and will protect headwaters and wetlands through the permit process. Alternative L will not provide adequate protection of fisheries resources. We believe that reasonable and practicable alternatives are available that will not degrade the sensitive habitat of the Pamlico River, South Creek, and its tributaries. If reasonable alternatives cannot be found, we request that the permit be denied.

Sincerely,

Mac Currin

Mac Currin, Chairman
N.C. Marine Fisheries Commission

cc: DENR Secretary William G. Ross, Jr.
Melba McGee, Environmental Coordinator
N.C. Marine Fisheries Commission
Louis Daniel, DMF Director

North Carolina Wildlife Resources Commission

MEMORANDUM

TO: Melba McGee, Environmental Coordinator
Office of Legislative and Intergovernmental Affairs
North Carolina Department of Environment and Natural Resources
and
Tom Walker
U.S. Army Corps of Engineers
Wilmington District

FROM: Shannon L. Deaton, Manager
Habitat Conservation Program
Shannon R Deaton

DATE: July 1, 2008

SUBJECT: Comments on Final Environmental Impact Statement for the PCS Mine Continuation, Aurora, North Carolina.
OLIA No. 08-0356; Corps Action ID No. 200110096

Biologists with the North Carolina Wildlife Resources Commission (NCWRC) reviewed the final environmental impact statement (FEIS) with regard to impacts of the project on fish and wildlife resources. Our comments are provided in accordance with the North Carolina Environmental Policy Act (G.S. 113A-1 et seq., as amended; 1 NCAC-25), provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the Clean Water Act of 1977 (as amended) and the Coastal Area Management Act (G.S. 113A-100 through 113A-128), as amended.

The applicant, PCS Phosphate, Inc., Aurora (PCS) submitted a DEIS with the US Army Corps of Engineers (USACE) on October 20, 2006. This document was reviewed by the NCWRC and formal comments were issued on February 1, 2007. On December 31, 2007 the NCWRC submitted formal comments to a supplement of the DEIS that presented two new alternatives, Alternative L and Alternative M. Descriptions of these alternatives and differences in impact area have been thoroughly described in the DEIS and SDEIS. The USACE posted the FEIS for review on May 23, 2008. The applicant's overall purpose and need is to continue mining its phosphate reserve in an economically viable fashion. More specifically, the applicant's purpose and need is to implement a long-term systematic and cost-effective mine advance within the project area for the ongoing PCS mine operation at Aurora, North Carolina. Although the purpose and need of the applicant has remained the same, PCS is now pursuing Alternative L rather than the Applicant Preferred (AP) and Expanded Applicant Preferred (EAP) boundaries.

collected after Jack's Creek watershed had already been diminished by almost 20% as "pre-data". Small reductions in watershed area, less than 10%, may have large biotic impacts and therefore is problematic when comparing watershed reduction and biota in the South Creek system if "pre-data" includes significantly impacted areas.

Removal of headwater streams and drainage areas would directly alter flow from ground water and stormwater runoff, therefore decreasing fresh water input, increasing salinity through estuarine tidal influences, impact filtration of nutrients and other contaminants from decreased wetlands, increase sedimentation, and reduce the input of organic materials. The disruption of these functions in the drainage basin will significantly impact the ability of these systems to function as an inland PNA. The value of a PNA cannot be measured in fisheries catch per unit effort alone.

Special conditions for the Department of the Army Permit No. 198899449 and DWQ issued Water Quality Certification #3092 included three conditions stating PCS must perform appropriate studies to assess whether there are water quality impacts or hydrologic impacts of the tributaries of South Creek and the Pamlico River due to the removal of drainage area from these tributaries. PCS requested CZR Incorporated (CZR) and Dr. Wayne Skaggs to prepare a stream monitoring plan. This plan, "NCPC Tract Stream Monitoring Program", has been implemented and reported to state and federal agencies for six years. Included in this plan were the monitoring and data comparison of Huddles Cut, Tooley, and Jacks creeks. As a result of the issued permit, the drainage basins for these streams were significantly altered. The drainage area for Huddles Cut was reduced from 872 acres to 651 acres (25.3%); Jacks Creek was reduced from 528 acres to 331 acres (37.3%), and Tooley Creek from 498 acres to 431 acres (13.5%). Review of these data has shown elevated levels of cadmium (Cd) within Huddles Cut and Jacks Creek as compared to background levels of Cd in the open areas of the Pamlico River estuary. Cd is a priority pollutant with no known biological function and a host of known adverse effects, including mutagenicity, teratogenicity and suspected carcinogenicity. The "NCPC Tract Stream Monitoring Program" reports state, "*We may predict, within the limits of established guidelines, that Cd concentrations in sediments from Jacks Creek may occasionally cause adverse biological effects*". These results were found in only six years of study, with 37.3% of the total drainage area reduced. Therefore, it can be concluded that the predicted long term effects would be greater when the drainage area is significantly reduced again. One explanation of the increased levels of Cd within the sediment of Huddles Cut was that the sediment is rich in fine grained, clay material. This result may be due to recent deposition or part of an overall patchy distribution of sediment in the area. A reduction of wetlands adjacent to surface waters would once again greatly reduce the opportunity for removal of these sediments prior to reaching the creeks and river.

The FEIS states drainage area impacts are considered temporary for those areas where mine configuration allows drainage areas to be restored throughout the approximate 15-year land reclamation process. However, due to the importance of these systems and lack of examples and references on reconstructing functional drainage basins especially on reclaimed mines containing high levels of nutrients and contaminants we feel the impacts will likely be much more far reaching and these systems may never recover. The FEIS states the area impacted will be reclaimed, not restored. Therefore essential components such as headwater drainages, riparian wetlands, and transitional areas that lead to coastal marshes that support the highly productive Pamlico estuarine system will be directly impacted and permanently removed, indirectly impacting the entire South Creek and Pamlico River systems.

Alternative L has less impact than AP / EAP, but still significantly impacts wetlands and watersheds with the meandering path between creeks and watersheds. We do not concur that appropriate avoidance and minimization has been conducted prior to consideration of mitigation. Reduction of impacts to these valuable systems would allow mitigation to be considered appropriate and adequate. We understand the

applicant does not have to demonstrate "no impact", but we feel impacts within the current proposal will be significant and could not be adequately offset even with compensatory mitigation.

The FEIS contains a section that provides information on several proposed mitigation sites located near the South Creek area and within the Tar / Pamlico River Basin. The NCWRC appreciates the effort PCS has put forth to show commitment in moving forward to mitigate impacts that cannot be avoided and minimized. However, we believe impacts could be reduced significantly and are concerned with the ability to mitigate for the loss of wetlands, streams, stream buffers, and the biological and chemical functions of the systems within Alternative L. The mitigation strategy proposed in the FEIS does not appropriately compensate for the proposed impacts to submerged aquatic vegetation (SAV), shallow water habitat, essential fish habitat (EFH), riparian wetlands, coastal marsh, inland PNAs, and the role of drainage basin areas to these important inland and estuarine systems immediately adjacent the Pamlico River system in the NCPC tract. Direct removal of some of these resources may not occur with the proposed actions, but the indirect, secondary, and cumulative impacts with the removal and degradation of the system leads to the impacts and the potential functional removal of these resources. The FEIS states impacts to jurisdictional areas under Alternative L within the NCPC and Bonnerton tracts would be mitigated at approximately a 1.8:1 ratio. This ratio is used to help calculate the cost models and therefore the expense of mitigation for each alternative and was obtained by giving 1:1 to poor-fair valued systems, 2:1 to good systems, and 3:1 to excellent systems. NCWRC has reviewed the provided information and does not agree that the proposed 1.8:1 ratio is adequate for the impacts the project will have on the ecosystem.

The potential mitigation sites at Bay City Farm, Hell Swamp, and Scott Creek may be good wetland enhancement or restoration sites for the wetlands and streams they once were, but may not replace the valuable wetland and aquatic habitats and functions lost within the NCPC and Bonnerton tracts. We still do not believe the FEIS adequately addresses the differences in complexity and function between ecosystems within the NCPC tract and the proposed mitigation areas. Replacement of lost functions is a critical consideration as well as general availability of lands in the area appropriate for wetland, stream, and buffer mitigation. Due to the inability of the applicant to find adequate area to mitigate and restore mined buffers, PCS is proposing to present "flexible buffer mitigation" before the Environmental Management Commission. We do not support this proposal especially for the proposed area of impact versus conventional buffer mitigation. This discrepancy could be resolved by avoiding and minimizing impacts to these areas.

The FEIS states continued mining of the NCPC tract would have temporary impacts that would be mitigatable. However, due to the importance of these systems, NCWRC disagrees. The FEIS states the area impacted will be reclaimed, not restored. Therefore, essential components such as headwater drainages, riparian wetlands, and transitional areas that lead to coastal marshes that support the highly productive Pamlico estuarine system will be directly impacted and permanently removed, indirectly impacting the entire South Creek and Pamlico River systems. We continue to question how the functional loss of three inland PNAs would be mitigated.

The NCWRC has reviewed the compensatory mitigation section contained within the FEIS. At this time, we are not providing detailed comments about these proposals. These options are being pursued with the understanding from the applicant that they may not be accepted as adequate mitigation for the proposed mining plan. We will provide more detailed comments on the individual mitigation sites during the 401(b)(1) review process of the NC Division of Water Quality. Concerns and comments for overall proposed mitigation as well as individual sites would include inability to mitigate the complexity and function of areas in the South Creek estuary with proposed mitigation areas, inability to mitigate the

functional loss of PNAs, restoration versus enhancement, insuring restored mitigation areas are not limited in their function by downstream constraints, grading, planting, and site specific construction conditions.

Due to the afore mentioned concerns, we cannot concur that Alternative L is an appropriate mining option on the NCPC tract because of significant degradation of fish and wildlife resources and the uncertainty in providing adequate, functional compensatory mitigation. We have made this statement for alternatives AP, EAP, SCR, SJA, and Alternative M on the NCPC tract as well. This concern also extends to the significant wetland areas on Bonnerton.

The concerns we have with the impacts of mining important ecosystems adjacent the South Creek, Durham Creek, and Pamlico River systems and the inability to adequately mitigate those impacts could be addressed with more intense avoidance and minimization. Once avoidance and minimization has been satisfied, a detailed mitigation plan for unavoidable impacts should be submitted detailing the ability to mitigate for the loss of important wetland habitat areas as well as water quality functions. The mitigation plan should include specific details for any areas impacted including potential SAV, shallow water habitat, EFH, inland PNAs, perennial streams, intermittent streams, coastal marsh, riparian wetlands, and riparian buffers. All impacts should be considered when developing such a plan, including direct, indirect, secondary, and cumulative impacts.

We appreciate the opportunity to participate in the commenting process and review of the FEIS. We also look forward to any additional information, response, and discussion of our comments during this process. If you have further questions or comments, please contact Maria Dunn at (252) 948-3916.

cc: Lekson, D. – US Army Corps of Engineers
Wicker, M. – US Fish and Wildlife Service
Fox, B. – US Environmental Protection Agency
Sechler, R. – National Marine Fisheries Service
Moye, D. – NC Division of Coastal Management
Rynas, S. – NC Division of Coastal Management
Peed, R. – NC Division of Land Resources
McKenna, S. – NC Division of Marine Fisheries
Dorney, J. – NC Division of Water Quality
Barnes, K. – NC Division of Water Quality
Emmerling, D. – Pamlico-Tar River Foundation
McNaught, D. – Environmental Defense
Cooper, S. – CZR, Inc - Wilmington
Furness, J. – PCS Phosphate Co.

ATTACHMENT 1
(sent to Tom Walker from Ron Sechler)

Review of the ENTRIX Report Titled: Potential Effects of Watershed Reduction on Tidal Creeks- An Assessment.

In reviewing the report by ENTRIX concerning the proposal by PCS Phosphate mine expansion I have difficulty believing the conclusions of the report. There are many reasons to question these conclusions, but I will enumerate some of the more significant ones.

The analyses that were performed were flawed in that the Kolmogorov-Smirnov two sample test, which is used to compare distribution frequency, was used. This type of test should be used for continuous data (as in length, weight, volume etc.) frequency analysis, and not catch data (which is not continuous) that has been altered in an attempt to make it continuous. Because of this the analyses provided and conclusions derived from these analyses are not acceptable evidence. Further, the replication level is too low to give an appropriate indication of significant difference at the $p < 0.05$ level. The maximum number of annual catch replicates used in this report is seven, and this is much too low for a reasonable and reliable testing. Distribution analysis typically involves many more observations than used in this report and even Chi Square Analysis (a more appropriate test for this data) requires at least 6 independent replicates to show significant differences, and those can only be revealed if all 6 replicate outcomes favor a particular treatment. If differences between treatments are not so overwhelmingly consistent then many more replicates are necessary to detect significant differences that might occur. The fact is, that even had that correct analysis been conducted, the replication level used was not sufficient to test for significant differences and the replication level would have needed to be much higher, by at least a factor of 2-3 times.

Another major flaw is the nekton community assessed for effects. The community that should have been tested should be that which might be reliant on the shallow water marsh and wetland. Species that spawn in pelagic marine environments (spot, flounder, shrimp etc.) and who are known to have good dispersal ability should be less affected than marsh dependant species such as mummichog and sheepshead minnow. Mummichog and sheepshead minnow are key estuarine species and are useful in determining marsh health. These two species are marsh residents and complete their entire life history within marshes. Based on the limited data that this report presents, these two species were prevalent in the less impacted marsh at Tooley Creek and essentially non-existent in the more impacted Jacks Creek and created marsh PAII. These two species are reliant on shallow marsh and lay their eggs in the shallows where their larvae and juveniles grow until they are large enough to survive in deeper water areas of the marsh. Any direct or in this case indirect impact to shallow water marsh areas can significantly negatively affect these species population size and extinction potential. Mummichog and sheepshead minnow are also important vectors for energy transfer of marsh productivity to higher trophic levels, thus providing a key ecological link to economically valuable fisheries species.

I am also concerned that a well designed study to assess the effect of drainage basin reduction on creek nekton function was not instituted with a replication level sufficient to adequately test for potential effects. Given the planned expansion for the mining operation, it would have been better to institute such a study which could have produced appropriate original data and perhaps more convincing results based on specifically testing associated hypotheses. Instead, what is presented is a poorly composed report that does not give details of how data were collected, collection frequency, temporal periods, site or sub-site replication, excludes the marsh community that could be most impacted, and uses inappropriate data analysis that are bound to show no significant effect, as was the intent of the report. This method of data mining really does nothing to support the report conclusions.

To exacerbate the obvious bias the report further does not tend to recognize the results that are contrary to the reports predetermined objectives nor realize their significance. The trend of differences in mummichog and sheepshead minnow abundance and the preponderance of "freshwater" benthic species in the downstream location of Muddy Creek (un-impacted) compared to Jacks Creek (after impact), and their preponderance within the downstream location of Jacks Creek prior to impact compared to after impact, suggests that freshwater pulses into Jacks Creek might have become too less frequent and intense for support of these species. These results, tentative as they are, suggest that a change within Jacks Creek might have occurred with only a 51% reduction in drainage basin. One can only imagine what a 90% or larger reduction in drainage basin would do.

I have no choice but to reject the conclusions of this study due to its shortcomings and suggest that no such permit be allowed for mining expansion due to apparent detrimental effects on the bordering creeks and adjacent estuary.

Rebecca Fox /R4/USEPA/US
04/13/2009 03:47 PM

To Palmer Hough/DC/USEPA/US@EPA
cc
bcc
Subject FWS 3f1 letter

mike just sent me a draft of their letter --see attached. just starting to read it. b

FWS 3f1 draft letter.doc

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

Dear:

This letter is provided under Part IV, paragraph 3(f)(1), of the 1992 Memorandum of Agreement (MOA) between the Department of the Interior and the Department of Army, under Clean Water Act (CWA) Section 404(q). The U.S. Fish and Wildlife Service (Service) has decided not to seek higher level review of the proposed decision by the Army Corps of Engineers' Wilmington District to issue a CWA Section 404 permit to the Potash Corporation of Saskatchewan, Phosphate Division, Aurora Operation. Nonetheless, the Service has substantial unresolved concerns regarding the proposed project and our decision to not seek higher level review is not an indication that these concerns have been resolved. To the contrary, the Service fully concurs with the views expressed by the U.S. Environmental Protection Agency in their letter to the Assistant Secretary of the Army (Civil Works) dated April 6, 2009.

The Wilmington District issued a Notice of Intent to Proceed letter regarding this permit under paragraph 3(c)(3) of the MOA on March 2, 2009; this letter was received by our Southeast Regional Office on March 5, 2009. The proposed project is an expansion of the mine's 1997 CWA permit. The expansion, as currently proposed, will impact 3,953 acres of wetlands and 25,727 linear feet of streams, including a portion of a Significant Natural Heritage Area designated as "nationally significant." In addition, the project is adjacent to the Pamlico River and will result in a loss of approximately 70 percent of the watersheds of the project area streams which drain to the Albemarle-Pamlico Estuary Complex.

The March 2, 2009, Notice of Intent to Proceed included some provisions to minimize impacts through minor project reduction and compensatory mitigation. The Wilmington District concluded that these steps would adequately address our concerns for the project. Both the Service's Raleigh, North Carolina Field Office and Southeast Regional Office staff carefully considered these measures, and responded on March 20, 2009, pursuant to Part IV, paragraph 3(d)(2) of the 1992 MOA. That response stated that the Service does not concur that our concerns have been adequately addressed.

Pursuant to Part IV, paragraph 3(f) of the 1992 MOA, the Department of the Interior had until April 9, 2009, to notify the ASA (CW) that Interior was requesting higher level review. On April 3, 2009, the District provided the Service with an 80-page draft Record of Decision containing information not previously reviewed by the Service. In response the Service requested, via a letter dated April 8, 2009, an extension of the MOA timeframe in order to allow a review of the new information. The Corps denied that request, and the Service was unable to complete its review within the timeframe prescribed by the MOA.

Throughout the permit review process, the Service has consistently stated our concerns regarding the effects of the proposed project on the nationally significant fish and wildlife resources of the Albemarle-Pamlico Estuary System, of which the project site is apart. The proposed project would eliminate critical ecological functions provided by approximately 3,953 acres of wetlands and 25,727 linear feet of streams within the nationally significant Albemarle Pamlico Estuary. Wetland functions include temporary storage of surface water, nutrient cycling, organic carbon export, pollutant filtering/removal, and maintenance of biologically diverse plant and animal habitat. Stream functions include transport of water, nutrients and sediment downstream, pollutant processing and removal, and maintenance of biologically diverse plant and animal habitat. Of particular concern are the proposed projects:

- Direct impacts to portions of a nonriverine hardwood wetland forest that has been designated as a Nationally Significant Natural Heritage Area by the NC Natural Heritage Program; and,
- Indirect impacts to the site's tidal creeks, four of which have been designated as Primary Nursery Areas by the NC Wildlife Resources Commission, associated with the 70 percent reduction in the drainage basins for these creeks.

The Service believes that impacts to these ecological functions at the scale associated with this project would cause substantial and unacceptable adverse impacts to these aquatic resources of national importance and that the concerns expressed by the Service throughout the permit review process have not been adequately addressed. Eliminating the headwater streams and wetlands and significantly reducing the drainage areas of the project site's Primary Nursery Areas and other tidal creeks would:

- Reduce flow from ground water and increase variability in surface water flows to the tidal creeks, thereby increasing the frequency and magnitude of short-term salinity fluctuations;
- Reduce filtration of nutrients and other contaminants previously accomplished by the site's streams and wetlands, increasing sedimentation and turbidity in tidal creeks;
- Reduce productivity of native fish and shellfish in the downstream estuary by disrupting the estuarine food web (caused by a reduction of organic materials critical for biological activity in the surface water drainage); and
- Shift downstream estuarine productivity from the benthic community which is dominated by sensitive submerged aquatic vegetation and benthic invertebrate species to tolerant phytoplankton species. This would exacerbate ongoing environmental stress and create an open niche for problematic invasive plant and animal species to colonize and degrade the estuary.

We believe the disruption of these processes and functions in the drainage basin will significantly impact the site's tidal creeks and impair the ability of these systems to function as Primary Nursery Areas. Further, we agree with the EPA that the adverse impacts to these resources have not been avoided and minimized to the extent possible and the proposed compensatory mitigation would not reduce these adverse impacts to an acceptable level.

Since the formal permit elevation process was initiated with the Corps' March 2, 2009, letter, the Service has continued to coordinate with the Corps, Applicant, and others in an effort to resolve our concerns regarding the proposed project. To this end, on March 24, 2009, representatives from the Service, Environmental Protection Agency (EPA), and National Marine Fisheries Service (NMFS) met with the Corps and the Applicant to discuss our continued concerns with the proposed project. At that meeting, the Service, EPA, and NMFS presented a potential alternative plan for mining the site that would address the concerns raised by the agencies by avoiding and minimizing impacts to the aquatic ecosystem. Details regarding the development of the EPA/FWS/NMFS alternative are provided in the April 6, 2009, letter from the EPA and are incorporated herein by reference.

To summarize, the EPA/FWS/NMFS proposal includes four key components:

1) Additional Aquatic Resource Avoidance: The alternative reduces impacts to wetlands from the approximately 3,953 acres of impacts associated with the proposed project down to approximately 2,787 acres of impacts. As previously discussed, the Service has significant concerns regarding the proposed project's direct and indirect adverse impacts to the site's high value aquatic resources, specifically the site's Nationally Significant Natural Heritage Area as well as the site's estuaries, including those identified as Primary Nursery Areas. The additional avoidance was designed to reduce the project's direct and indirect impacts to these resources down to an acceptable level. It should be noted that this alternative which would allow impacts to approximately 2,787 acres of wetlands continues to be extraordinarily large, and would continue to represent the single largest wetland fill authorized to date in the state of North Carolina, amplifying the need to pay very close attention to the execution, monitoring and adaptive management of the project's compensatory mitigation so that the Nation's waters are not significantly degraded.

2) Protection of Avoided Aquatic Resources: The alternative provides permanent protection from mining to the site's avoided areas through the use of appropriate binding real estate instruments such as conservation easements. We are open to discussion regarding compensatory mitigation credit for the permanent protection of these avoided areas. We also note that many of the aquatic resource areas avoided under this alternative provide restoration and enhancement opportunities. We are open to discuss the Applicant's recommendations regarding the appropriate level of compensation credit for the preservation, enhancement, and/or restoration of avoided aquatic resources.

3) Improvements to Site Reclamation: The alternative includes additional measures to minimize the impact of the mining project on avoided aquatic resources by improving the quality of the reclamation areas. Specifically, these measures include the reuse of topsoil from mined areas to re-cover reclaimed areas to the extent appropriate and practicable and the replanting of reclaimed areas with target tree species (longleaf pine, bald cypress and/or Atlantic white cedar) that are expected to improve soil quality and habitat over the long-term.

4) Improvements to Monitoring and Adaptive Management Plan: The alternative includes additional measures to improve the monitoring and adaptive management of both the mining and mitigation sites. While the footprint of the mining alternative does not extend into the Primary Nursery Areas, we are concerned that the extensive mining of wetlands and streams that serve as the headwaters of these creeks may impair the function of these Primary Nursery Areas. Accordingly, a monitoring program coupled with an adaptive management process is proposed to gauge the impacts to the Primary Nursery Areas from the mining so that appropriate adjustments can be made to mine operations. The monitoring provisions also require the establishment of an independent panel of scientists and engineers to annually evaluate whether direct and indirect impacts from mining and

benefits from the compensatory mitigation are in accordance with expectations at the time of permitting.

The Service has conducted an expedited review of the draft Record of Decision provided by the Corps on April 3. It appears as though the Corps has included permit conditions intended to address our recommendations related to site reclamation and monitoring. The monitoring protocols represent an improvement; however, the conditions regarding site reclamation provide no standards or performance measures, and appear to the Service to be unenforceable, and hence ineffective.

The draft Record of Decision also contains the same flaws the Service and others have previously noted in the Final Environmental Impact Statement (FEIS). Specifically, in addition to comments of the EPA referenced above regarding the availability of less environmentally damaging practicable alternatives, it is also our view that the Corps has consistently drawn inappropriate conclusions from limited data that are contrary to, and not supported, by the vast body of knowledge regarding the functioning of estuarine systems.

The FEIS, the March 2, 2009, Notice of Intent to Proceed letter, and the draft Record of Decision rely heavily on monitoring data and studies of local estuaries to support the conclusion that project-related reductions of approximately 70 percent of the watersheds of project area streams would not substantially impair the functioning of those stream or their associated estuaries. The Service and other agencies have consistently noted the limitations of these analyses.

To summarize, it has been pointed out by the Service and others that these studies are of insufficient scope, duration, and design to provide a basis for determining the effects of project-related drainage basin reduction on the creeks and estuaries of the project area. The Corps appears to acknowledge this in the FEIS with statements such as those appearing on page 4-14 of the FEIS: "...although a definitive conclusion cannot be made because the pre-drainage basin reduction monitoring data on flow and salinity for this creek covers less than a year." The FEIS further states (page 4-16) "it is difficult to draw any definite conclusions because there was no control site for Stanley's 1990 statistical study and there was only one year of baseline water quality and flow data for Jacks Creek." Also in Appendix J.II-7 of the FEIS it is stated in reference (in part) to a report by Entrix: "Although the Corps does not endorse or agree with all of the conclusions and statements found in either of these reports, both have been included in Appendix F in their entirety and the relevant information from these reports has been used as appropriate in the discussion of potential impacts found in Section 4.0 of the FEIS. Additionally, the Entrix report was supplied to the Review Team and their comments have been considered." We note that this is apparently in response (at least in part) to a critique of the Entrix study provided by NMFS following the February 12, 2008, interagency meeting (see attached). We concur completely with the NMFS comments, and note that although the Corps states that these comments were "considered" we can find no specific evidence of such consideration in the FEIS or draft Record of Decision.

Despite acknowledgement of the limitations of these studies, the Corps consistently overlooks these limitations and draws definitive conclusions that the project will not result in substantial adverse impacts to the Albemarle-Pamlico Estuary. We view this as an inappropriate use of the available information. We point again to the comments submitted throughout the process by the

State and federal agencies responsible for the management and conservation of the Albemarle-Pamlico Estuary including the Service, NMFS, EPA, NC Wildlife Resources Commission, and NC Division of Marine Fisheries (see attached comments of the NC WRC and NC DMF) that have noted the limitations of these studies, and drawing on their accumulated expertise and the vast body of available scientific information have concluded that one cannot deprive a stream of 70 percent of its watershed and expect it to function normally.

We remain committed to working with the Corps of effectively address our concerns. We are hopeful that a reasonable outcome can be achieved that satisfies the economic interests of the applicant while sustaining the ecologically and economically vital resources of the Albemarle-Pamlico Estuary. Thank you for your consideration in this matter. Should you have any questions regarding these comments or wish to discuss this matter further please contact Pete Benjamin, Supervisor of the Raleigh Field Office, at (919) 856-4520 extension 11.

Sincerely,

Sam D. Hamilton
Regional Director

Attachments

Rebecca Fox/R4/USEPA/US
04/15/2009 09:34 AM

To pace.wilber@noaa.gov
cc
bcc
Subject Fw: Onsite ASA(CW) Meeting 17 April 2009 - PCS Phosphate

Sorry Pace. This got bounced too because had your address error from my original message (nmfs instead of noaa -- comes from trying to do too much at once...) b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

----- Forwarded by Rebecca Fox/R4/USEPA/US on 04/15/2009 09:32 AM -----

Rebecca Fox/R4/USEPA/US
04/15/2009 09:22 AM

To Mike_Wicker@fws.gov
cc pace.wilber@nmfs.gov, Pete_Benjamin@fws.gov, Palmer Hough/DC/USEPA/US@EPA
Subject Re: Fw: Onsite ASA(CW) Meeting 17 April 2009 - PCS Phosphate

Hi Mike,

Quickly looked over your revised letter. One editorial comment is to change date of EPA letter to April 3 -- it was dated on this date but sent on April 6. I think it looks good. Just a few comments.

I noted that you deleted a lot from your first version and I understand the desire to streamline and not repeat what has been already said. I do think the paragraph that was the last one on page 1 and carrying over to page 2 on the first version was a good one that you may want to consider keeping. I will copy below so you know which one I am referring to.

Throughout the permit review process, the Service has consistently stated our concerns regarding the effects of the proposed project on the nationally significant fish and wildlife resources of the Albemarle-Pamlico Estuary System, of which the project site is apart. The proposed project would eliminate critical ecological functions provided by approximately 3,953 acres of wetlands and 25,727 linear feet of streams within the nationally significant Albemarle Pamlico Estuary. Wetland functions include temporary storage of surface water, nutrient cycling, organic carbon export, pollutant filtering/removal, and maintenance of biologically diverse plant and animal habitat. Stream functions include transport of water, nutrients and sediment downstream, pollutant processing and removal, and maintenance of biologically diverse plant and animal habitat. Of particular concern are the proposed projects:

Direct impacts to portions of a nonriverine hardwood wetland forest that has been designated as a Nationally Significant Natural Heritage Area by the NC Natural Heritage Program; and,

Indirect impacts to the site's tidal creeks, four of which have been designated as Primary Nursery Areas by the NC Wildlife Resources Commission, associated with the 70 percent reduction in the drainage basins for these creeks.

The only other suggestion is maybe to expand the discussion on the COE's conclusions on drainage basin reduction based on monitoring and PA2. They keep repeating the PA2 discussion throughout the draft ROD namely the WRC publication which they say states PA2 has a similar mixture of fresh and saltwater species as PNAs. I am going to try and touch base with WRC and also get their comments on this. I like the FWS discussion on this but since they keep repeating this over and over in draft ROD thought it might be good to be hit back hard on this...

Thanks Mike! b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

Mike_Wicker@fws.gov

Mike_Wicker@fws.gov
04/15/2009 08:31 AM

To Rebecca Fox/R4/USEPA/US@EPA, pace.wilber@nmfs.gov
cc Pete_Benjamin@fws.gov
Subject Fw: Onsite ASA(CW) Meeting 17 April 2009 - PCS Phosphate

Becky,

It is my understanding that we are not invited. However I guess we could ask to attend and see what their response would be. Is Jennifer the only EPA person that will be at the meeting? I know the COE likes to use overwhelming force at meetings (standard military procedure) and it would be uncomfortable for anyone to be one when arguing a position against the legion.

We will think about what we can do and get back to you.

Here's the latest version of the letter that we are in process of getting out.

Mike

(See attached file: PCS 3(f)(1)Letter to COE revised.doc)

(See attached file: 20090413_PCS_NCMFC.pdf)(See attached file: 20090413_PCS_ncwrc.pdf)(See attached file: 20090413_PCS_NMFS.doc)

----- Forwarded by Mike Wicker/R4/FWS/DOI on 04/15/2009 08:21 AM -----

"Smith, Chip R Mr CIV USA ASA CW" <Chip.Smith@HQDA.Army.Mil>

04/13/2009 05:32 PM

To <Mike_Wicker@fws.gov>

cc <Pete_Benjamin@fws.gov>, <Jeff_Weller@fws.gov>, "Gaffney-Smith, Margaret E" <Meg.E.Gaffney-Smith@usace.army.mil>, <Jennifer.A.Moyer@usace.army.mil>, "Chubb, Suzanne L Ms CIV USA ASA CW" <Suzanne.L.Chubb@us.army.mil>, <William.L.James@usace.army.mil>

Subject RE: FW: Onsite ASA(CW) Meeting 17 April 2009 - PCS Phosphate

Mike:

No inconvenience at all. These things are always a bit confusing, and we haven't faced a potential elevation request for 8 years. I did 8 or 10 during the Clinton years.

EPA did request that my office review the case and their letter appears to cover some of the issues of concern to FWS. I will be looking at all of the issues raised by EPA as part of the 404q review.

Chip

-----Original Message-----
From: Mike_Wicker@fws.gov [mailto:Mike_Wicker@fws.gov]
Sent: Monday, April 13, 2009 5:23 PM
To: Smith, Chip R Mr CIV USA ASA CW
Cc: Pete_Benjamin@fws.gov; Jeff_Weller@fws.gov
Subject: Re: FW: Onsite ASA(CW) Meeting 17 April 2009 - PCS Phosphate

Chip,

You are correct that no elevation request was sent. We decided not to continue the elevation process. I hope this has not caused you any inconvenience.

We are in the process of reading and discussing the draft ROD. Unfortunately it appears as though we still have significant concerns.

Thanks,

Mike Wicker

Inactive hide details for "Smith, Chip R Mr CIV USA ASA CW" <Chip.Smith@HQDA.Army.Mil>"Smith, Chip R Mr CIV USA ASA CW" <Chip.Smith@HQDA.Army.Mil>

"Smith, Chip R Mr CIV USA ASA CW"
<Chip.Smith@HQDA.Army.Mil>

04/13/2009 04:34 PM

To

<Mike_Wicker@fws.gov>

cc

<dave_stout@fws.gov>, <Jennifer.A.Moyer@usace.army.mil>, "Chubb, Suzanne
L Ms CIV USA ASA CW" <Suzanne.L.Chubb@us.army.mil>

Subject

FW: Onsite ASA(CW) Meeting 17 April 2009 - PCS Phosphate

Mike:

By separate email Jennifer Moyer, from Corps HQ, clarified that the
USFWS had until COB April 10th to provide me/my office with a request
for higher level review in accordance with the 404q MOA. Although it
appeared that the Service was on track to request higher level review,
the deadline passed and no request was received. I am sending you this
email to confirm that no elevation request was sent and to close out the
process. Thanks.

Dave, I called earlier and left you a message.

Chip Smith
Office of the Assistant Secretary of the Army (Civil Works) Assistant
for Environment, Tribal and Regulatory Affairs
108 Army Pentagon 3E427
Washington, D.C. 20310-0108
703-693-3655 Voice
703-839-0389 Cell
703-697-8433 Fax

-----Original Message-----
From: Jennifer.A.Moyer@usace.army.mil
[mailto:Jennifer.A.Moyer@usace.army.mil]
Sent: Thursday, April 09, 2009 12:48 PM
To: Mike_Wicker@fws.gov
Cc: Meg.E.Gaffney-Smith@usace.army.mil;
Samuel.K.Jolly@usace.army.mil;
pete_benjamin@fws.gov; William.T.Walker@usace.army.mil; Smith, Chip R Mr
CIV USA ASA CW; Chubb, Suzanne L Ms CIV USA ASA CW;
William.L.James@usace.army.mil
Subject: RE: Onsite ASA(CW) Meeting 17 April 2009

Mr. Wicker,

I have been in direct coordination with the office of the ASA(CW).
There will not be an extension granted; the draft ROD was provided to
the USFWS as a courtesy by the Wilmington District not as a part of the
404(q) process.
Therefore, the deadline for USFWS to elevate the PCS Phosphate permit
action remains, pursuant to paragraph 3(f) of the MOA, close of business
today, April 9, 2009.

If USFWS decides to elevate this action, the office of the ASA(CW) has
scheduled a site visit for April 17 to which you are invited.

Please do not hesitate to contact me with any questions.

Jennifer

Jennifer Moyer
Regulatory Program Manager
Regulatory Community of Practice
Headquarters, U.S. Army Corps of Engineers
441 G Street, NW
Washington, DC 20314-1000
206-764-5526 (office)
703-589-5746 (mobile)
jennifer.a.moyer@usace.army.mil

-----Original Message-----
From: Mike_Wicker@fws.gov [mailto:Mike_Wicker@fws.gov]
Sent: Thursday, April 09, 2009 6:52 AM
To: Jolly, Samuel K SAW

Cc: Moyer, Jennifer A HQ02; Gaffney-Smith, Margaret E;
pete_benjamin@fws.gov; Smith, Chip R HQDA; Walker, William T SAW
Subject: Re: Onsite ASA(CW) Meeting 17 April 2009

Ken,

Do you have any information as to the response to our request for an
extension as it will have a bearing on what we do? Please let us know as
soon as possible because our deadline for elevation is today (April 9)
so that we will have time to make arrangements.

(See attached file: 040617 FINAL signed 20 day extenson to review ROD.pdf)

Thanks,

Mike

Inactive hide details for "Jolly, Samuel K SAW" <Samuel.K.Jolly@usace.army.mil>"Jolly, Samuel K SAW" <Samuel.K.Jolly@usace.army.mil>

"Jolly, Samuel K SAW"
<Samuel.K.Jolly@usace.army.mil>

04/09/2009 09:18 AM

To

<pete_benjamin@fws.gov>, <mike_wicker@fws.gov>

cc

"Walker, William T SAW" <William.T.Walker@usace.army.mil>, "Moyer, Jennifer A HQ02" <Jennifer.A.Moyer@usace.army.mil>, "Smith, Chip R HQDA" <SmithCR@HQDA.Army.Mil>, "Gaffney-Smith, Margaret E" <Meg.E.Gaffney-Smith@usace.army.mil>

Subject

Onsite ASA(CW) Meeting 17 April 2009

Pete/Mike,

As per the below email, Chip Smith (ASA(CW)) has scheduled his 404(q)
site visit to PCS on 17 April 2009. Should USFWS elevate the decision to
ASA this Friday, please accept this email as your agency's invitation to
attend and notify your Region and HQ personnel accordingly.
Thanks.

Ken Jolly
Chief, Regulatory Division
Wilmington District

From: Smith, Chip R Mr CIV USA ASA CW
To: Peck.Gregory@epamail.epa.gov
Cc: evans.david@epa.gov ; Chubb, Suzanne L Ms CIV USA ASA CW ; James,
William L LRN; Gaffney-Smith, Margaret E; Pfenning, Michael COL HQDA

Sent: Wed Apr 08 15:44:28 2009
Subject: PCS Phosphate Site Visit

As stated previously I have scheduled the 404q site visit for April
17th.
This is firm. I will meet with the applicant and agency representatives
that day. This site visit will cover EPA and FWS should they request
higher level review. If NMFS requests ASA review we will address that
separately, with a separate site visit and separate documentation.

Chip

Sent from my BlackBerry Wireless Device

[attachment "PCS 3(f)(1)Letter to COE revised.doc" deleted by Rebecca Fox/R4/USEPA/US] [attachment "20090413_PCS_NCMFC.pdf" deleted by Rebecca Fox/R4/USEPA/US] [attachment "20090413_PCS_ncwrc.pdf" deleted by Rebecca Fox/R4/USEPA/US]

[attachment "20090413_PCS_NMFS.doc" deleted by Rebecca Fox/R4/USEPA/US]

Mike_Wicker@fws.gov
04/16/2009 10:23 AM

To Rebecca Fox/R4/USEPA/US@EPA, pace.wilber@noaa.gov, Ron Sechler <ron.sechler@noaa.gov>
cc Pete_Benjamin@fws.gov
bcc
Subject Information for your files, a letter hopefully will be sent from our RD today stating we still have significant concerns, will send as soon as it is available

(See attached file: Weinstein et al 1992.pdf)(See attached file: West et al 2000.pdf)(See attached file: WESTetal_2000_EcologicalEngineering.pdf)

link to Rulifson 1991 follows
http://www.springerlink.com/content/706114551137352l/

(See attached file: PCS October 31, 2001 Letter.pdf)(See attached file: PCS JAN 8, 2001 LETTER.pdf)(See attached file: PCS July 16, 2001 LETTER.pdf)(See attached file: PCSPhosphate.pdf)(See attached file: PCS DEIS 3b letter.pdf)(See attached file: PCS DEIS DEC 2006.pdf)

(See attached file: 040617 FINAL signed 20 day extenson to review ROD.pdf)(See attached file: DOC20090320134028.pdf)

Arch. Environ. Contam. Toxicol. 23, 355–362 (1992)

Archives of Environmental Contamination and Toxicology

Shell Disease and Metal Content of Blue Crabs, *Callinectes sapidus*, from the Albemarle-Pamlico Estuarine System, North Carolina

John E. Weinstein*,**, Terry L. West*[1], and John T. Bray*

*Department of Biology, East Carolina University Greenville, North Carolina 27858, USA, **Belle W. Baruch Institute for Marine Biology and Coastal Research, and Department of Biological Sciences, University of South Carolina, Columbia, South Carolina 29208, USA, and *School of Medicine, East Carolina University, Greenville, North Carolina 27858, USA

Abstract. Concentrations of 13 elements were determined for three tissues (gill, hepatopancreas, muscle) in diseased crabs from a contaminated estuary (Pamlico River, NC), and in non-diseased crabs from both the contaminated estuary and a relatively uncontaminated area (Albemarle Sound, NC) during the fall 1989 and summer 1990. The diseased crabs had lesions which completely penetrated their dorsal integument, while the non-diseased crabs lacked lesions.

Sediments within the contaminated area showed enrichment of arsenic, cadmium, manganese, titanium and vanadium relative to the uncontaminated area. Levels of aluminum, arsenic, cobalt, manganese, nickel, titanium, vanadium and zinc were significantly higher in both gill and hepatopancreas in crabs from the contaminated area. Manganese was always highest in the diseased crabs in all tissues measured. The concentrations of the remaining elements were greater in the gills of diseased crabs, while highest values of these elements in the hepatopancreas varied among the diseased and non-diseased crabs from the polluted area. Conversely, copper levels were always highest in all tissues in crabs from the uncontaminated area, and typically lowest in the diseased crabs. Concentrations of aluminum and arsenic were also significantly greater in the muscle tissue of crabs from the contaminated area, but no distinct trend was evident with regard to diseased versus non-diseased crabs.

Arsenic was the only element accumulated by crabs in the contaminated area which has a known toxic affect on the tissue responsible for cuticle synthesis and repair (hypodermis) in crustaceans. Metals also accumulated could possibly act synergetically to compromise normal metabolism. The results suggest that metal and trace element accumulation plays a minor direct role in the local etiology of shell disease.

Shell disease in crustaceans is the progressive microbial degradation and necrosis of the cuticle (Rosen 1970). This disease is common and has been reported in several commercially important species including the American lobster (*Homarus americanus*) (Hess 1937; Young and Pearce 1975), the blue crab (*Callinectes sapidus*) (Rosen 1967; Cook and Lofton 1973), and penaeid shrimp (*Penaeus* spp.) (Cipriani *et al.* 1980).

Shell disease is initially manifested as small reddish brown depressions which later coalesce to form lesions with cracked and pitted necrotic areas (Rosen 1967; Baross *et al.* 1978). Molting normally eliminates the disease because superficial lesions are not transferred to the new cuticle (Rosen 1970). However, mortality may result in the event cuticular erosion is sufficient to permit invasion of the underlying soft tissue by pathogenic bacteria (Baross *et al.* 1978).

Although shell disease has been attributed to mechanical damage of the outermost cuticular layer (epicuticle) followed by the activities of chitinoclastic bacteria and fungi (Rosen 1970; Gopalan and Young 1975; Baross *et al.* 1978), laboratory experiments have demonstrated that long-term exposure to some heavy metals can result in the formation of cuticular lesions resembling those of shell disease. Nimmo *et al.* (1977) observed cuticular lesions in pink shrimp (*Penaeus duorarum*) exposed to 1.0 μg/L cadmium for 21 days. Similarly, Doughtie *et al.* (1983) induced cuticular lesions in grass shrimp (*Palaemonetes pugio*) exposed to 0.5 μg/L chromium for 28 days. Crabs (*Cancer irroratus*) and lobster (*Homarus americanus*) exposed to sediments contaminated with lead, copper, and chromium (2–37 μg/g) developed exoskeletal lesions within six weeks (Pearce 1972).

The incidence of shell disease is known to vary with habitat quality, being lowest (2.5%) in unstressed environments and highest (10.5%) in heavily polluted environments (Cipriani *et al.* 1980). High incidences of shell disease have been reported from sewage sludge and dredge spoils dumping ground of the New York Bight which contain high concentrations of heavy metals in the sediments (Young and Pearce 1975; Gopalan and Young 1975).

Since 1986, lesions have been observed on the carapace of approximately 10% (but regionally as high as 90%) of the blue crabs (*Callinectes sapidus*) harvested from the Pamlico River estuary, North Carolina (McKenna *et al.* 1990). In many cases, these lesions were frequently large (>2 cm diameter) and completely penetrated the integument (personal observation). Re-

[1]To whom correspondence should be addressed.

Table 1. Results of the analyses of National Institute of Standards and Technology (NIST) (formerly National Bureau of Standards) SRM-1566 oyster tissue during the Fall 1989 and Summer 1990 ICAPES analyses (all values in μg/g, unless otherwise noted)

Element	NIST Certificate Value	Measured Value Fall 1989 (N = 5)	Measured Value Summer 1990 (N = 13)[b]
Al	N/A[c]	76.35 ± 12.90	69.72 ± 6.13
As	13.4 ± 1.9	14.35 ± 0.54	13.07 ± 0.89
Cd	3.5 ± 0.4	3.27 ± 0.14	3.11 ± 0.17
Co	0.4[a]	0.31 ± 0.01	0.28 ± 0.03
Cr	0.69 ± 0.27	0.25 ± 0.02	0.13 ± 0.08
Cu	63.0 ± 3.5	65.05 ± 0.94	61.59 ± 2.16
Mn	17.5 ± 1.2	17.51 ± 0.45	16.85 ± 0.64
Mo	<0.2*	0.15 ± 0.02	0.15 ± 0.03
Ni	1.03 ± 0.19	0.69 ± 0.07	0.64 ± 0.09
Pb	0.48 ± 0.04	0.48 ± 0.15	0.54 ± 0.42
V	2.8[a]	2.23 ± 0.05	2.12 ± 0.07
Zn	852 ± 14	939.50 ± 28.74	810.07 ± 25.55

[a] Indicates Non-Certified Value
[b] Sample size for zinc was 12
[c] N/A = Not Available

cent sediment analyses have also revealed long term metal and trace element enrichment at several locations within the Pamlico River environs (Riggs *et al.* 1989).

The above evidence suggests a link between the occurrence of shell disease among Pamlico River blue crabs and exposure to sediments containing high levels of metals and trace elements. We tested this hypothesis by quantifying metal and trace element content in the tissues of three groups of crabs: (1) diseased crabs (*i.e.*, bearing cuticular lesions) from a contaminated area (Pamlico River); (2) non-diseased crabs (*i.e.*, without any overt indications of shell disease) from a contaminated area; and (3) non-diseased crabs from a relatively uncontaminated area (Albemarle Sound).

This study is the first to determine metal and trace element concentrations in crustaceans showing symptoms of shell disease. In addition, this study is unique with regard to the number of elements analyzed (cf. Engel and Brouwer 1984; Kneip and Hazen 1979; Sanders 1984). Element concentrations were determined by inductively coupled plasma-atomic emission spectrometry (ICP-AES). Our method and instrumentation permitted as many as 24 elements to be quantified simultaneously from a single sample. Typically, trace metal analyses of crustaceans are conducted by flame atomic absorption spectrometry (FAAS); FAAS limits measurements to one element at a time, although detection limits for some elements are lower than those determined by ICP-AES.

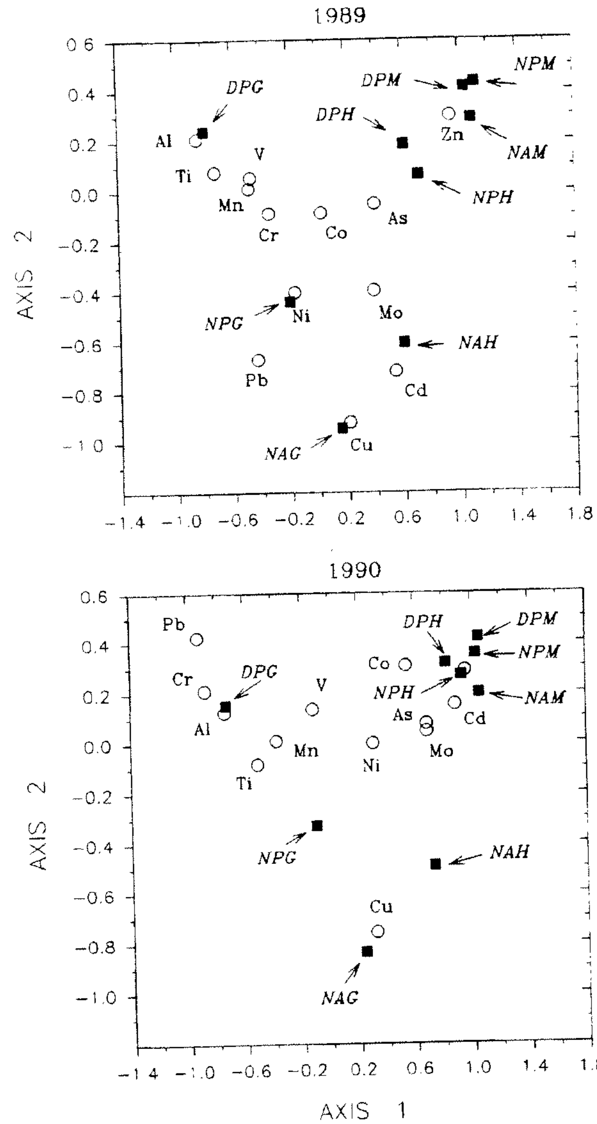


Fig. 1. Correspondence analysis ordination of metal and trace element burdens of tissues from diseased and non-diseased blue crabs collected during fall 1989 (upper graph), and summer 1990 (lower graph). Arrows point to combinations of crab group and tissue; open circles pertain to individual elements. DP = diseased Pamlico; NP = non-diseased Pamlico; NA = non-diseased Albemarle; G = gill; H = hepatopancreas; M = muscle

Materials and Methods

Element concentrations were determined in gill, hepatopancreas (digestive gland), and muscle (cheliped and fifth pereopod) in diseased and non-diseased crabs from a contaminated environment, and in non-diseased crabs from an uncontaminated area. Crabs were obtained from a crab dealer during October and November, 1989 and during May and June, 1990. All crabs were free of external sediment, and were kept frozen until tissue extraction. All tissue was removed by plastic forceps, and stored in 50 ml polystyrene centrifuge tubes at −20°C. Forty-eight crabs were used in each group in the Fall 1989 collection. Within each group, tissue samples from three individuals were pooled to yield a sample size (n) of 16 per tissue type. Pooling was not done for crabs collected in 1990. Thirty crabs were used in each group, giving a sample size of 30 per tissue type.

All samples were lyophilized, using a Labconco Freeze-Dry System and subsequently homogenized with a plastic spatula. Samples were digested using a nitric acid-hydrogen peroxide digestion procedure.

Tissue burdens of elements were determined by ICP-AES using a Jarrell-Ash Plasma AtomComp (Mark II System) modified with the Ward Scientific, Ltd., and MDA (Multiple Data Acquisition and WICS) hardware and software upgrades. Analyses were made with a six-point exposure of all element profiles simultaneously in order to provide on-peak and off-peak (baseline) readings for each element. The system was calibrated with the appropriate matrix matched multi-element standards and corrections were made for potential spectral

Table 2. Student-Newman-Keuls comparisons of element content in gill tissue of blue crabs collected during 1989 and 1990. Underlined groups are not significantly different ($\alpha = 0.05$). DP = diseased Pamlico; NP = non-diseased Pamlico; NA = non-diseased Albemarle

Fall 1989 (N = 16)

Element	Mean	Crab Group (μg/g dry wt.)	
Al	DP 1273.3	NP 216.6	NA 70.3
As	DP 8.08	NP 4.46	NA 3.45
Cd	NA 0.70	DP 0.63	NP 0.27
Co	DP 0.92	NP 0.36	NA 0.21
Cr	DP 1.25	NP 0.64	NA 0.11
Cu	NA 302.48	NP 207.92	DP 102.26
Mn	DP 435.65	NP 87.34	NA 76.21
Mo	DP 0.43	NP 0.30	NA 0.27
Ni	NP 1.32	DP 0.89	NA 0.22
Pb	NP 7.35	DP 1.94	NA[a] −0.33
Ti	DP 15.71	NP 3.76	NA 1.56
V	DP 2.85	NP 0.91	NA 0.20
Zn	DP 110.56	NA 100.80	NP 96.54

Summer 1990 (N = 30)

Element	Mean	Crab Group (μg/g dry wt.)	
Al	DP 1454.0	NP 238.6	NA 89.5
As	DP 5.43	NP 3.39	NA 2.48
Cd	DP 1.08	NP 0.87	NA 0.63
Co	DP 1.18	NP 0.67	NA 0.19
Cr	DP 1.34	NP 0.15	NA 0.04
Cu	NA 227.25	NP 178.49	DP 131.17
Mn	DP 281.24	NP 79.17	NA 35.84
Mo	DP 0.45	NP 0.31	NA 0.21
Ni	DP 0.96	NP 0.52	NA 0.35
Pb	DP 1.11	NP* −0.23	NA* −0.29
Ti	DP 23.59	NP 3.27	NA 2.05
V	DP 2.19	NP 0.43	NA 0.27
Zn	NP 107.33	DP 94.02	NA 85.79

[a]Mean concentration was below limit of detection

interferences involving Fe, Al, P, Zn, Ca, and Cu. Quantitative analysis was performed on twenty-four elements. Controls included acid digested blanks, National Institute of Standards and Technology (NIST) (formerly the National Bureau of Standards) Standard Reference Material (SRM-1566 Oyster Tissue), and several internally prepared reference standards.

Measurement of 24 elements in three tissues in three categories of crabs over a period of two years generates a large and complex data set. We have therefore limited our statistical analyses to 13 of the 24 elements examined in order to reduce the size and complexity of the data matrix, and in order to minimize difficulties in interpreting the data. The 13 elements included in the statistical analyses were some of those: (1) designated by the USEPA as toxic (arsenic, cadmium, chromium, copper, nickel, lead, and zinc); (2) occurring at high levels in the Pamlico River sediments (molybdenum, manganese, titanium, and vanadium) (Riggs *et al.* 1989), and (3) occurring at high concentrations within the phosphate ore being mined locally (nickel and cobalt) (Ellington 1984). Elements eliminated were the macronutrients and those trace elements for which the analytical quality may have been in question. A novel chemometric technique designed to enable statistical analysis of the 3-mode data array of all 24 elements is the subject of another report (Gemperline *et al.* 1992).

Statistical analyses consisted of an ordination technique (correspondence analysis) and standard analyses of variance and *a posteriori* contrasts (Student-Newman-Kuels). Correspondence analyses (COA) were carried out using mean values of each element. COA estimates similarities between sampling units, such as metal content and crab tissue type. Hence this technique can be used to delineate associations between specific metals and the tissues of diseased and non-diseased crabs. Similarity is denoted by the extent of proximity of two or more sampling units when these units are positioned relative to one or more coordinate axes.

Analyses of variance were carried out with log-transformed or inverse square root-transformed data. Data for cobalt were not normalized using these transformations, and were therefore analyzed using the non-parametric Kruskal-Wallis Analysis of Variance and Mann-Whitney U Test to characterize crab group effects for a specific metal and tissue type. All analyses other than the COA were done using both CSS:Statistica (Statsoft, Inc.), and SYSTAT software. COA were carried out using Anthropac software.

Control values of all elements except chromium and nickel were similar to the corresponding NIST Reference Standards (Table 1). The chromium and nickel controls were low compared to the NIST values in both the 1989 and 1990 analyses. The concentrations of these elements have not been corrected for these discrepancies because the primary objective of this study was to determine if relative differences in metal tissue burdens existed among the groups of crabs.

Results

Metal and trace element content of the crabs varied markedly as a function of tissue analyzed. The COA show clear separations between gill, hepatopancreas, and muscle tissues for all crabs collected in both 1989 and 1990 (Figure 1). Albemarle crabs were distinct from Pamlico crabs with regard to the metal content of their hepatopancreas, and all three groups of crabs

Table 3. Student-Newman-Keuls comparisons of element content in hepatopancreas tissue of blue crabs collected during 1989 and 1990. Underlined groups are not significantly different ($\alpha = 0.05$). DP = diseased Pamlico; NP = non-diseased Pamlico; NA = non-diseased Albemarle

Fall 1989 (N = 16)

Element	Mean	Crab Group (μg/g dry wt.)	
Al	DP	NP	NA
	14.55	5.07	4.76
As	DP	NA	NP
	6.40	4.13	4.10
Cd	NA	DP	NP
	2.91	1.16	0.56
Cr	NP	NA	DP
	0.19	0.16	0.13
Co	DP	NP	NA
	0.48	0.40	0.21
Cu	NA	NP	DP
	87.81	43.80	28.65
Mn	DP	NP	NA
	47.34	39.01	16.99
Mo	NA	NP	DP
	0.61	0.57	0.47
Ni	NP	DP	NA
	0.29	0.23	0.15
Pb	DP[a]	NA[a]	NA[a]
	−0.49	−0.55	−0.62
Ti	DP	NP	NA
	0.40	0.34	0.16
V	NP	DP	NA
	0.38	0.35	0.17
Zn	NP	DP	NA
	157.84	151.12	89.34

Summer 1990 (N = 30)

Element	Mean	Crab Group (μg/g dry wt.)	
Al	DP	NP	NA
	20.65	19.99	9.67
As	NP	DP	NA
	7.15	6.33	5.08
Cd	NP	DP	NA
	4.81	3.61	2.33
Cr	NP[a]	DP[a]	NA[a]
	0.00	−0.09	1.66
Co	NP	DP	NA
	1.75	1.21	0.27
Cu	NA	NP	DP
	99.51	52.86	29.74
Mn	DP	NP	NA
	25.17	19.86	14.21
Mo	NP	DP	NA
	0.91	0.72	0.49
Ni	NP	DP	NA
	0.72	0.49	0.21
Pb	NP[a]	NA[a]	DP[a]
	0.38	−0.31	−0.31
Ti	NP	DP	NA
	0.54	0.65	0.39
V	NP	DP	NA
	0.69	0.44	0.21
Zn	NP	DP	NA
	243.94	166.00	105.74

[a] Mean concentration was below limit of detection

showed marked differences in the metal content of their gill tissue. Comparatively minor differences in the metal content of the muscle tissue were observed among crab groups.

The correspondence analyses also link particular elements to tissue type and crab groups. Thus, gill tissue is distinguished by its levels of aluminum, titanium, manganese, vanadium, chromium, nickel, lead and copper. Furthermore, gill tissue from diseased Pamlico River crabs is particularly associated with the first four of these metals, while gill tissue of Albemarle crabs is associated with copper (Figure 1). Similarly, hepatopancreas is distinguished by its concentrations of cadmium, molybdenum, and arsenic. Hepatopancreas tissue from both diseased and healthy Pamlico crabs was strongly affiliated with arsenic in 1989, and with all three elements in 1990. Muscle tissue is distinguished by its zinc concentration, and the absence of any consistent linkage with a specific crab group.

Details of the relationships between particular elements, tissues, and crab groups are provided by the ANOVAs, and the *a posteriori* contrasts (Tables 2–4). Concentrations of all thirteen elements differed significantly among tissues and among crab groups. Interactions between tissues and groups were significant for all elements except copper, indicating that for these elements, relative differences in content among crab groups varied with the type of tissue (Figure 2).

Plots of tissue burdens as a function of crab group (=ANOVA interactions) show that elements associated with a specific tissue and crab group according to the COA are found in highest concentration in that tissue (aluminum and gill, cadmium and hepatopancreas, zinc and muscle), and crab group (aluminum and diseased Pamlico crabs, copper and Albemarle crabs) (Figure 2). Gills of diseased Pamlico crabs were denoted by levels of aluminum, cobalt, chromium, manganese, titanium and vanadium which were 6–16 times higher than those of Albemarle crabs, and a copper concentration approximately one half that of Albemarle crabs. Arsenic, lead, molybdenum and zinc were also significantly more concentrated in diseased crabs than in Albemarle crabs. Levels of metals in the gills of non-diseased Pamlico crabs were usually intermediate between these two extremes, and always significantly greater than those of the Albemarle crabs (Table 2). Lead was an exception to this trend; the concentration of lead in the gills of non-diseased Pamlico crabs in 1989 was at least three times higher than that in any other crab group during either 1989 or 1990.

Table 4. Student-Newman-Keuls comparisons of element content in muscle tissue of blue crabs collected during 1989 and 1990. Underlined groups are not significantly different ($\alpha = 0.05$). Cr, Mo, Ni, Pb, and V were omitted because their concentrations were below the limit of detection for both 1989 and 1990. DP = diseased Pamlico; NP = non-diseased Pamlico; NA = non-diseased Albemarle

FALL 1989 (N = 16)

Element	Mean Crab Group (µg/g dry wt.)		
Al	DP 7.15	NP 2.92	NA 1.61
As	DP 3.54	NP 3.28	NA 1.86
Cd	NA[a] 0.07	DP[a] 0.06	NP[a] 0.05
Co	DP[a] 0.05	NP[a] 0.01	NA[a] 0.01
Cu	NA 52.78	DP 28.57	NP 23.60
Mn	DP 13.58	NP 3.87	NA 3.56
Ti	DP 0.14	NP[a] 0.10	NA[a] 0.06
Zn	NA 329.91	DP 301.91	NP 291.80

SUMMER 1990 (N = 30)

Element	Mean Crab Group (µg/g dry wt.)		
Al	NP 8.16	DP 7.23	NA 5.47
As	NP 2.12	DP 1.94	NA 1.58
Cd	NP 0.15	NA 0.13	DP 0.11
Co	NP 0.13	DP 0.08	NA[a] 0.02
Cu	NA 46.54	NP 28.65	DP 22.37
Mn	NP 9.47	DP 9.23	NA 4.34
Ti	NP 0.12	NA 0.10	DP 0.09
Zn	NA 178.82	NP 169.07	DP 163.94

[a] Mean concentration was below limit of detection

Most of the elements found in high concentrations in the gills of diseased crabs were also present at high levels in the hepatopancreas of these crabs. Thus diseased crabs had significantly greater levels of aluminum, arsenic, cobalt, manganese, titanium, vanadium, and zinc in their hepatopancreas than did Albemarle crabs (Table 3). Non-diseased Pamlico crabs also showed significantly higher concentrations of cobalt, titanium, vanadium, and zinc than did Albemarle crabs. Levels of aluminum, arsenic and manganese in healthy Pamlico crabs typically exceeded those in Albemarle crabs, but the differences were not significant during either 1989 or 1990. Levels of copper in diseased Pamlico crabs, and non-diseased Pamlico crabs were again a fraction of those of Albemarle crabs (Table 3; Figures 2,3).

Metals which lacked this correspondence in concentration between gill and hepatopancreas tissue were chromium, lead, and molybdenum. Chromium concentrations in the hepatopancreas were similar in diseased crabs and Albemarle crabs in 1989, and were undetectable in all crab groups the following year (Table 3). Lead was undetectable in the hepatopancreas in all groups during both 1989 and 1990. Molybdenum content of the hepatopancreas was inconsistent between years, being highest in Albemarle crabs in 1989, and highest in healthy Pamlico crabs in 1990.

Differences in metal and trace element content of muscle between diseased crabs and Albemarle crabs were limited to the signficantly higher concentrations of manganese, and the significantly lower levels of copper, in the diseased crabs (Table 4). Aluminum and arsenic were significantly elevated in Pamlico crabs relative to Albemarle crabs, but the group of Pamlico crabs with the greatest levels of these elements varied between years. Levels of zinc fluctuated widely in all groups of crabs between 1989 and 1990. The remaining elements (cadmium, cobalt, molybdenum, and titanium), were below the limit of detection for all crabs in 1989, and occurred at the highest levels in the healthy Pamlico crabs the following year.

Discussion

The findings indicate that metal and trace element burdens of diseased blue crabs collected from a contaminated environment (Pamlico River) were substantially higher than those of nondiseased crabs collected from a relatively uncontaminated environment (Albemarle Sound). Tissue burdens of non-diseased crabs from the Pamlico River either fell between these two extremes, or were similar to those of diseased crabs.

Fewer differences in metal and trace element burdens between the two groups of Pamlico crabs occurred in the 1990 samples than in the 1989 samples. The 1990 samples were collected earlier in the year (June) than were the 1989 samples (November). Differences in collection time between 1989 and 1990 imply different residence times of the crabs in their respective habitats. Blue crabs enter estuaries as post-larvae ("megalopa" stage), and colonize the upper regions of estuaries as juveniles (Van Engel 1957; Epifanio 1988; McConaugha 1988). All crabs used in this study were obtained from upstream locations within the Albemarle-Pamlico Estuary. Hence annual variations in metal burdens may reflect differences in the length of time the crabs were exposed to contaminated sediments prior to the time of collection.

Diseased crabs were distinguished by highly elevated gill tissue burdens of aluminum, arsenic, cobalt, manganese, titanium and vanadium during both 1989 and 1990. These elements are found in high concentrations in the Pamlico River sediments (Harding and Brown 1976; Riggs *et al.* 1989). The disproportionately high levels of these elements in the gills of diseased crabs may have resulted in part from direct sediment

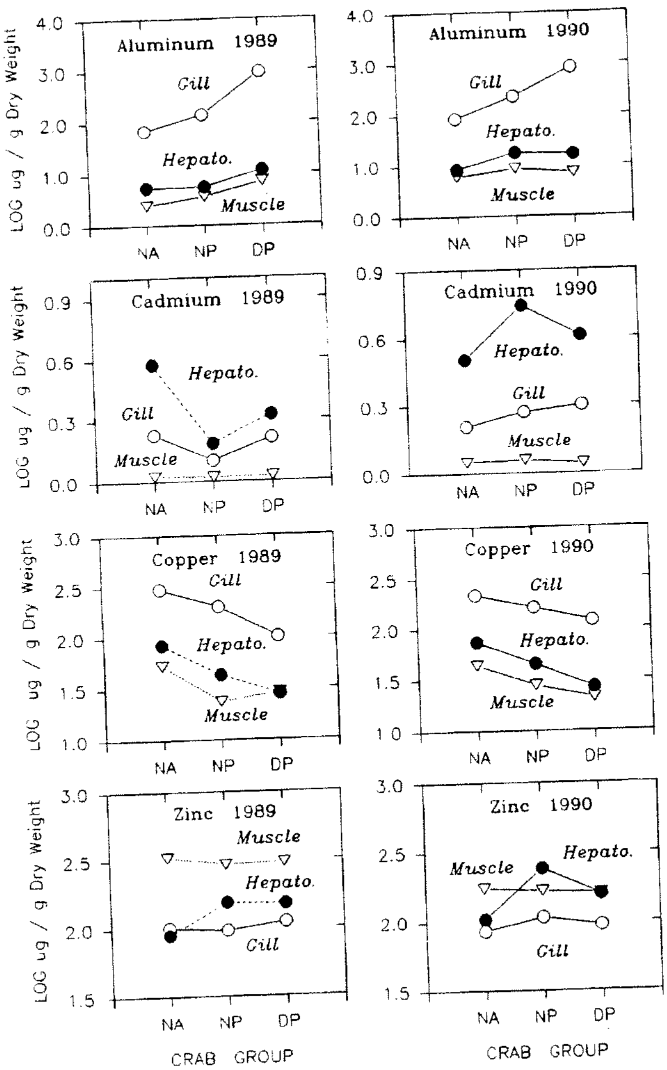


Fig. 2. Concentrations of selected elements in gill, hepatopancreas (hepato.), and muscle of diseased Pamlico crabs (DP), non-diseased Pamlico crabs (NP), and non-diseased Albemarle crabs (NA) during fall 1989 and summer 1990. Non-parallel lines between tissue types indicate an interaction between tissue type and crab group

contamination, given that the diseased crabs sampled had lesions which often penetrated the entire integument, and were located over the gill chamber. However, the same elements were also present in substantial quantities in the gills of non-diseased crabs from the contaminated environment, and in the hepatopancreas of both groups of crabs from this environment. Thus the high concentration of these elements in crabs from an environment with high levels of metals and trace elements cannot be easily dismissed as an artifact of direct sediment contamination of tissues. Aluminum, arsenic and manganese were also found in significantly higher concentrations in the muscle of both groups of crabs from the contaminated environment compared to crabs from the uncontaminated environment.

Toxic levels of metals or trace elements could promote shell disease by causing physical degradation of the tissue (hypodermis) which secretes the cuticle, or by impairing either the synthesis of new cuticle or the process of wound repair. In this context, arsenic is potentially the most important trace element

Table 5. Estimated excessive amounts of muscle for human consumption from blue crabs obtained in the Pamlico River estuary. Mean muscle concentrations are the highest mean from either healthy or diseased crabs from the Summer 1990

Element	Adult (70 Kg) excessive daily intakes (μg/day)[a]	Summer 1990 Mean muscle conc. (μg/g dry weight)	Excessive consumption of muscle (g dry weight)
Cd	71[b]	0.15	473
As	not established[b]	2.12	—
Cr	200	−0.14[c]	—
Cu	5,000	28.65	174
Mn	10,000	9.47	1,055
Zn	15,000	169.07	89

[a] National Academy of Sciences-National Research Council, 1989
[b] World Health Organization, 1972
[c] Concentration below limit of detection

pollutant found in the tissues of Pamlico River crabs. Arsenic is toxic to freshwater fishes at concentrations as low as 1.3 μg/L (Salila and Segar 1979). Short term exposure (96 hours) to higher concentrations (17 μg/L) can produce degenerative changes to crab gill hypodermis and hepatopancreas tissue (Krishnaja *et al.* 1987).

Lead and cadmium have deleterious effects on the general body surface or gill epithelia of crustaceans (Couch 1977; Nimmo *et al.* 1977; Williams and Duke 1979; Krishnaja *et al.* 1987). Both of these metals represent anomalies within this study. High levels of lead were found just in the gills of non-diseased Pamlico crabs only in 1989. Elevated levels of cadmium were not consistently found in the tissues of diseased crabs, despite the fact that Pamlico River sediments are enriched with cadmium (Riggs *et al.* 1989). The causes of these anomalies are unclear. Nevertheless, there is no strong evidence of either lead or cadmium involvement with the local outbreak of shell disease.

Other elements accumulated by Pamlico River crabs could play an indirect role in the etiology of shell disease. The effects of aluminum on the crustacean hypodermis have not been well studied. However, in mammals, exposure to aluminum hydroxide can alter normal calcium metabolism, resulting in a loss of calcium from bone (Spencer *et al.* 1981). Interference with the normal process of calcification during formation of the cuticle in crabs could produce a structurally weakened shell more vulnerable to injury, and thus more susceptible to degradation by chitinoclastic fauna.

Levels of copper in both diseased and non-diseased crabs from the Pamlico River were ½ to ⅓ of that found in non-diseased Albemarle crabs for all tissues. Copper is a highly regulated metal in crustaceans; 50–60% of the total copper content is bound to the respiratory pigment hemocyanin, where it functions to reversibly bind oxygen (Engel 1987; Engel and Brouwer 1984; Depledge and Bjerregaard 1989). Hemocyanin content of blue crabs from the Pamlico River is approximately ½ that of crabs from uncontaminated areas in Core Sound, N.C. (Noga *et al.* 1990). Disturbances in normal copper metabolism could reduce overall health of the crabs by lowering hemocyanin levels and thereby impairing oxygen transport to the tissues. Other work has indicated that both diseased and non-diseased Pamlico crabs were clearly "unhealthy" compared to Albemarle crabs in terms of behavior, survival, hemocyte levels, and wound repair capability (Weinstein 1991). Hence, shell disease may be a manifestation of poor health due to impaired copper metabolism.

Zinc is also highly physiologically regulated in crustaceans (Rainbow 1985). It is an important constituent of enzymes involved in calcification (carbonic anhydrase) (Zatta 1984; Henry and Kormanick 1985), and plays a critical regulatory role in muscle contraction in crustaceans (Depledge 1989). Pamlico crabs had significantly higher zinc concentrations in the gills and hepatopancreas than did the Albemarle crabs. Nevertheless, these concentrations were within the range of normal concentrations reported by other workers (Hall *et al.* 1978; Engel and Brouwer 1984; Eisenberg and Topping 1984; Sanders 1984).

Nickel and vanadium are considered relatively non-toxic to marine invertebrates (Mance 1987). Toxicity and cellular effects of cobalt, manganese and titanium on crustaceans are largely unknown (Eisler 1981; Mance 1987).

The above inferences concerning metal burdens and shell disease are severely constrained given the paucity of information on toxicity levels, ionic form, route of entry, and pathological effects of most of these elements for aquatic invertebrates. Much work needs to be done to delineate their individual and synergistic effects in order to define their contribution to the occurrence of shell disease among the local blue crab population.

None of the metals and trace elements found to be significantly enriched in the edible portion (muscle) of the Pamlico River blue crabs appear to constitute potential health risks to human consumers (Table 5). The excessive daily intakes listed in Table 5 are considered toxic only if maintained for long periods of time (National Academy of Sciences-National Research Council 1989). Acutely toxic levels of these elements are several times higher than those found in the crabs sampled. Cadmium is of particular interest because it can accumulate in seafood and become potentially toxic to humans. The "average" blue crab meal consists of the muscle from 6 adult crabs and weighs approximately 240 g wet weight (O'Conner 1983), or roughly 57 g dry weight. However, these results indicate that even three average crab meals per day would be below the excessive intake level of cadmium.

Acknowledgments. I wish to thank Drs. C. Bland, G. Kalmus, and P. McClellan-Green for providing critical assistance during my research and in the preparation of this paper. The manuscript was also improved by the helpful comments of R. Nakamoto and B. Hargreve. This paper is based on a thesis submitted by J. Weinstein to the Department of Biology, East Carolina University in partial fulfillment of the requirements of the Master of Science degree.

References

Baross JA, Tester PA, Morita RY (1978) Incidence, microscopy, and etiology of exoskeleton lesions in the tanner crab, *Chionoecetes tanneri*. J Fish Res Board Can 35:1141–1149

Cipriani GR, Wheeler RS, Sizemore RK (1980) Characterization of brown spot disease of Gulf coast shrimp. J Invert Pathol 36:255–263

Cook DW, Lofton SR (1973) Chitinoclastic bacteria associated with shell disease in *Penaeus* shrimp and the blue crab, *Callinectes sapidus*. J Wildlife Diseases 9:154–159

Couch, JA (1977) Ultrastructural study of lesions in gills of a marine shrimp exposed to cadmium. J Invert Pathol 29:267–288

Depledge, MH (1989) Re-evaluation of metabolic requirements for copper and zinc in decapod crustaceans. Mar Environ Res 27:115–126

Depledge MH, Bjerregaard P (1989) Haemolymph protein composition and copper levels in decapod crustaceans. Heloglander Meersuntersuchungen 43:207–223

Doughtie DG, Conklin PJ, Rao KR (1983) Cuticular lesions induced in grass shrimp exposed to hexavalent chromium. J Invert Pathol 42:249–258

Eisenberg M, Topping JJ (1984) Trace metal residues in shellfish from Maryland waters, 1976–1980. J Environ Sci Health B 19(7):649–671

Eisler R (1981) Trace Metal Concentrations in Marine Organisms. Pergamon Press, NY

Ellington MD (1984) Major and trace element composition of phosphorites of the North Carolina continental margin. MS Thesis. East Carolina Univ, Greenville, NC

Engel DW (1987) Metal regulation and molting in the blue crab, *Callinectes sapidus*: Copper, zinc, and metallothionein. Biol Bull 172:69–82

Engel DW, Brouwer M (1984) Cadmium-binding proteins in the blue crab, *Callinectes sapidus*: Laboratory-field comparison. Mar Environ Res 14:139–151

Epifanio, CE (1988) Transport of invertebrate larvae between estuaries and the continental shelf. Amer Fish Soc Sympos 3:104–114

Gemperline PJ, Miller K, West TL, Weinstein JE, Hamilton JC, Bray JT (1992) Chemometrics, trace metals and blue crab shell disease. Anal Chem 64:523–532

Gopalan UK, Young JS (1975) Incidence of shell disease in shrimp in the New York Bight. Mar Pollut Bull 6:149–153

Hall RA, Zook EG, Meaburn GM (1978) National Marine Fisheries Service survey of trace elements in the fishery resource. NMFS SSRF-721

Harding SC, Brown HS (1976) Distribution of selected trace elements in sediments of Pamlico River Estuary, North Carolina. Environ Geol 1:181–191

Henry RP, Kormanik GA (1985) Carbonic anhydrase activity and calcium deposition during the molt cycle of the blue crab, *Callinectes sapidus*. J Crustacean Biol 5:234–241

Hess E (1937) A shell disease in lobsters (*Homarus americanus*) caused by chitinovorous bacteria. J Biol Board Can 3(4):358–362

Kneip TJ, Hazen RE (1979) Deposit and mobility of cadmium in a marsh-cove ecosystem and the relation to cadmium concentration in the biota. Environ Health Perspectives 28:67–73

Krishnaja AP, Rege MS, Joshi AG (1987) Toxic effects of certain heavy metals (Hg, Cd, Pb, As, and Se) on the intertidal crab Scylla serrata. Mar Environ Res 21:109–119

Mance G (1987) Pollution threat of heavy metals in aquatic environments. Elsevier Applied Scientific, NY

McKenna S, Jansen M, Pulley MG (1990) Shell disease of blue crabs, *Callinectes sapidus*, in the Pamlico River, North Carolina. North Carolina Department of Natural Resources and Community Development, Division of Marine Fisheries. Spec Sci Rep Number 51

McConaugha JR (1988) Export and reinvasion of larvae as regulators of estuarine decapod populations. Am Fish Soc Symp 3:90–103

National Academy of Sciences-National Research Council (1989) Recommended dietary allowances, 10th ed. National Academy Press, Washington, DC

Nimmo DWR, Lightner, DV, Bahner LH (1977) Effects of cadmium on the shrimps, *Penaeus duorarum*, *Palaemonetes pugio*, and *Palaemonetes vulgaris*. In: Vernberg FJ, Calabrese A, Thurberg FB, Vernberg W (eds.) Physiological Responses of Marine Biota to Pollutants. Academic Press, NY pp 131–183

Noga EJ, Engel DW, Arroll TW (1990) Shell disease in blue crabs, *Callinectes sapidus*, from the Albemarle-Pamlico Estuary. Report to the North Carolina Department of Natural Resources and Community Development, Report No 90-22

O'Conner JM (1983) Cadmium in the edible flesh of blue crabs (*Callinectes sapidus*) and the northern lobster (*Homarus amricanus*). Report to NOAA Northeast Office, 7 pp

Pearce JB (1972) The effects of solid waste disposal on benthic communities in the New York Bight. In: Ruivo M (ed.) Marine Pollution and Sea Life. Fishing News (Books) Ltd, London, pp 404–411

Rainbow PS (1985) Accumulation of Zn, Cu, and Cd by crabs and barnacles. Estuarine, Coastal and Shelf Science 21:699–686

Riggs SR, Powers ER, Bray JT, Stout PM, Hamilton C, Ames D, Lucas S, Moore R, Watson J, Williamson M (1989) Heavy metal pollutants in organic-rich muds of the Pamlico River estuarine system: Their concentration, distribution, and effects upon benthic environments and water quality. Report to the North Carolina Department of Natural Resources and Community Development

Rosen B (1967) Shell disease of the blue crab, *Callinectes sapidus*. J Invert Pathol 9:348–353

——(1970) Shell disease of aquatic crustaceans. In: S. Snieszko (ed.) A Symposium on Diseases of Fishes and Shellfishes. Amer Fish Soc Spec Publ No. 5, Washington, DC, pp 409–415

Salia SB, Segar DA (1979) Metals Subpanel Report. In: O'Conner JS, Stanford HM (eds.) Chemical Pollutants of the New York Bight; Priorities for Research. NOAA, pp 10–19, 121–150

Sanders M (1984) Metals in crab, oyster, and sediment in two South Carolina estuaries. Mar Pollut Bull 15:159–161

Spencer H, Kramer L, Osis D, and Wiatrowski E (1981) Effects of aluminum hydroxide on fluoride and calcium metabolism. J Environ Pathology 5:33–41

Van Engel WA (1957) The blue crab and its fishery in the Chesapeake Bay. Part 1-Reproduction, early development, growth, and migration. Commer Fish Rev 20:6–17

Weinstein JE (1991) Wound repair and metal content of blue crabs, *Callinectes sapidus*, from the Albemarle-Pamlico estuarine system. Ms Thesis. East Carolina Univ., Greenvile, NC

Williams AB, Duke TW (1979) Crabs (Arthropoda: Crustacea: Decapoda: Brachyura). In: Hart CW Jr., Fuller SL (eds.) Pollution Ecology of Estuarine Invertebrates. Academic Press, NY, pp 171–233

Young JS, Pearce JB (1975) Shell disease in crabs and lobsters from New York Bight. Mar Pollut Bull 6:101–105

Zatta P (1984) Zinc transport in the haemolymph of *Carcinus maenas* (Crustacea:Decapoda). J Mar Biol Assoc UK 64:801–807

Manuscript received March 19, 1992 and in revised form June 1, 1992.

ELSEVIER

Ecological Engineering 15 (2000) 303–321

ECOLOGICAL ENGINEERING

www.elsevier.com/locate/ecoleng

Assessment of function in an oligohaline environment: Lessons learned by comparing created and natural habitats

Terry L. West [a,*], Lisa M. Clough [a], William G. Ambrose Jr [b]

[a] *Department of Biology, East Carolina University, Greenville, NC 27858, USA*
[b] *Biology Department, Bates College, Lewiston, ME 04240, USA*

Received 12 December 1998; accepted 10 March 2000

Abstract

Assessments of nursery area function were carried out over a 10-year period in a 3-ha oligohaline marsh and creek system ('Project Area 2') and four natural 'control' creeks (Drinkwater, Jacks, Jacobs, and Tooley) located in the Pamlico River estuary, North Carolina. Habitat function was assessed by comparing (1) growth and survival of fish; (2) long-term monitoring of water quality, sediment organic carbon, and the benthic infaunal community; and (3) measurement of benthic food availability. Growth (weight gain) and survival of the fish *Leiostomus xanthurus* held within enclosures were similar in both created and natural habitats. Species composition, total fauna density, and species richness of the infaunal community of the Project Area and the natural creeks were comparable within 3 years after construction of the Project Area. However, the sediments of the Project Area lacked the woody detrital cover, high peat content, and predominance of silt and clay characteristic of the natural creek sediments. There was no evidence of significant accretion of total organic carbon in the Project Area during the course of the study. This study has heuristically inspired four recommendations concerning assessment criteria of mitigation success. (1) Direct experimentation is needed to assess habitat function for motile species such as fish. (2) Studies of community structure need to be carried out long enough to permit testing of community stability, especially when working in areas exposed to stochastic abiotic and biotic stressors. (3) Measurements of nutritional content of the sediments should include estimates of overall organic quantity and nutritional quality. (4) Site design or restoration techniques should be included in the experimental design of each mitigation effort. Specifically, the lack of replication in these aspects of the mitigation process limits the inferential potential of the study, constrains the ability to make accurate predictions about the probability of success of future mitigation endeavors, and impedes our understanding of the critical mechanisms governing successful habitat creation, restoration, and enhancement.

Keywords: Mitigation; Oligohaline; Fish; Benthic infauna; Sediment; Organic carbon; Biological protein

1. Introduction

Increasing development of wetlands and coastal areas in the United States during the past 20 years

* Corresponding author. Tel.: +1-252-3281845; fax: +1-252-3284178.
E-mail address: westt@mail.ecu.edu (T.L. West).

PII: S0925-8574(00)00083-5

has fueled concerns about the ecological consequences of the reduction of biodiversity and loss of critical habitats. Coincident with this increasing development has been a growth in the knowledge of, and applied efforts toward, restoring damaged or altered habitats, and creating new habitats to compensate for those lost to human activities (Zedler, 1988; Race and Fonseca, 1996).

Efforts to remediate habitat alteration or loss have met with mixed results with 'failures' and inconclusive efforts greatly outnumbering 'successes'. The lack of success in mitigation has resulted from (1) improper construction or implementation of mitigation efforts; (2) non-compliance with permitting goals, objectives, and guidelines; (3) insufficient time frame for monitoring; (4) inadequate knowledge of forces structuring natural communities; and (5) inadequate knowledge of local ecosystem function (Zedler, 1988, 1996; Mitsch and Wilson, 1996; Race and Fonseca, 1996).

Such 'failures' have taught that criteria for determining 'success' of habitat remediation may focus on inadequate measures of the salient ecological processes that drive spatial and temporal change in the natural communities. Success is generally viewed in terms of a system's biological viability and sustainability. Indices of success commonly include species lists and measures of abundance, biomass or percent cover over time, sedimentary features (e.g. concentrations of organic carbon and nitrogen, porosity, chlorophyll, grain size), and measures of relevant abiotic variables (temperature, dissolved oxygen, salinity for aquatic systems). These indices have been favored because they are simple and relatively inexpensive to carry out, but they have been subject to criticism because the sampling may have been occasional, of short overall duration, and with little evidence of prior knowledge of the most ecologically suitable timing; moreover, the indices themselves may not be sufficient tests of ecosystem function (Mitsch and Wilson, 1996).

In this paper, we present both experimental and correlative work that (1) links traditional success criteria of (a) patterns of species abundance and (b) sedimentary organic carbon levels with habitat function; and (2) evaluates the importance of time as an element of mitigation research. All work was carried out during 1985–1995 in four natural and one created non-tidal oligohaline subtributaries of the Pamlico River estuary, North Carolina, USA. We link patterns of faunal abundance with habitat function by comparing the capability of natural and created habitats to support the growth of fish (*Leiostomus xanthurus* Lacepede) that prey on resident benthic invertebrate infauna (Tenore, 1972a; West and Ambrose, 1992). We evaluate the utility of sedimentary organic carbon as a predictor of habitat viability by comparing infaunal abundance and two separate measures of putative food availability; total organic carbon and nitrogen, and 'biologically available protein' (BAP). We assess the role of time by delineating the influence of 'predictable' periodic stressors (salinity) and novel stressors (invasion by the vascular plants *Myriophyllum spicatum* L. [Eurasian watermilfoil], and *Ruppia maritima* L. [widgeon grass]) on infaunal community structure.

2. Methods

2.1. Site description

All work was carried out in a single created 3-ha oligohaline marsh ('Project Area 2') and four adjacent natural oligohaline creeks (Drinkwater, Jacks, Jacobs, and Tooley) located in the Pamlico River estuary, North Carolina (Fig. 1). Project Area 2 is about half to one-fourth the area of the natural creeks (Table 1, North Carolina Phosphate Corporation, 1982). The land converted to the Project Area was originally a lowland forest of mixed hardwoods identical to those that border the undeveloped subtributaries of the Pamlico River estuary. The Project Area was constructed during 1980–1981 by North Carolina Phosphate Corporation. Four species of emergent vascular plants (*Juncus roemarianus* Scheele, *Spartina patens* (Aiton) Muhl., *Spartina cynosuroides* (L.) Roth, and *Spartina alterniflora* Loisel) were planted during 1981. In 1983, the earthen dam

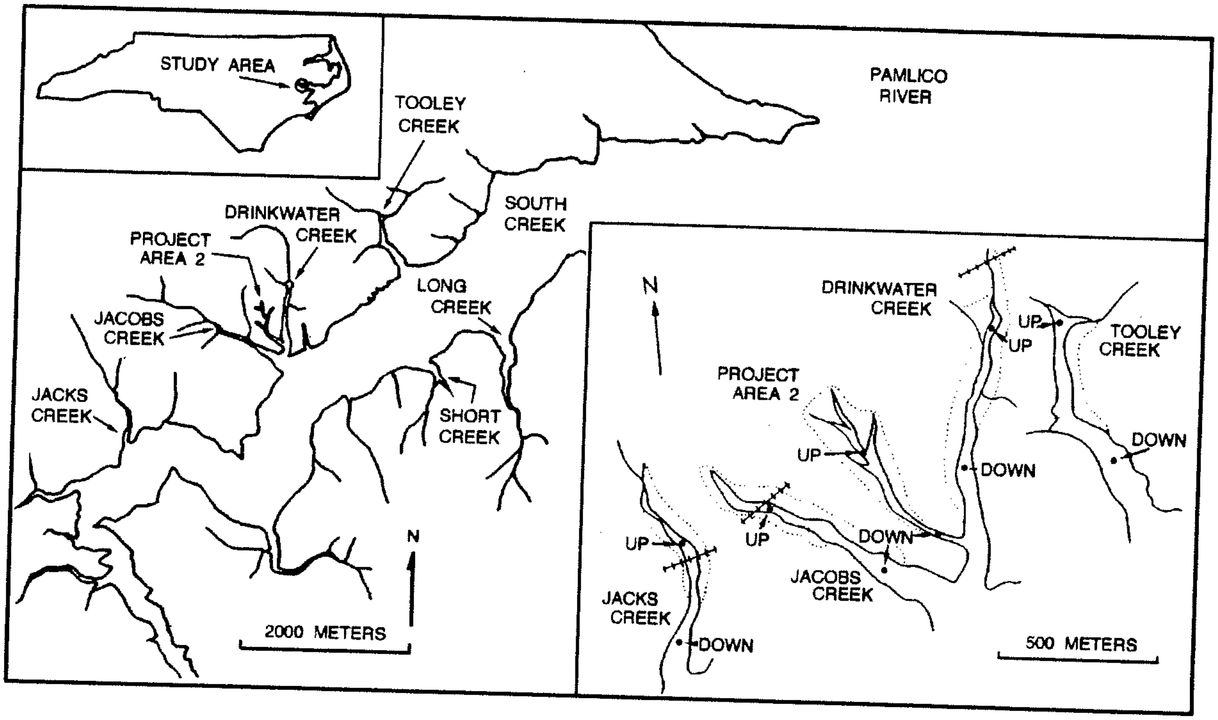


Fig. 1. Location of the sampling stations (upstream, downstream), Project Area 2, and the natural 'control' creeks (Tooley, Drinkwater, Jacobs, Jacks) in the Pamlico River estuary, North Carolina.

was removed that separated the Project Area from the confluence of Drinkwater and Jacobs creeks.

2.2. Water quality

Bottom temperature, salinity, and dissolved oxygen were measured with Yellow Springs Instruments recorders. Water quality measurements were taken at approximately monthly intervals throughout the study period. Water depths ranged from 0.3 to 1.8 m depending upon sampling station (upstream is shallower) and prevailing winds (southwesterlies produce high water levels; Pietrafesa et al., 1986). Continuous recording water quality meters were installed at the downstream sites of the Project Area and Drinkwater creek for a 7-day period in April and May 1995. Temperature, conductivity, and dissolved oxygen were measured at 15-min intervals during this 7-day period using a Yellow Springs Instruments PC6000 submersible environmental monitor.

2.3. Collection of invertebrates

Subtidal benthic samples (0.02 m^2) were taken using an Ekman or Ponar grab from upstream and downstream locations in Tooley creek, Drinkwater creek, and Jacks creek, and in Project Area 2 (Fig. 1). During 1985–1988, three samples were collected from a single site at each upstream and downstream location; during 1989–1995,

Table 1
Areal comparisons of Project Area 2 and the natural creeks involved in this study[a]

Creek	Open water	Marsh surface	Total
Jacks	2.63	2.88	5.51
Jacobs	6.78	5.61	12.39
Drinkwater	5.12	4.17	9.29
Tooley	4.98	4.99	9.97
Project Area 2	0.81	2.23	3.04

[a] All listed values are in hectares and are taken from North Carolina Phosphate Corporation (1982).

three samples were collected from each of two sites at both upstream and downstream locations. The sampling sites were located near the middle of the creek within each location, and sampling depths ranged from 0.3 to 2.5 m. Sampling was done quarterly (January, April, July, October) beginning in July 1985 and ending in July 1995. Samples were sieved in the field through a 0.5 mm mesh, and the residue was preserved in 10% formalin containing 0.1 g/l of Rose Bengal stain. Infauna were separated, counted, and identified to the lowest practical taxon in the laboratory, and subsequently stored in 70% *iso*-propanol.

2.4. Fish growth experiments

Fish growth experiments were carried out in May (29 May–13 June) and July (24 July–9 August), 1985. Juvenile *L. xanthurus* ('spot') were collected in 30–60 s trawls using a 3.9 m two seam otter trawl of 6.3 mm bar mesh equipped with a cod-end bag of 3.1 mm mesh. Collected fish were held overnight in an enclosure to allow for expression of latent mortality associated with the stress of capture. During an experiment, fish were contained within circular enclosures (0.9 or 1.9 m diameter) constructed of black plastic netting (Vexar; 6 mm bar mesh), supported on a frame of stainless steel and concrete reinforcing bar. Each enclosure was 1.2 m high and covered with a Vexar top.

Five pairs of cages (one large and one small) were placed in the downstream regions of Project Area 2, Drinkwater creek, and Jacobs creek. The cages were placed in water 0.4–1.0 m deep, and were forced about 20–30 cm into the sediment to prevent fish from escaping and to deter entry of unwanted predators. The cages were initially seined to remove fish inadvertently captured during installation. Eight fish were added to each large cage and two fish were added to each small cage. Thus, each enclosure contained the same number of fish per unit bottom surface area. Each fish had previously been individually marked by fin clipping and weighed while immersed in water (West, 1990a). The order of addition of fish to the cages was randomly determined. The cages were censused by seining after 16 days. Surviving fish were placed in 10% formalin and later weighed in the laboratory. Growth (weight gain) of wild *L. xanthurus* was estimated by taking 90 s trawls in Drinkwater creek at approximately 14 day intervals between March and October.

2.5. Measurement of sediment features

Grain size determinations were made on intact 4 cm (diameter) × 10 cm (depth) cores according the procedures of Folk (1968). Samples were sieved wet using mesh sizes of 2.0 mm (detrital fraction), 0.84 mm (sand fraction), and 0.074 mm (silt and clay fraction). Data are presented as percentage of the total sample weight represented by each size fraction.

In 1995, three intact 6 cm (diameter) by 15 cm (depth) sediment cores were collected from the downstream station of Drinkwater creek and Project Area 2 during January and April. Cores were returned to the lab and immediately sectioned into five separate 1 cm intervals (0–1, 1–2, 2–3, 3–4, 4–5 cm below the sediment–water interface). Each interval was placed in a −20°C freezer until further analysis (within 6 months of sampling). Samples were thawed, dried to a constant mass at 60°C, and ground and homogenized using a mortar and pestle. TOC and nitrogen were then determined using a Control Corporation model 440 elemental analyzer. Acetanilide was used as a standard for all samples. Possible inclusion of inorganic carbon was assessed for each sample interval using the gasometric technique of Schink et al. (1979). No inorganic carbon was found in any of the samples.

Biologically available protein was assessed for surface (0–1 cm interval) and deep (4–5 cm interval) sediment at each site during January and April 1995 according to the technique described by Mayer et al. (1986). This technique determines the content of the smaller, more labile components of the protein pool following a sequence of acidic digestion, enzymatic degradation, serial protein addition, and final analysis of an extensive set of replicates using spectrophotometric detection of Coomassie Blue dye. All data represent the means of three cores, each of which was subsampled four times.

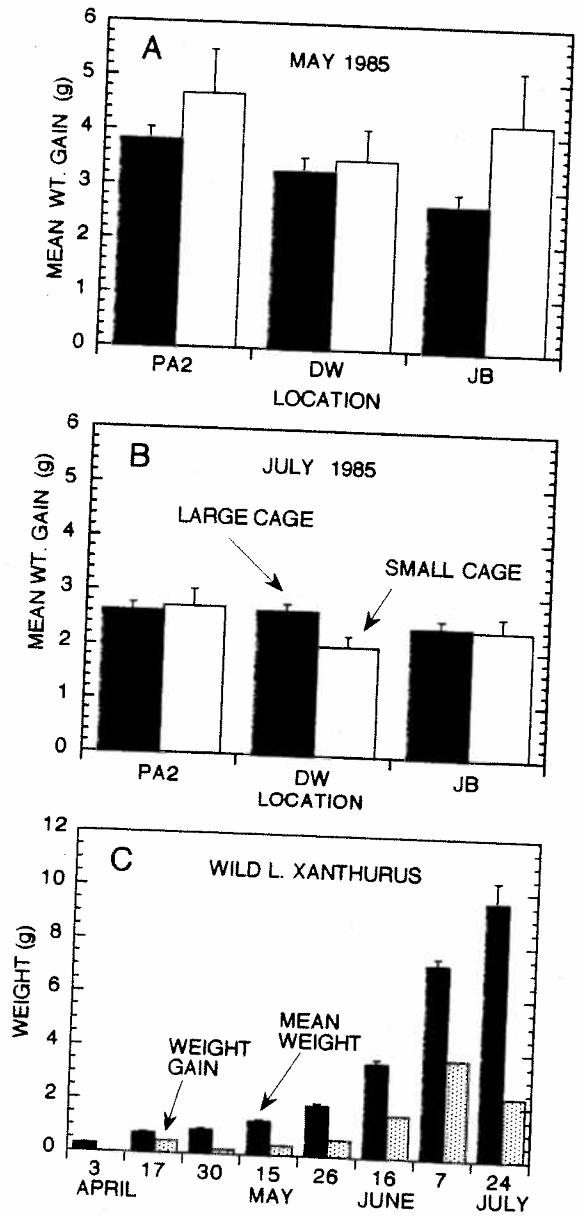


Fig. 2. Weight gain (g) of caged and wild *L. xanthurus* in Project Area 2 (PA 2), Drinkwater creek (DW), and Jacobs creek (JB). (A) May 1985 caging experiment. (B) July 1985 caging experiment. (C) Weight gain and mean weight (g) of *L. xanthurus* trawled at approximately 2-week intervals in Drinkwater creek during 1986. Columns represent mean values + 1 S.E.

Subsequent analyses (West and Clough, in prep.) have shown that wet volume and dry weight of sediment are both required for accurate analysis of sedimentary food concentration. Porosity of the sediment was not determined concurrently with the results being discussed. Instead, corrections for differences in porosity and dry sediment density were made using data obtained at each site during January and April 1997. Porosity was calculated using the wet and dry weights of a known volume of sediment.

2.6. Data analyses

Randomized block analyses of variance (ANOVA's) were carried out to test for creek and cage effects on weight gain and survival of *L. xanthurus*. Survival data were arcsin transformed prior to the ANOVA's. A series of three-way ANOVA's was carried on the infaunal density and species richness data to test for differences due to season (winter, spring, summer, fall), creek (natural vs. created), and location (upstream vs. downstream). Each three-way ANOVA analyzed the data for a single calendar year. A canonical analysis was carried out to test for correlations between infaunal species densities and salinity, and cluster analyses were used to discern temporal and spatial patterns in infaunal community structure. All multi-level ANOVA's and multivariate analyses were done on log $(x+1)$ transformed data. The canonical analyses were done using STATSTICA (StatSoft, Inc. Tulsa, OK); all other data analyses were carried out using DataDesk (Data Description, Inc. Ithaca, NY).

3. Results

3.1. Growth and survival of *L. xanthurus*

Mean weight gain of *L. xanthurus* during May (3–5 g/16 days) was approximately twice as high as that during July (Fig. 2A and B). Weight gain was significantly lower in Jacobs creek than in the Project Area during the May experiment, but differences in weight gain among creeks were not significant during the July experiment. Cage effects were limited to the May experiment, when significantly more growth occurred in the smaller cages in Jacobs creek (Fig. 2A). Weight gain of caged *L. xanthurus* equaled or exceeded that estimated for the ambient wild *L. xanthurus* population during similar time periods and months of the year (Fig. 2A vs. C).

Mean survival was similar among creeks during both experiments, with May values slightly lower than July values. Cage effects on survival were not significant. Mean survival values ranged from 50 to 100%.

3.2. Temporal and spatial patterns of benthic infauna

Data for each of the three natural creeks were pooled in all analyses comparing faunal abundance, diversity, and community structure in created and natural creeks. Data were pooled because (1) the primary issue of this study was whether the abiotic and biotic features of the created creek would fall within the normal range of values exhibited by nearby natural creeks, and not whether it was going to develop to resemble a particular, predesignated creek; and (2) to remain consistent with the symposium theme of assessment of success criteria for habitat restoration. The dynamics of the infaunal communities have been detailed in part in earlier reports (West, 1990b; Ambrose, 1992; Ambrose and Renaud, 1996) and will be dealt with more comprehensively in a future paper.

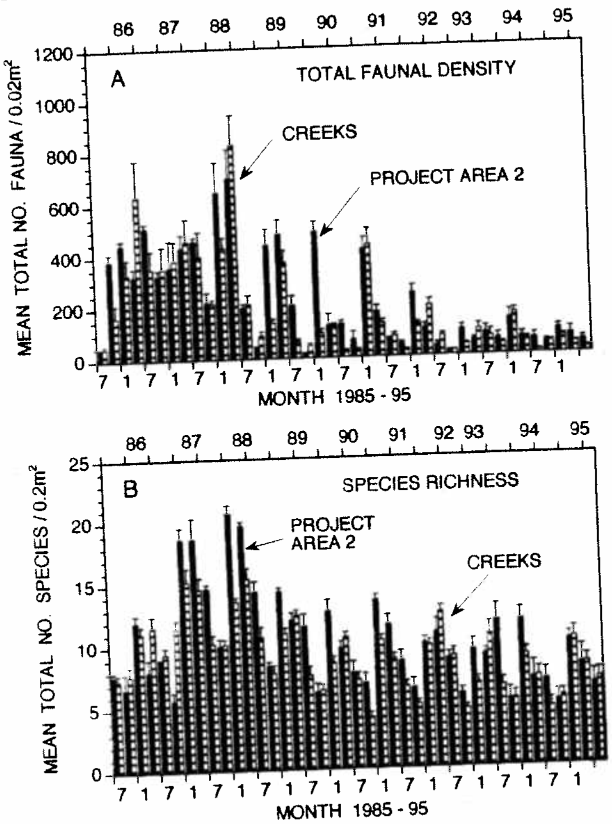


Fig. 3. Temporal variation in mean total faunal density (average total number of infauna/0.02 m^2 sample) and species richness (average total number of infaunal taxa/0.02 m^2 sample) at the downstream locations in Project Area 2 and the natural creeks between July 1985 and July 1995. Columns represent mean values + 1 S.E.

Total faunal density (mean total number of animals/unit area) varied markedly within and between years (Fig. 3A) in both the created and natural creeks. Within a given year, density peaked in the winter, declined sharply between spring and summer, and rose again during the late fall. Winter and spring values showed highly significant differences in all but 1 of the 10-year study (Table 2).

Annual differences in total faunal density were also pronounced. Winter and spring density values generally increased during 1986–1988, varied erratically between 1989 and 1991, and subsequently declined to values one-third to one-sixth of the 1986–1988 values. Summer and fall densities were similarly affected, with densities of individual species diminishing to near zero values in the summer months since 1992 (Fig. 3A).

The temporal and spatial patterns in total numbers of fauna described above were observed in both the Project Area 2 and the natural creeks (Fig. 3A). Summer and fall densities were occasionally significantly lower in the Project Area between 1985 and 1988. However, total densities of the Project Area have equaled or exceeded those of the natural creeks since 1988 (Fig. 3A; Table 2).

Similar annual and seasonal patterns in total faunal density occurred at the upstream and downstream stations in both the Project Area and the natural creeks. Within a single year, densities

Table 2
Selected significant ($P<0.015$) main effects and interactions of the three-way ANOVA's carried out on total faunal density and species richness in Project Area 2 (PA 2) and the natural creeks[a]

Year	Fauna	M	C	M × C × L
1986	Density	1 4 7 10	n.s.	n.s.
1986	Richness	1 4 7 10	n.s.	n.s.
1987	Density	2 4 7 10	n.s.	n.s.
1987	Richness	2 4 7 10	n.s.	n.s.
1988	Density	1 5 7 10	P>N	n.s.
1988	Richness	1 5 7 10	n.s.	n.s.
1989	Density	1 4 7 10	n.s.	n.s.
1989	Richness	1 4 7 10	P>N	n.s.
1990	Density	1 5 7 10	P>N	1 P Dn >1 N Dn
1990	Richness	1 5 7 10	n.s.	n.s.
1991	Density	1 4 7 10	P>N	n.s.
1991	Richness	1 4 7 10	P>N	n.s.
1992	Density	1 4 7 10	n.s.	n.s.
1992	Richness	1 4 7 10	n.s.	n.s.
1993	Density	1 4 7 10	P>N	n.s.
1993	Richness	1 4 7 10	n.s.	n.s.
1994	Density	1 4 7 10	P>N	4 P Up >4 N Up
1994	Richness	1 4 7 10	P>N	4 P Up >4 N Up
1995	Density	1 4 7 10	P>N	4 M Up >4 N UP
1995	Richness	1 4 7 10	n.s.	n.s.

[a] Month (M) numbers underlined are not significantly different. Creek (C) differences are listed as an inequality (P, PA2; N, natural creeks). Significant three-way interactions are limited to those pertaining to the winter (1, 2) or spring (4, 5) months. L, station location; DN, downstream station; Up, upstream location; n.s., not significant.

were typically greater at the downstream stations in each creek.

Species richness (mean total number of species/unit area) showed the same within-year temporal and spatial patterns as described above for total faunal densities. Numbers of species were highest in the winter and fall, and lowest during the summer (Fig. 3B), and fewer species occurred upstream than downstream. However, the pattern of annual variation in species richness differed from that of total density. Species richness attained highest values during 1988 and 1989, but in the succeeding years did not show either the variability or the precipitous decline noted for faunal densities (Fig. 3B vs. A).

Numbers of species in the Project Area were initially lower than the natural creeks, particularly during the summer. However, species richness in both created and natural creeks has remained similar since 1988.

3.3. Community structure

Approximately 50 taxa comprise the infaunal communities of the created and natural creeks (Fig. 4). However, 10 of the 50 taxa accounted for 95% or more of all individuals collected during any year, season, creek, or location within a creek. These taxa consisted of, oligochaetes; the polychaetes *Mediomastus* sp.; *Hobsonia florida* Hartmann; *Laeonereis culveri* Webster; *Capitella* sp.; and *Streblospio benedicti* Webster; chironomid insect larvae; and the amphipod crustaceans *Corophium lacustre* Vanhoffen; *Gammarus tigrinus* Sexton; and *Leptocheirus plumulosus* Shoem. The bivalve *Macoma balthica* L. and the gastropod *Hydrobia* sp. occasionally occurred in high densities in the natural creeks and Project Area 2, respectively. Consequently, differences in community structure among the creeks were derived primarily from temporal and spatial differences in the relative abundance of these species, and not from the absence of particular species.

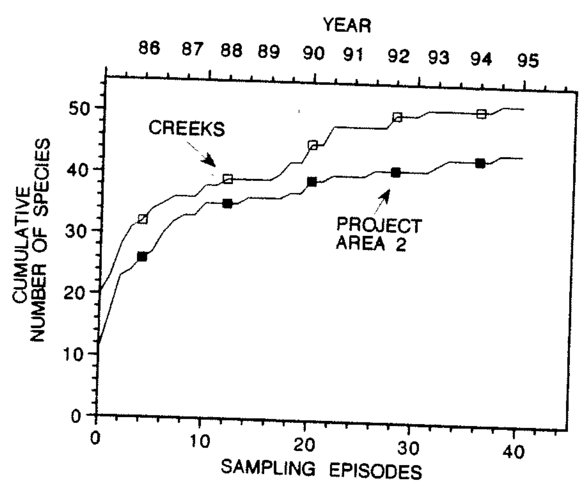


Fig. 4. Cumulative number of taxa collected in Project Area 2 vs. the pooled cumulative number of taxa of the natural creeks during the seasonal sampling schedule ('sampling episodes') between July 1985 and July 1995.

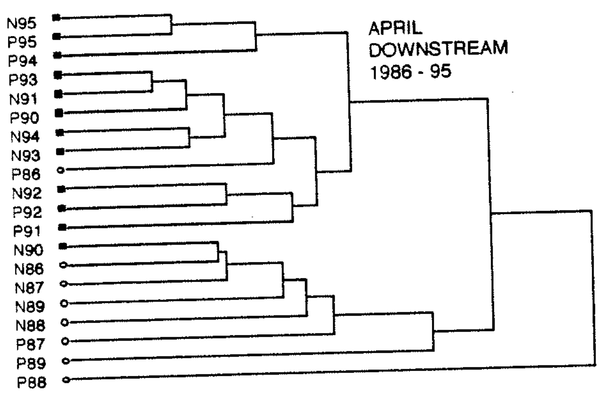


Fig. 5. Cluster analyses of spring infaunal communities of Project Area 2 and the natural creeks between April 1986 and April 1995. Codes indicate creek (*P*, Project Area; N, natural creeks) and year (open symbols, 1986–1989; closed symbols, 1990–1995).

Eight rare taxa were found only in the natural creeks. These taxa were insect larvae (three taxa of unidentified Coleoptera, Diptera), two unidentified crustacean taxa (Isopoda and Cumacea), the crab *Rhithropanopeus harrisii* Gould, and the polychaetes *Glycera dibranchiata* Ehlers and *Neanthes succinea* Frey and Leuckart. These taxa accounted for about 0.06% of the total faunal density for the natural creek fauna.

Cluster analyses of communities during seasons of highest faunal densities and species richness (winter and spring) show strong separation into a 1986–1989 group, and a 1990–1995 group (Fig. 5). This separation reflects the widespread reduction in species densities that occurred between these two time periods, and concomitant changes in the relative abundances of the numerically dominant species. The taxa showing large increases or decreases in relative abundance were virtually the same in the Project Area and the natural creeks. Chironomids, the amphipod *C. lacustre*, and the polychaetes *H. florida* and *S. benedicti* showed large gains in relative abundance, while oligochaetes, the amphipod *L. plumulosus*, and the polychaetes *Mediomastus* sp., and *S. benedicti* showed large declines in relative abundance (Table 3).

3.4. Abiotic variation

Salinity, temperature, and dissolved oxygen (DO) each evinced characteristic seasonal patterns. These patterns were the same in the Project Area and the natural creeks. Salinity usually fell sharply during the spring and rose during the summer to peak in the late fall or early winter (Fig. 6). Temperature was unimodal with a peak in July; values ranged from 6 to $>30°C$. Dissolved oxygen varied inversely with temperature, with typical July values falling well below 25% saturation (West, 1990b; West and Ambrose, 1992).

Salinity also varied greatly among years. Three major episodes of salinity change occurred during the course of the study, resulting in fall–winter salinities exceeding 14 ppt during 1985–1986, 1988–1989, and 1994–1995 (Fig. 6). Late fall and early winter represent peak recruitment times for the infauna in the Project Area and natural Creeks (Ambrose, 1992). Canonical analyses were carried out on the relationship between salinity and infaunal density and species richness. The results did not reveal any important correlations and are therefore not presented here.

3.5. Colonization by aquatic vascular plants

M. spicatum (Eurasian watermilfoil) and *R. maritima* (widgeon grass) were first observed in the Project Area during 1989 and were abundant throughout the Pamlico estuary by 1990. Above-ground biomass of both species rose each spring, crested in June and July, and may have completely disappeared by the early fall (Fig. 7A and B). Biomass of both species was similar in the Drinkwater creek, but *M. spicatum* dominated in Project Area 2 (Fig. 7A vs. B).

Abnormally low DO readings (<1–2 mg/l) became increasingly common during the spring and summer months following the invasion by the submersed aquatic plants, suggesting that the plants were influencing the DO levels. Continuous water quality recorders placed in Drinkwater creek and Project Area 2 during April and May 1995 showed a clear diurnal rhythm in DO concentration (Fig. 7C and D). Concentrations were lowest in the early morning (04:00–09:00) and rose steadily to the highest levels in the evening (17:00–21:00). The magnitude of the oscillation in oxygen content and the variance in diurnal highs and lows were greater during the May series of recordings, particularly in the Project Area (Fig. 7D vs. C). The relatively larger oscillations in DO in the Project Area during May coincided with a two-fold greater increase vascular plant biomass at this site (Fig. 7B vs. A). No diurnal pattern of variability was evident in specific conductivity during the same April and May time periods.

3.6. Features of the benthic sediments

Nearly 70% (by weight) of natural creek sediments consisted of silts and clays (< 0.074 mm), and approximately 30% consisted of sand-sized particles (0.074–0.84 mm; Table 4) in samples collected in 1992. This ratio was nearly reversed in the Project Area, where sand-sized particles accounted for about 60% of the sediment. Comparable particle size distributions were found in samples of natural creek and Project Area 2 sediments collected in 1984 (Craft et al., 1986; Table

Table 3

Changes in the relative abundances of the 12 numerically dominant taxa before (1985–1989) and after (1990–1995) colonization by *Myriophyllum spicatum* and *Ruppia maritima*

Project Area 2	1985–1989	Project Area 2	1990–1995
Taxon	Relative percent	Taxon	Relative percent
Mediomastus sp.	22.6	*Chironomida*	26.9
Hobsonia florida	13.2	*Hobsonia florida*	19.4
Chironomida	10.0	*Capitella* sp.	12.4
Hydrobia sp.	9.9	*Corophium lacustre*	11.3
Oligochaeta	9.4	*Laeonereis culveri*	7.0
Capitella sp.	8.7	*Mediomastus* sp.	4.9
Streblospio benedicti	5.6	*Gammarus tigrinus*	4.6
Laeonereis culveri	5.2	*Oligochaeta*	4.5
Corophium lacustre	3.5	*Polydora ligni*	2.1
Leptocheirus plumulosus	2.5	*Streblospio benedicti*	1.9
Polydora ligni	2.1	*Leptocheirus plumulosus*	1.1
Macoma balthica	2.1	*Macoma balthica*	0.7
Cumulative percent	94.8	Cumulative percent	96.9
Total number of fauna	39 713	Total number of fauna	34 530
Natural creeks	**1985–1989**	**Natural creeks**	**1990–1995**
Taxon	Relative percent	Taxon	Relative percent
Mediomastus sp.	22.8	*Chironomida*	28.3
Oligochaeta	22.6	*Mediomastus* sp.	12.4
Leptocheirus plumulosus	11.3	*Hobsonia florida*	12.2
Capitella sp.	9.6	*Corophium lacustre*	8.2
Hobsonia florida	8.9	*Gammarus tigrinus*	7.0
Chironomida	6.8	*Oligochaeta*	6.9
Streblospio benedicti	6.1	*Capitella* sp.	4.9
Laeonereis culveri	2.9	*Leptocheirus plumulosus*	4.2
Corophium lacustre	1.6	*Laeonereis culveri*	3.3
Macoma balthica	1.4	*Streblospio benedicti*	3.0
Polydora ligni	1.4	*Macoma balthica*	2.7
Macoma phenax	0.7	*Polydora ligni*	1.5
Cumulative percent	96.1	Cumulative percent	94.6
Total number of fauna	88 617	Total number of fauna	56 820

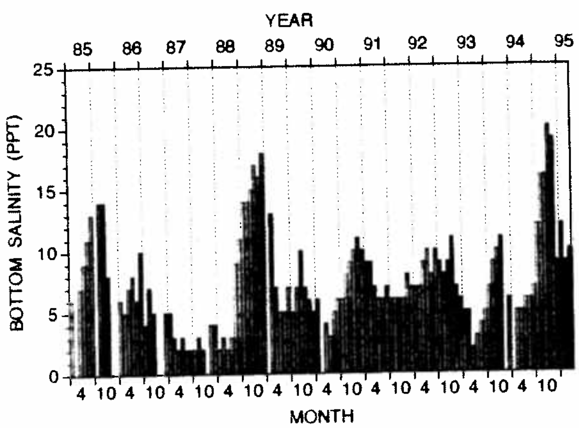


Fig. 6. Temporal variation in bottom salinity of the natural creeks. Samples were taken at approximately monthly intervals between July 1985 and July 1995.

4). Natural sediments also contained large amounts of peat and woody detritus, both of which were absent from the Project Area sediments.

Organic carbon normalized to per g dry weight of sediment was always at least an order of magnitude higher in natural sediments relative to the Project Area sediments (e.g. for the 0–1 cm interval, 13.94% C from Drinkwater creek vs. 0.93% C from Project Area 2 during January 1995; Fig. 8A and C). Samples collected intermittently between 1985 and 1992 showed similar differences in organic carbon levels among the natural creeks and Project Area 2, and the absence of any clear trend of increasing organic carbon content over time for the Project Area sediments (Fig. 9).

Drinkwater creek also contained approximately an order of magnitude more nitrogen than did Project Area 2 (e.g. for the 0–1 cm interval,

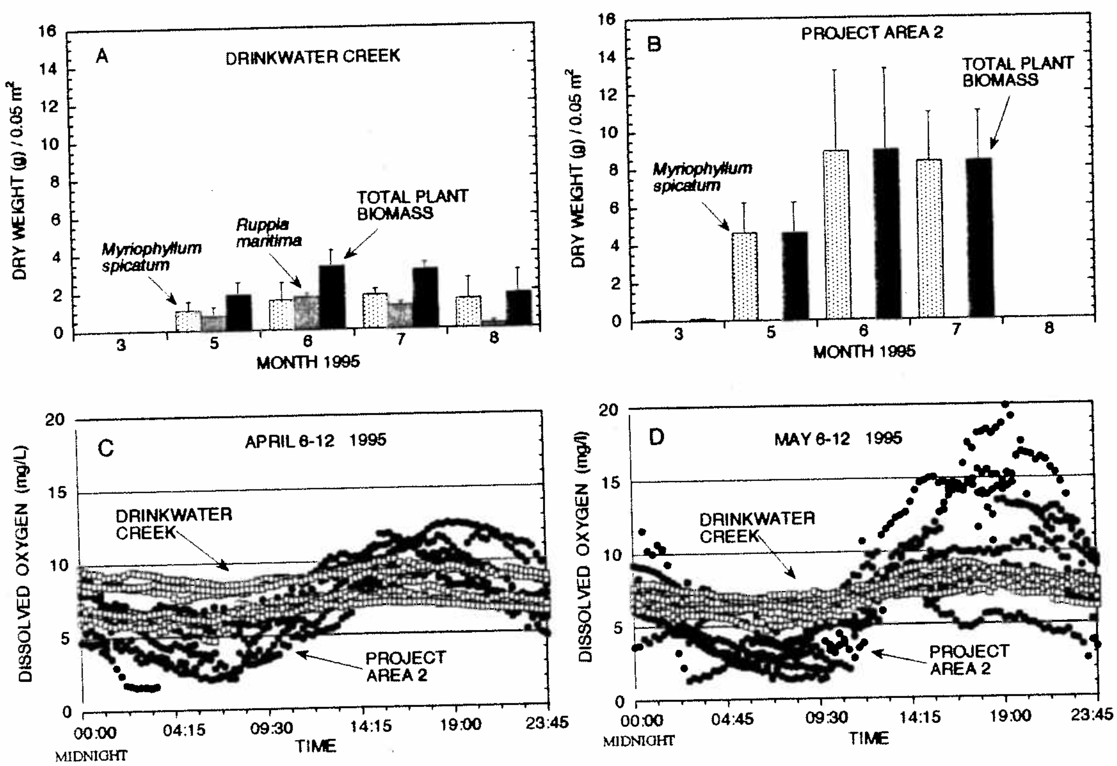


Fig. 7. Seasonal change in biomass of aquatic vascular plants, and diurnal variation in DO concentration, in Project Area 2 and Drinkwater creek. (A) and (B). Individual and combined mean biomass (+ 1 S.E.) of *Ruppia maritima* and *Myriophyllum spicatum* in Drinkwater creek (A) and Project Area 2 (B) during 1995. (C) and (D). Diurnal change in DO during April 1995 (C) and May 1995 (D).

Table 4
Relative percentage (by weight) of grain sizes of the subtidal sediments of Project Area 2 and the natural creeks

Year	Size class (mm)	Upstream creeks	Upstream PA 2	Reference
1984	>0.5 <2.0	5.85	0.48	Craft et al., 1986
	>0.05 <0.5	33.03	72.38	
	<0.05	60.62	27.12	
1992	>2.00	1.3	0.0	This study
	>0.84 <2.00	0.6	0.0	
	>0.074 <0.84	27.0	63.2	
	<0.074	71.8	35.9	

Year	Size class (mm)	Downstream creeks	Downstream PA 2	Reference
1992	>2.00	1.4	0.0	This study
	>0.84 <2.00	0.8	0.0	
	>0.074 <0.84	24.2	59.6	
	<0.074	73.2	41.0	

1.20% N in Drinkwater creek vs. 0.12% in Project Area 2 during January 1995; Fig. 8B and D). Project Area sediment showed the expected downcore decreases in both organic carbon and nitrogen, while organic carbon tended to increase with depth below the sediment–water interface in Drinkwater creek (Fig. 8A and D).

Sediment porosity and dry density also varied between the two locations. Average porosity of the Drinkwater sediments during January 1997 was 0.886, or approximately 90% water (by volume), while the coincident porosity of the Project Area sediments was only 0.673, or approximately 70% water (by volume). In addition, the natural sediments were less dense than the Project Area sediments (1.13 vs. 2.27 g/ml). Thus, in each ml of wet Project Area sediment there were many more particles than there were in each ml of wet Drinkwater sediment.

Normalizing organic carbon and nitrogen values to per g wet sediment has the effect of reducing the magnitude of differences in carbon and nitrogen levels between Drinkwater creek and Project Area 2 sediments relative to the percent dry weight values (Fig. 8E–H). For example, Drinkwater creek sediment contained only about three times the amount of organic carbon of Project Area sediment when normalized to wet volume (e.g. for the 0–1 cm interval, 17.95 vs. 6.87 mgC/ml during January of 1995; Fig. 8E vs. G). Relative differences in organic nitrogen decrease as well (e.g. for the 0–1 cm interval, 1.54 mg/ml for Drinkwater creek vs. 0.89 mg/ml in Project Area 2; Fig. 8F vs. H).

BAP was assessed to provide a better estimate of food quality than total organic carbon and nitrogen, given the large quantities of refractory material (e.g. peat) present in the natural creek sediments. BAP concentration normalized to per g dry sediment in Drinkwater creek was two times greater than in Project Area 2 (1.30 sediment vs. 0.60 mg BAP per g dry; Fig. 10A and B), reinforcing the patterns observed for organic carbon and nitrogen. However, Project Area 2 BAP values normalized to per wet ml of sediment equaled or exceeded those of Drinkwater (1.08 mg BAP per ml wet in Project Area 2 vs. 0.78 mg BAP per ml wet in Drinkwater creek; Fig. 10C and D). Both sites also showed the expected downcore decreases in BAP (Fig. 10).

4. Discussion and conclusions

4.1. Fish growth and survival experiments

The fundamental objective of this work was to determine whether created marshes could be a viable solution to the alteration of wetland and subtidal habitat by phosphate mining operations. A critical test in this regard concerned the capacity of the created habitat to emulate the nursery area functions of the ambient natural oligohaline creeks (Weinstein and Brooks, 1983; Miller et al., 1984; Ross and Epperly, 1985). We have presented two lines of evidence that argue for functional equivalence among the Project Area and the natural creeks. First, Project Area 2 developed an infaunal community of abundance and diversity rivaling that of the natural creeks. Second, growth and survival of spot were similar in the Project Area and the natural creeks.

Evidence of persistence of an infaunal community through time indicates utilization of the habitat in several dimensions, i.e. a place sufficient to permit survival, growth, and reproduction. The same cannot be said for motile fauna such as fish that use the habitat when conditions are favorable, but migrate elsewhere as conditions decline. Some form of direct assessment in addition to population surveys is therefore needed to evaluate utilization by the fish community, and we suggest experimentation is needed to accurately assess

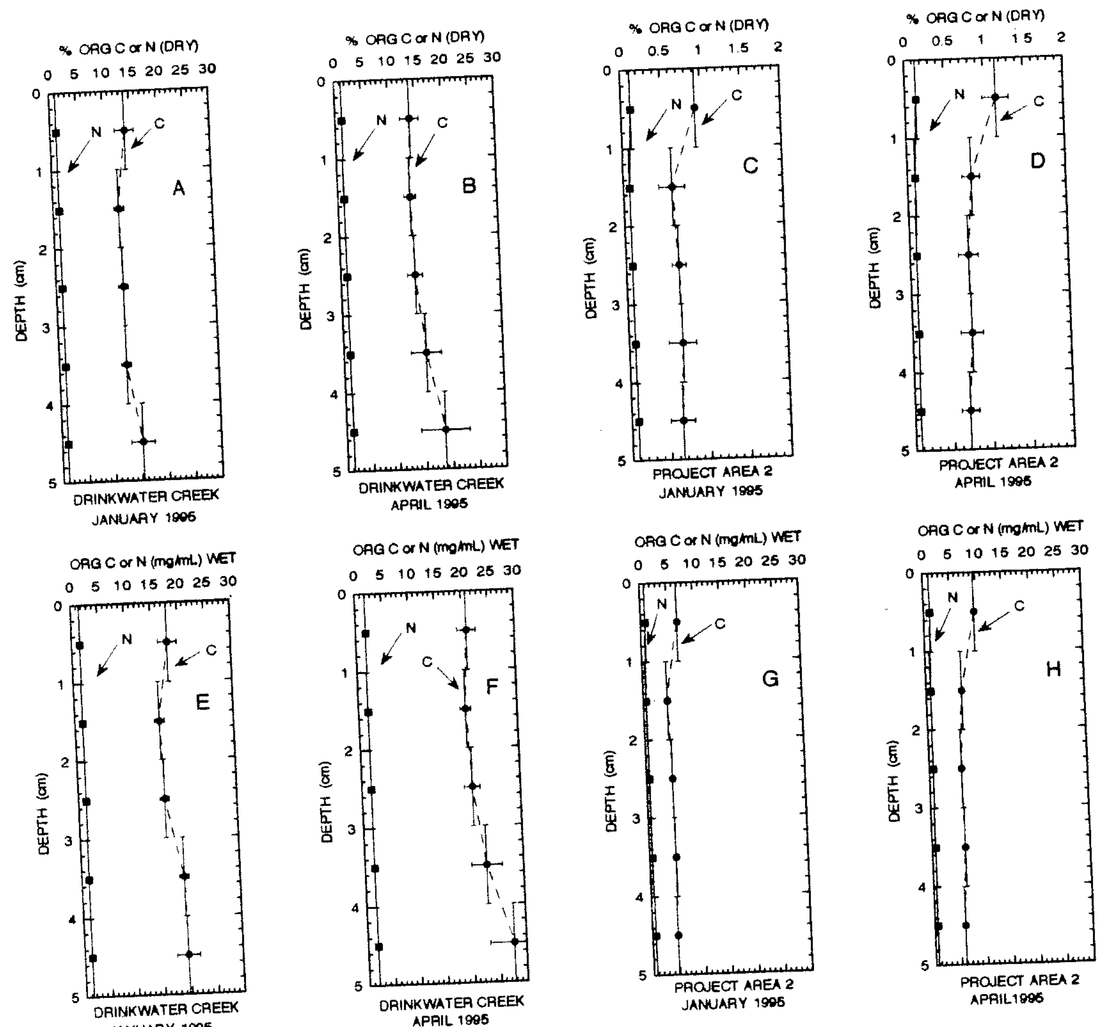


Fig. 8. Downcore distributions of organic carbon and total nitrogen. (A)–(D). Downcore concentrations expressed on a percent dry weight basis. Note order of magnitude differences in values for Drinkwater creek (A and B) and Project Area 2 (C and D). (E)–(H). Downcore concentrations of organic carbon and total nitrogen expressed as mg/ml wet weight sediment. Note that all values are on the same scale. Horizontal bars are +/− 1 S.D., vertical error bars indicate sampling depth interval.

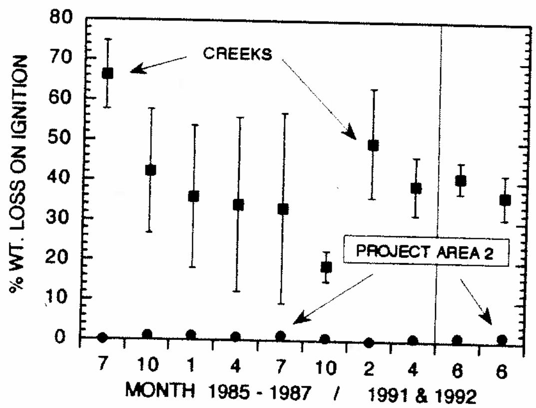


Fig. 9. Loss on ignition estimates of total organic carbon content of downstream sediments from Project Area 2 and the natural creeks. Values are mean + 1 S.D.

function from the perspective of this motile community.

Our fish growth experiments utilized enclosures to retain marked fish that could later be censused for measurements of growth. However, the presence of an enclosure can also alter the physical environment by reducing current flow and trapping sediment (Virnstein, 1977), acting as an attachment site for fouling organisms, and serving as a refuge for small crustacean predators (Peterson, 1979). These particular artifacts should be sensitive to some aspect of cage size (e.g. bottom surface area enclosed, cage surface area or volume), and we accordingly used enclosures of different diameter in an attempt to control for these artifacts. We found that a cage effect was important in fish growth but not survival. The effect was limited to the May experiment and was largely the result of an outlier in one of the small cages in Jacobs creek; therefore, it does not significantly detract from basic inference that all of

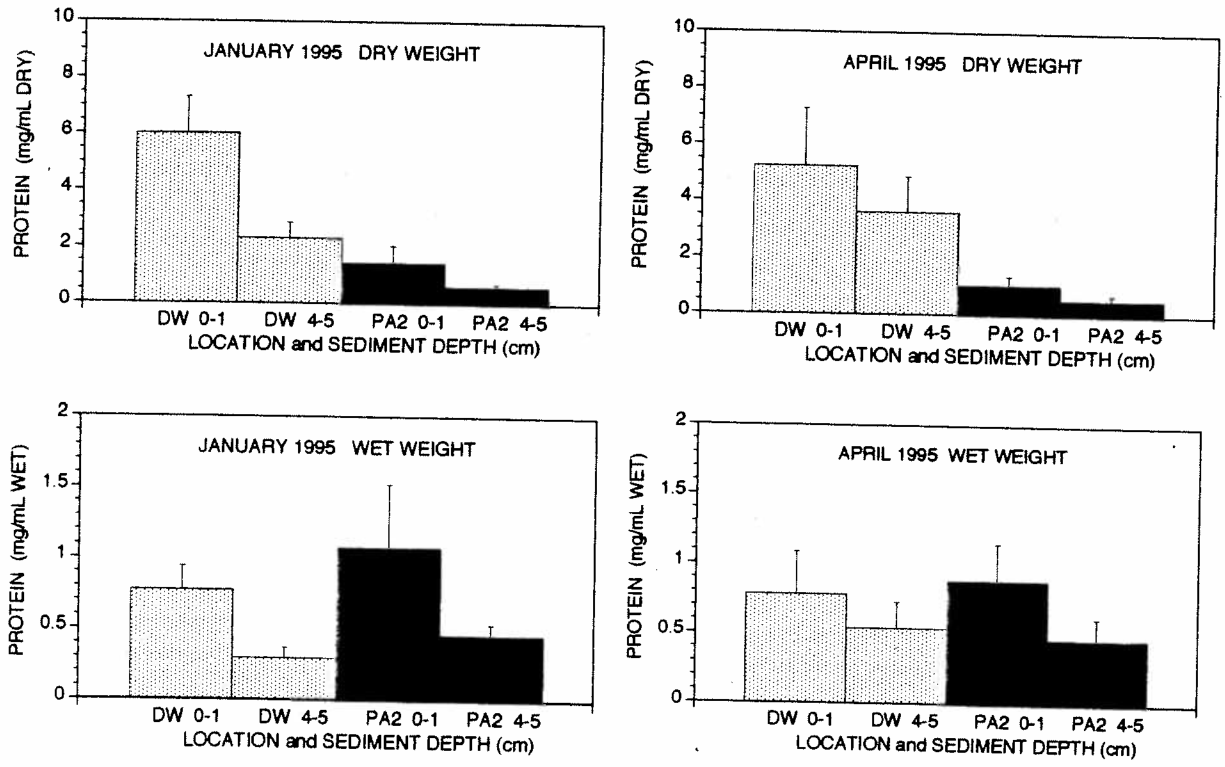


Fig. 10. Concentration of BAP in the surface interval (0–1 cm depth) and bottom interval (4–5 cm depth) of sediment cores taken from Project Area 2 and Drinkwater creek. (A)–(B). Concentrations of BAP expressed as mg/g dry weight. (C)–(D). Concentrations of BAP expressed as mg/ml wet sediment.

the creeks demonstrated a similar capacity to support the growth of *L. xanthurus*.

Enclosures may not accurately mimic normal competitive and predatory pressures encountered in the natural environment. We had no direct control for this kind of artifact. Growth of caged *L. xanthurus* equaled or exceeded that estimated for wild *L. xanthurus* trawled at comparable time intervals during the same months of the year. Our estimates of growth of wild *L. xanthurs* may not reflect true growth rates if foraging success and survival of juvenile *L. xanthurus* are size-dependent. However, the density of fish in the enclosures was within the range of natural densities (Rulifson, 1991), and there is no evidence of food limitation of juvenile spot in the Pamlico River estuary (Currin et al., 1984). We conclude that the use of the enclosures permitted a valid estimate of the relative ability of the created site and the natural creeks to support the growth of *L. xanthurus*.

4.2. Importance of time

The current work represents one of the longest continuous monitoring programs of a created or restored estuarine habitat (Zedler, 1988; Simenstad and Thom, 1996). The duration of the study is important in developing an accurate portrait of the faunal community. Numerically dominant species characteristic of the oligohaline environment were evident within the first 3 years of the study, and the continued increase in the species pools with time reflected the addition of rare species.

A more salient feature of time is the necessity to have a study duration be sufficient for the site to be exposed to a representative range of stochastic biotic and abiotic events characteristic of the local ecosystem, particularly those that constitute a potential stress to the biota. The long duration of this research has provided us with the opportunity to assess the response of the Project Area to both abiotic (salinity) and biotic (colonization by *M. spicatum* and *R. maritima*) stressors.

The magnitude of annual variation in salinity occurring during this work equaled that observed in the Pamlico River estuary during the past 20 years (Stanley, 1988). While it is evident that both the Project Area and the natural creeks responded similarly to salinity change, our understanding of the impact of salinity on community structure remains incomplete. Multivariate analyses of salinity and infaunal species did not explain more than 30% of the variation in abundance of any species, due to the persistent high variability in species densities. Similar results were also obtained for the relationship between salinity and abundance of ichthyofauna in other subtributaries of the Pamlico River estuary (West and Ambrose, 1992).

In contrast, the invasion by *M. spicatum* and *R. maritima* was accompanied by large and persistent reductions in faunal densities, and to a lesser extent, in species richness. The magnitude and character of these changes were similar in the Project Area and the natural creeks. The nature of the relationship between these plants and the infaunal community is unclear. It is possible that the plants affect the infauna indirectly by influencing water quality. Seasonal increases in plant biomass were accompanied by increasing diurnal variation in DO levels, and this phenomenon was most pronounced in the creek with the greatest plant biomass (Project Area 2). The smaller water volume of the Project Area, and the absence of significant water movement between it and south creek (as indicated by static water depth) may also have contributed to the more extreme fluctuations in DO observed at the Project Area.

Mortality of infauna could have resulted directly from exposure to hypoxia or to supersaturated levels of dissolved gases (see Au-Spearde, 1991), or indirectly from increased susceptibility to predation as infauna moved to the sediment surface in response to the low oxygen levels (Pihl et al., 1991, 1992). This interaction between the creek flora, water quality, and infauna could account for the low faunal densities in the summer, but not for the lowered densities during the winter when plant biomass is negligible.

4.3. Features of the benthic sediments

The sediments of the Project Area lacked the woody detrital covering, large peat component, and the predominance of silt and clay that characterized the natural creek sediments. Furthermore, there was no evidence of a trend in accretion of these materials in the Project Area during the 10 years of the study.

The persistent similarity of the species composition of the infaunal communities in the Project Area and the natural creeks suggests that gross features of the sediments such as grain size distribution, surface topography, and total organic carbon levels do not play key roles in the distribution of the species that dominate oligohaline sediments. Most of these species are widely distributed and are among the first to colonize new habitat (Tenore, 1972b; Santos and Simon, 1980; Marsh and Tenore, 1990). They are also prone to dramatic fluctuations in population size (Boesch et al., 1976), associated with sediments of high organic carbon content (Snelgrove and Butman, 1994), and occur in high densities in eutrophic and other stressed environments (Tenore, 1972b; Snelgrove and Butman, 1994; Grall and Glemarec, 1997).

The association of oligohaline fauna with organic-rich sediments and the order of magnitude greater concentrations of carbon and nitrogen in Drinkwater creek versus Project Area 2 might have led us to predict greater infaunal densities in the natural creek. However, faunal densities have proven to be consistently similar, not different. This apparent paradox suggests that (1) food is not limiting in either environment, or (2) measurements of total organic carbon and nitrogen do not accurately represent what actually constitutes food for the infauna.

At the present time, we cannot distinguish between these two hypotheses. In support of the first, a concentration of 1% organic carbon is certainly high compared with other regions of the world's oceans that are known to support infaunal populations (e.g. Lopez and Levinton, 1987). Direct manipulation of organic carbon concentration is needed to assess if and when food limitation occurs. In support of the second, we argue that the data obtained for BAP (but not organic C or N) negates the apparent paradox when considered on a per wet volume basis.

Inclusion of additional estimates of labile food quantities such as microbial and algal biomass will help to further refine our hypothesis that organic carbon does not accurately predict infaunal success in created oligohaline habitats. One possible solution is to use total organic carbon and nitrogen measurements as estimates of gross food quantity (i.e. if carbon contents are > 1% infaunal populations should not be food limited), and more specific estimates of labile food sources such as BAP as estimates of food quality.

We emphasize the utility of collecting porosity data and food evaluations simultaneously. Normalizing to wet volume instead of dry weight allowed the observation that BAP concentration is actually higher in the restored habitat. This result was obtained because the sediments in the created and natural creeks were physically dissimilar. Currently the decision to normalize to wet volume or dry weight varies arbitrarily in accordance with the particular technique used to measure food quantity. For example, pigment concentrations are traditionally reported on a per wet volume basis, while organic carbon and nitrogen data are reported on a per dry weight basis. This problem is compounded because comparisons between these different data sets are routinely made as a part of habitat assessments. We accordingly recommend including porosity in all investigations of sedimentary food quality, enabling each investigator to normalize to either wet volume or dry weight as appropriate.

In view of the similarities in community structure between Project Area 2 and the natural creeks, we argue that the BAP normalized to per volume wet sediment more accurately represents true food availability in created and natural systems than does total carbon or nitrogen. We are currently investigating this hypothesis in both oligohaline and polyhaline habitats.

4.4. Functional equivalency and limitations of the study

Evidence accumulated to date for Project Area 2 on wetland vascular plant productivity (Broome et al., 1986; Broome, 1989), ichthyofauna (Rulifson, 1991), and benthic infauna (this study) contends that it supports nursery area functions and responds to local ecological processes in a manner similar to the natural creeks. These findings contrast with most of the other restoration work carried out in estuarine systems (Moy and Levin, 1991; Sacco et al., 1994; Simenstad and Thom, 1996).

The 'success' of the Project Area may be linked to four aspects of its location. First, the created habitat is surrounded by the aquatic environs it was intended to mimic, thereby providing proximity to sources of infaunal recruits (Cammen, 1976; Christensen, et al., 1996). Second, the Project Area and the adjacent natural creeks are part of a large expanse of undeveloped habitat (South creek) and therefore are remote from municipal (but not agricultural) anthropogenic influences known to impede restoration efforts (Zedler, 1988; Simenstad and Thom, 1996). Third, it is a non-tidal habitat and therefore not as subject to sedimentary erosional forces as are restored intertidal projects (Simenstad and Thom, 1996).

Finally, and perhaps most importantly, the oligohaline ecosystem of which the Project Area is a part is characterized by intensely variable abiotic factors (temperature, salinity, DO). This variability evidently limits faunal diversity to a small subset of resilient eurytolerant estuarine taxa (Boesch et al., 1976). The number of taxa collected in the Project Area and natural creeks is half to one-tenth that reported for polyhaline areas of North Carolina estuaries (Cammen, 1976; Chester et al., 1983; Summerson and Peterson, 1984; West, 1985, 1990b) and of other Atlantic coast estuaries (Watling, 1975; Virnstein, 1977). Population dynamics of this oligohaline system appear to be driven primarily by these abiotic factors, especially hypoxia or anoxia (Tenore, 1972b; West and Ambrose, 1992), and the majority of the taxa are short-lived, prolific, deposit-feeding opportunists that rapidly invade new or disturbed habitats (Grall and Glemarec, 1997; Sheridan, 1997). As a result, these oligohaline infaunal communities probably never reach a stable state before a seasonal disturbance initiates a new round of recruitment. Therefore, from the perspective of infaunal community structure, mitigation is likely to be more successful in oligohaline areas than in areas of more constant and benign abiotic factors, because the organisms in oligohaline regions are more tolerant of the disturbance inherent in the process of habitat creation and restoration.

A caveat to inferences of functional equivalency discussed above for the Project Area 2 is the limitation imposed by reliance on that single site as the primary basis for our comparisons of structural and functional attributes of local created and natural oligohaline creeks. A second site exists (Project Area 1), but was not included in the analyses because the data for Project Area 1 are limited to descriptions of the infaunal community, and are confined to a relatively small time period (1991–1994) beginning about 10 years after the site was created.

The lack of replication of created or restored habitats is a general feature of mitigation research, and has several causes. First, space for a mitigation site may be limited due to a history of extensive development, such as urban areas and properties with waterfront access (Clark, 1989; Willard and Hiller, 1989). Mitigation efforts at these sites may encounter an additional difficulty if development has proceeded to the point where no undisturbed reference habitats remain, and the original ecological functions of these habitats are not fully understood (Zedler, 1996). Second, experimental design concerns such as site replication may not be required to be addressed in the planning and permitting procedures. Mitigation planning has often been poorly organized, ad hoc, and lacking in appropriate, standardized guidelines for construction and assessment (Clark, 1989; Garbisch, 1989). State agencies need to develop a strategic vision of environmental protection, and the administrative means to implement it. Third, replication is not included in the project design because mitigation efforts can be costly. The cost can be high because the permitting process is time consuming, land is expensive, construction is labor intensive, and planning, monitoring, and assessment require special skills. Estimates of the cost of constructing and monitoring Project Area 2 exceed one million dollars (NCPC staff, pers. commun.).

Finally, mitigation plans have had the objective of building a site in such a way as to maximize its potential for success. Thus, there has been reluctance to systematically vary physical or biological features of a site in order to determine their respective importance in the outcome of the mitigation process (e.g. size of watershed; ratio of marsh surface to water surface area; amount and character of detrital cover) (e.g. Pacific Estuarine Research Laboratory, 1990). Similarly, reliance on single mitigation sites does not permit assessment of site performance relative to known key abiotic and biotic variables that vary in kind and intensity along a spatial gradient (e.g. Brinson and Rheinhardt, 1996). All of these concerns combine to complicate the interpretation of the results, limit the ability to make accurate predictions about the probability of success (or failure) of future mitigation efforts, and impede our understanding of the critical mechanisms governing successful habitat creation, restoration, and enhancement. We accordingly emphasize the importance of including appropriate experimental design in the all phases of the mitigation process.

Acknowledgements

This work was supported in its entirety by North Carolina Phosphate Corporation, Texasgulf Chemicals, Inc., and PCS Phosphate (Aurora, NC). Of the legion of technicians that carried out the work, we are especially indebted to the efforts of Ken Sholar, David Bronson, William Bell, Page Faulkner, Scott Wood, Jean Thomson, and Rainey Eason. Dr Steven Ross was kind enough to loan us the YSI continuous water quality recorders during 1995. We also are grateful for the helpful criticisms of two anonymous reviewers, and the editing provided by the NOAA staff at the Coastal Services Center, office.

References

Ambrose Jr., W.G., 1992. Macroinfaunal colonization in natural and man-made wetlands. Annual Report to Texasgulf Chemicals, Inc. 40 pp.

Ambrose Jr., W.G., Renaud, P.E., 1996. Macrofaunal colonization of natural and man-made wetlands. Annual Report to Texasgulf Chemicals, Inc. 59 pp.

Au-Spearde, D.J., 1991. Endothelial lesions associated with gas bubble disease in fish. J. Comp. Pathol. 104, 327–335.

Boesch, D.F., Wass, M.L., Virnstein, R.W., 1976. The dynamics of estuarine benthic communities. In: Wiley, M. (Ed.), Estuarine Processes. Uses, Stresses, and Adaptation to the Estuary, vol. 1. Academic Press, New York, pp. 177–196.

Brinson, M.M., Rheinhardt, R., 1996. The role of reference wetlands in functional assessment and mitigation. Ecol. Appl. 6, 69–76.

Broome, S.W., 1989. Creation and restoration of tidal wetland of the southeastern United States. In: Kusler, J.A., Kentula, M.E. (Eds.), Wetland Creation and Restoration: The Status of the Science. US Environmental Protection Agency/600/3-89/038, pp. 37–72.

Broome, S.W., Seneca, E.D., Woodhouse, W.W., 1986. Long-term growth and development of transplants of the salt-marsh grass *Spartina alterniflora*. Estuaries 9, 63–74.

Cammen, L., 1976. Macroinvertebrate colonization of *Spartina* marshes artificially established on dredge spoil. Estuar. Coast. Mar. Sci. 4, 357–372.

Chester, A., Ferguson, R., Thayer, G., 1983. Environmental gradients and benthic macroinvertebrate distributions in a shallow North Carolina estuary. Bull. Mar. Sci. 33, 282–295.

Christensen, N.L., Bartuska, A.M., Brown, J.H., Carpenter, S.C., D'Antonio, C., Francis, R., Franklin, J.F., MacMahon, J.A., Noss, R.F., Parsons, D.J., Peterson, C.H., Turner, M.G., Woodmansee, R.G., 1996. The report of the Ecological Society of America Committee on the scientific basis for ecosystem management. Ecol. Appl. 6, 665–691.

Clark, J.R, 1989. Regional aspects of wetland restoration and enhancement in the urban waterfront environment. In: Kusler, J.A., Kentula, M.E (Eds.), Wetland Creation and Restoration: The Status of the Science. Perspectives, vol. II. EPA/600/3-89/038, US EPA Environmental Research Lab, Corvallis, OR, pp. 85–103.

Currin, B.M., Reed, J.P., Miller, J.M., 1984. Growth, production, food consumption, and mortality of juvenile spot and croaker: a comparison of tidal and non-tidal nursery areas. Estuaries 7, 451–459.

Craft, C.B., Broome, S.W., Seneca, E.D., 1986. Carbon, nitrogen and phosphorus accumulation in man-initiated marsh soils. In: Amoozegar, A. (Ed.), Proceedings of the 29th Annual Meeting of Soil Science Society North Carolina. Soil Science Society of North Carolina, Raleigh, NC, pp. 117–131.

Folk, R.L., 1968. Petrology of Sedimentary Rocks. Hemphill, Austin, TX, p. 120.

Garbisch, E.W., 1989. Information needs in the planning process for wetland creation and restoration. In: Kusler, J.A., Kentula, M.E. (Eds.), Wetland Creation and Restoration: The Status of the Science. Perspectives, vol. II. EPA/600/3-89/038, US EPA Environmental Research Lab, Corvallis, OR, pp. 9–13.

Grall, J., Glemarec, M., 1997. Using biotic indices to estimate macrobenthic community perturbations in the Bay of Brest. Estuar. Coast. Shelf. Sci 44 (Suppl. A), 43–53.

Lopez, G.R., Levinton, J.S., 1987. The ecology of deposit-feeding animals in marine sediments. Q. Rev. Biol. 62, 235–260.

Marsh, A.G., Tenore, K.R., 1990. The role of nutrition in regulating the population dynamics of opportunistic, surface deposit feeders in a mesohaline community. Limnol. Oceanogr. 35, 710–724.

Mayer, L.M., Schick, L.L., Setchell, F.W., 1986. Measurement of protein in nearshore surface sediments. Mar. Ecol. Prog. Ser. 30, 159–165.

Miller, J.M., Reed, J.P., Pietrafesa, L.J., 1984. Patterns, mechanisms, and approaches to the study of migrations of estuarine-dependent fish larvae and juveniles. In: Mc-Cleave, J.D., Arnold, G.P., Dodson, J.J., Neill, W.H. (Eds.), Mechanisms of Migration in Fishes. Plenum Press, New York, pp. 209–225.

Mitsch, W.J., Wilson, R.F., 1996. Improving the success of wetland creation and restoration with know-how, time, and self-design. Ecol. Appl. 6, 77–83.

Moy, L.D., Levin, L.A., 1991. Are *Spartina* marshes a replaceable resource? A functional approach to evaluation of marsh creation efforts. Estuaries 14, 1–16.

North Carolina Phosphate Corporation, 1982. Wetlands mining and mitigation: A supplemental environmental impact report. NCPC, Beaufort County, NC.

Pacific Estuarine Research Laboratory, 1990. A manual for assessing restored and natural coastal wetlands with examples from southern California. California Sea Grant Report No. T-CSGCP-021, La Jolla, CA, 105 pp.

Peterson, C., 1979. Predation, competitive exclusion, and diversity in the soft-sediment benthic communities of estuaries and lagoons. In: Livingston, R. (Ed.), Ecological Processes in Coastal and Marine Systems. Plenum Press, New York, pp. 223–264.

Pietrafesa, L., Janowitz, G., Chao, T., Weisberg, R., Askari, F., Noble, E., 1986. The physical oceanography of pamlico sound. University of North Carolina Sea Grant Working Paper Publication No. 86-5, Raleigh, NC, 125 pp.

Pihl, L., Baden, S., Diaz, R.J., 1991. Effects of periodic hypoxia on distribution of demersal fish and crustaceans. Mar. Biol. 108, 349–360.

Pihl, L., Baden, S., Diaz, R.J., Schaffner, L.C., 1992. Hypoxia-induced structural changes in the diet of bottom-feeding fish and crustacea. Mar. Biol. 112, 349–361.

Race, M.S., Fonseca, M.S., 1996. Fixing compensatory mitigation: what will it take? Ecol. Appl. 6, 94–101.

Ross, S., Epperly, S., 1985. Utilization of shallow estuarine nursery area by fishes in Pamlico Sound, North Carolina, and adjacent tributaries. In: Yanez Arancibia, A. Jr (Ed.), Fish Community Ecology in Estuarine and Coastal Lagoons: Toward an Ecosystem Integration. Universidad Nacional Autonoma de Mexico, Mexico, pp. 207–232.

Rulifson, R.A., 1991. Finfish utilization of man-initiated and adjacent natural creeks of South creek estuary, North Carolina, using multiple gear types. Estuaries 14, 447–464.

Sacco, J.N., Seneca, E.D., Wentworth, T., 1994. Infaunal community development of artificially established salt marshes in North Carolina. Estuaries 17, 489–500.

Santos, S.L., Simon, J.L., 1980. Response of soft-bottom benthos to annual catastrophic disturbance in a south Florida estuary. Mar. Ecol. Prog. Ser. 3, 347–355.

Schink, J.C., Stockwell, J.H., Ellis, R.A., 1979. An improved device for gassometric determination of carbonate in sediment. J. Sed. Petrol. 49, 651–653.

Sheridan, P., 1997. Benthos of adjacent mangrove, seagrass, and non-vegetated habitats in Rookery Bay, Florida, USA. Estuar. Coast. Shelf. Sci. 44, 455–469.

Simenstad, C.A., Thom, R.M., 1996. Functional equivalency trajectories of the restored Gog-Le-Hi-Te estuarine wetland. Ecol. Appl. 6, 38–56.

Snelgrove, P.V.R., Butman, C.A., 1994. Animal–sediment relationships revisited: cause versus effect. Ann. Rev. Oceanogr. Mar. Biol. 32, 111–177.

Stanley, D., 1988. Water quality in the Pamlico River estuary, 1967–1986. Institute for Coastal and Marine Resources, East Carolina University, Technical Report 88-01, 199 pp.

Summerson, H., Peterson, C., 1984. Role of predation in organizing benthic communities of a temperate-zone seagrass bed. Mar. Ecol. Prog. Ser. 15, 63–77.

Tenore, K., 1972a. The importance of predation by crabs and fishes on benthic infauna in Chesapeake Bay. Ecology 58, 1199–1217.

Tenore, K., 1972b. Macrobenthos of the Pamlico River estuary, North Carolina. Ecol. Monogr. 42, 51–69.

Virnstein, R., 1977. The importance of predation by crabs and fishes on benthic infauna in Chesapeake Bay. Ecology 58, 1199–1217.

Watling, L., 1975. Analysis of structural variations in a shallow estuarine deposit-feeding community. J. Exp. Mar. Biol. Ecol. 19, 275–313.

Weinstein, M.P., Brooks, H.A., 1983. Comparative ecology of nekton residing in a tidal creek and adjacent seagrass meadow: community composition and structure. Mar. Ecol. Prog. Ser. 12, 15–27.

West, T.L., 1985. Abundance and diversity of benthic macrofauna in subtributaries of the Pamlico River estuary. J. Elisha Mitchell Sci. Soc. 101, 142–159.

West, T.L., 1990a. Growth and survival of *Leiostomus xanthurus* (spot) in man-made and natural wetlands. Annual report to Texasgulf Chemicals, Inc. Aurora, NC, 30 pp.

West, T. L., 1990b. Benthic invertebrate utilization of man-made and natural wetlands. Annual report to Texasgulf Chemicals, Inc. Aurora, NC, 100 pp.

West, T.L., Ambrose, W.G. Jr, 1992. Abiotic and biotic effects on population dynamics of oligohaline benthic invertebrates. In: Colombo, G., Ferrari, I., Ceccherelli, V., Rossi, R. (Eds.), Marine Eutrophication and Population Dynamics. Twenty-fifth European Marine Biology Symposium. Olsen and Olsen, Fredensborg, Denmark, pp. 189–194.

Willard, D.E., Hiller, A.K., 1989. Wetland dynamics: considerations for restored and created wetlands. In: Kusler,

J.A., Kentula, M.E. (Eds.), Wetland Creation and Restoration: The Status of the Science. Perspectives, vol. II. EPA/600/3-89/038, US EPA Environmental Research Lab, Corvallis, OR, pp. 47–54.
Zedler, J.B., 1988. Salt marsh restoration: lessons from California. In: Cairns, J. (Ed.), Rehabilitating Damaged Ecosystems, vol. 1. CRC Press, Boca Raton, FL, USA, pp. 123–138.
Zedler, J.B., 1996. Ecological issues in wetland mitigation: an introduction to the forum. Ecol. Appl. 6, 33–37.

ELSEVIER

Ecological Engineering 15 (2000) 303–321

ECOLOGICAL ENGINEERING

www.elsevier.com/locate/ecoleng

Assessment of function in an oligohaline environment: Lessons learned by comparing created and natural habitats

Terry L. West [a,*], Lisa M. Clough [a], William G. Ambrose Jr [b]

[a] Department of Biology, East Carolina University, Greenville, NC 27858, USA
[b] Biology Department, Bates College, Lewiston, ME 04240, USA

Received 12 December 1998; accepted 10 March 2000

Abstract

Assessments of nursery area function were carried out over a 10-year period in a 3-ha oligohaline marsh and creek system ('Project Area 2') and four natural 'control' creeks (Drinkwater, Jacks, Jacobs, and Tooley) located in the Pamlico River estuary, North Carolina. Habitat function was assessed by comparing (1) growth and survival of fish; (2) long-term monitoring of water quality, sediment organic carbon, and the benthic infaunal community; and (3) measurement of benthic food availability. Growth (weight gain) and survival of the fish *Leiostomus xanthurus* held within enclosures were similar in both created and natural habitats. Species composition, total fauna density, and species richness of the infaunal community of the Project Area and the natural creeks were comparable within 3 years after construction of the Project Area. However, the sediments of the Project Area lacked the woody detrital cover, high peat content, and predominance of silt and clay characteristic of the natural creek sediments. There was no evidence of significant accretion of total organic carbon in the Project Area during the course of the study. This study has heuristically inspired four recommendations concerning assessment criteria of mitigation success. (1) Direct experimentation is needed to assess habitat function for motile species such as fish. (2) Studies of community structure need to be carried out long enough to permit testing of community stability, especially when working in areas exposed to stochastic abiotic and biotic stressors. (3) Measurements of nutritional content of the sediments should include estimates of overall organic quantity and nutritional quality. (4) Site design or restoration techniques should be included in the experimental design of each mitigation effort. Specifically, the lack of replication in these aspects of the mitigation process limits the inferential potential of the study, constrains the ability to make accurate predictions about the probability of success of future mitigation endeavors, and impedes our understanding of the critical mechanisms governing successful habitat creation, restoration, and enhancement.

Keywords: Mitigation; Oligohaline; Fish; Benthic infauna; Sediment; Organic carbon; Biological protein

1. Introduction

Increasing development of wetlands and coastal areas in the United States during the past 20 years

* Corresponding author. Tel.: + 1-252-3281845; fax: + 1-252-3284178.
E-mail address: westt@mail.ecu.edu (T.L. West).

0925-8574/00/$ - see front matter
PII: S0925-8574(00)00083-5

has fueled concerns about the ecological consequences of the reduction of biodiversity and loss of critical habitats. Coincident with this increasing development has been a growth in the knowledge of, and applied efforts toward, restoring damaged or altered habitats, and creating new habitats to compensate for those lost to human activities (Zedler, 1988; Race and Fonseca, 1996).

Efforts to remediate habitat alteration or loss have met with mixed results with 'failures' and inconclusive efforts greatly outnumbering 'successes'. The lack of success in mitigation has resulted from (1) improper construction or implementation of mitigation efforts; (2) non-compliance with permitting goals, objectives, and guidelines; (3) insufficient time frame for monitoring; (4) inadequate knowledge of forces structuring natural communities; and (5) inadequate knowledge of local ecosystem function (Zedler, 1988, 1996; Mitsch and Wilson, 1996; Race and Fonseca, 1996).

Such 'failures' have taught that criteria for determining 'success' of habitat remediation may focus on inadequate measures of the salient ecological processes that drive spatial and temporal change in the natural communities. Success is generally viewed in terms of a system's biological viability and sustainability. Indices of success commonly include species lists and measures of abundance, biomass or percent cover over time, sedimentary features (e.g. concentrations of organic carbon and nitrogen, porosity, chlorophyll, grain size), and measures of relevant abiotic variables (temperature, dissolved oxygen, salinity for aquatic systems). These indices have been favored because they are simple and relatively inexpensive to carry out, but they have been subject to criticism because the sampling may have been occasional, of short overall duration, and with little evidence of prior knowledge of the most ecologically suitable timing; moreover, the indices themselves may not be sufficient tests of ecosystem function (Mitsch and Wilson, 1996).

In this paper, we present both experimental and correlative work that (1) links traditional success criteria of (a) patterns of species abundance and (b) sedimentary organic carbon levels with habitat function; and (2) evaluates the importance of time as an element of mitigation research. All work was carried out during 1985–1995 in four natural and one created non-tidal oligohaline subtributaries of the Pamlico River estuary, North Carolina, USA. We link patterns of faunal abundance with habitat function by comparing the capability of natural and created habitats to support the growth of fish (*Leiostomus xanthurus* Lacepede) that prey on resident benthic invertebrate infauna (Tenore, 1972a; West and Ambrose, 1992). We evaluate the utility of sedimentary organic carbon as a predictor of habitat viability by comparing infaunal abundance and two separate measures of putative food availability; total organic carbon and nitrogen, and 'biologically available protein' (BAP). We assess the role of time by delineating the influence of 'predictable' periodic stressors (salinity) and novel stressors (invasion by the vascular plants *Myriophyllum spicatum* L. [Eurasian watermilfoil], and *Ruppia maritima* L. [widgeon grass]) on infaunal community structure.

2. Methods

2.1. Site description

All work was carried out in a single created 3-ha oligohaline marsh ('Project Area 2') and four adjacent natural oligohaline creeks (Drinkwater, Jacks, Jacobs, and Tooley) located in the Pamlico River estuary, North Carolina (Fig. 1). Project Area 2 is about half to one-fourth the area of the natural creeks (Table 1, North Carolina Phosphate Corporation, 1982). The land converted to the Project Area was originally a lowland forest of mixed hardwoods identical to those that border the undeveloped subtributaries of the Pamlico River estuary. The Project Area was constructed during 1980–1981 by North Carolina Phosphate Corporation. Four species of emergent vascular plants (*Juncus roemarianus* Scheele, *Spartina patens* (Aiton) Muhl., *Spartina cynosuroides* (L.) Roth, and *Spartina alterniflora* Loisel) were planted during 1981. In 1983, the earthen dam

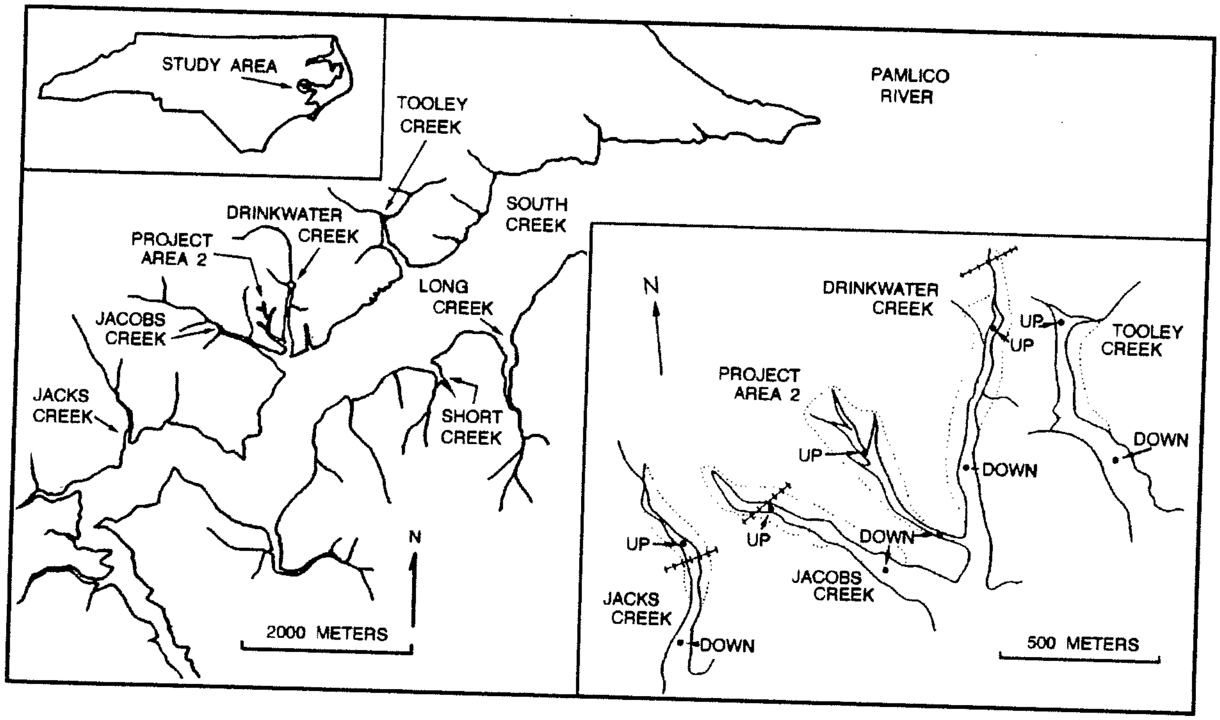


Fig. 1. Location of the sampling stations (upstream, downstream), Project Area 2, and the natural 'control' creeks (Tooley, Drinkwater, Jacobs, Jacks) in the Pamlico River estuary, North Carolina.

was removed that separated the Project Area from the confluence of Drinkwater and Jacobs creeks.

2.2. Water quality

Bottom temperature, salinity, and dissolved oxygen were measured with Yellow Springs Instruments recorders. Water quality measurements were taken at approximately monthly intervals throughout the study period. Water depths ranged from 0.3 to 1.8 m depending upon sampling station (upstream is shallower) and prevailing winds (southwesterlies produce high water levels; Pietrafesa et al., 1986). Continuous recording water quality meters were installed at the downstream sites of the Project Area and Drinkwater creek for a 7-day period in April and May 1995. Temperature, conductivity, and dissolved oxygen were measured at 15-min intervals during this 7-day period using a Yellow Springs Instruments PC6000 submersible environmental monitor.

2.3. Collection of invertebrates

Subtidal benthic samples (0.02 m^2) were taken using an Ekman or Ponar grab from upstream and downstream locations in Tooley creek, Drinkwater creek, and Jacks creek, and in Project Area 2 (Fig. 1). During 1985–1988, three samples were collected from a single site at each upstream and downstream location; during 1989–1995,

Table 1
Areal comparisons of Project Area 2 and the natural creeks involved in this study[a]

Creek	Open water	Marsh surface	Total
Jacks	2.63	2.88	5.51
Jacobs	6.78	5.61	12.39
Drinkwater	5.12	4.17	9.29
Tooley	4.98	4.99	9.97
Project Area 2	0.81	2.23	3.04

[a] All listed values are in hectares and are taken from North Carolina Phosphate Corporation (1982).

three samples were collected from each of two sites at both upstream and downstream locations. The sampling sites were located near the middle of the creek within each location, and sampling depths ranged from 0.3 to 2.5 m. Sampling was done quarterly (January, April, July, October) beginning in July 1985 and ending in July 1995. Samples were sieved in the field through a 0.5 mm mesh, and the residue was preserved in 10% formalin containing 0.1 g/l of Rose Bengal stain. Infauna were separated, counted, and identified to the lowest practical taxon in the laboratory, and subsequently stored in 70% *iso*-propanol.

2.4. Fish growth experiments

Fish growth experiments were carried out in May (29 May–13 June) and July (24 July–9 August), 1985. Juvenile *L. xanthurus* ('spot') were collected in 30–60 s trawls using a 3.9 m two seam otter trawl of 6.3 mm bar mesh equipped with a cod-end bag of 3.1 mm mesh. Collected fish were held overnight in an enclosure to allow for expression of latent mortality associated with the stress of capture. During an experiment, fish were contained within circular enclosures (0.9 or 1.9 m diameter) constructed of black plastic netting (Vexar; 6 mm bar mesh), supported on a frame of stainless steel and concrete reinforcing bar. Each enclosure was 1.2 m high and covered with a Vexar top.

Five pairs of cages (one large and one small) were placed in the downstream regions of Project Area 2, Drinkwater creek, and Jacobs creek. The cages were placed in water 0.4–1.0 m deep, and were forced about 20–30 cm into the sediment to prevent fish from escaping and to deter entry of unwanted predators. The cages were initially seined to remove fish inadvertently captured during installation. Eight fish were added to each large cage and two fish were added to each small cage. Thus, each enclosure contained the same number of fish per unit bottom surface area. Each fish had previously been individually marked by fin clipping and weighed while immersed in water (West, 1990a). The order of addition of fish to the cages was randomly determined. The cages were censused by seining after 16 days. Surviving fish were placed in 10% formalin and later weighed in the laboratory. Growth (weight gain) of wild *L. xanthurus* was estimated by taking 90 s trawls in Drinkwater creek at approximately 14 day intervals between March and October.

2.5. Measurement of sediment features

Grain size determinations were made on intact 4 cm (diameter) × 10 cm (depth) cores according the procedures of Folk (1968). Samples were sieved wet using mesh sizes of 2.0 mm (detrital fraction), 0.84 mm (sand fraction), and 0.074 mm (silt and clay fraction). Data are presented as percentage of the total sample weight represented by each size fraction.

In 1995, three intact 6 cm (diameter) by 15 cm (depth) sediment cores were collected from the downstream station of Drinkwater creek and Project Area 2 during January and April. Cores were returned to the lab and immediately sectioned into five separate 1 cm intervals (0–1, 1–2, 2–3, 3–4, 4–5 cm below the sediment–water interface). Each interval was placed in a −20°C freezer until further analysis (within 6 months of sampling). Samples were thawed, dried to a constant mass at 60°C, and ground and homogenized using a mortar and pestle. TOC and nitrogen were then determined using a Control Corporation model 440 elemental analyzer. Acetanilide was used as a standard for all samples. Possible inclusion of inorganic carbon was assessed for each sample interval using the gasometric technique of Schink et al. (1979). No inorganic carbon was found in any of the samples.

Biologically available protein was assessed for surface (0–1 cm interval) and deep (4–5 cm interval) sediment at each site during January and April 1995 according to the technique described by Mayer et al. (1986). This technique determines the content of the smaller, more labile components of the protein pool following a sequence of acidic digestion, enzymatic degradation, serial protein addition, and final analysis of an extensive set of replicates using spectrophotometric detection of Coomassie Blue dye. All data represent the means of three cores, each of which was subsampled four times.

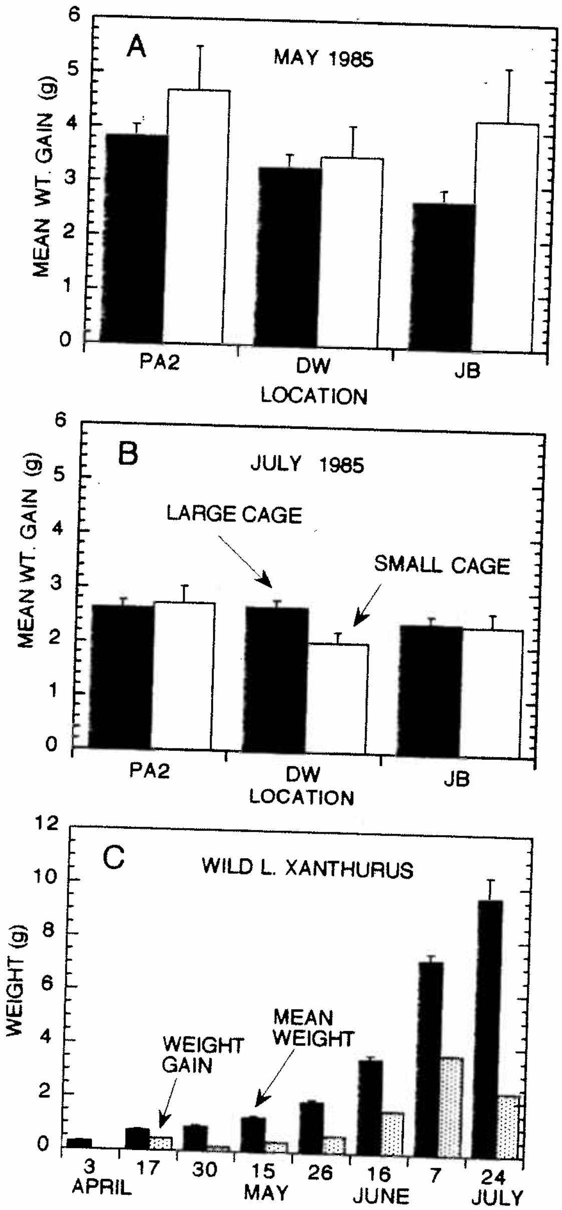


Fig. 2. Weight gain (g) of caged and wild *L. xanthurus* in Project Area 2 (PA 2), Drinkwater creek (DW), and Jacobs creek (JB). (A) May 1985 caging experiment. (B) July 1985 caging experiment. (C) Weight gain and mean weight (g) of *L. xanthurus* trawled at approximately 2-week intervals in Drinkwater creek during 1986. Columns represent mean values + 1 S.E.

Subsequent analyses (West and Clough, in prep.) have shown that wet volume and dry weight of sediment are both required for accurate analysis of sedimentary food concentration. Porosity of the sediment was not determined concurrently with the results being discussed. Instead, corrections for differences in porosity and dry sediment density were made using data obtained at each site during January and April 1997. Porosity was calculated using the wet and dry weights of a known volume of sediment.

2.6. Data analyses

Randomized block analyses of variance (ANOVA's) were carried out to test for creek and cage effects on weight gain and survival of *L. xanthurus*. Survival data were arcsin transformed prior to the ANOVA's. A series of three-way ANOVA's was carried on the infaunal density and species richness data to test for differences due to season (winter, spring, summer, fall), creek (natural vs. created), and location (upstream vs. downstream). Each three-way ANOVA analyzed the data for a single calendar year. A canonical analysis was carried out to test for correlations between infaunal species densities and salinity, and cluster analyses were used to discern temporal and spatial patterns in infaunal community structure. All multi-level ANOVA's and multivariate analyses were done on log $(x+1)$ transformed data. The canonical analyses were done using STATSTICA (StatSoft, Inc. Tulsa, OK); all other data analyses were carried out using DataDesk (Data Description, Inc. Ithaca, NY).

3. Results

3.1. Growth and survival of *L. xanthurus*

Mean weight gain of *L. xanthurus* during May (3–5 g/16 days) was approximately twice as high as that during July (Fig. 2A and B). Weight gain was significantly lower in Jacobs creek than in the Project Area during the May experiment, but differences in weight gain among creeks were not significant during the July experiment. Cage effects were limited to the May experiment, when significantly more growth occurred in the smaller cages in Jacobs creek (Fig. 2A). Weight gain of caged *L. xanthurus* equaled or exceeded that estimated for the ambient wild *L. xanthurus* population during similar time periods and months of the year (Fig. 2A vs. C).

Mean survival was similar among creeks during both experiments, with May values slightly lower than July values. Cage effects on survival were not significant. Mean survival values ranged from 50 to 100%.

3.2. Temporal and spatial patterns of benthic infauna

Data for each of the three natural creeks were pooled in all analyses comparing faunal abundance, diversity, and community structure in created and natural creeks. Data were pooled because (1) the primary issue of this study was whether the abiotic and biotic features of the created creek would fall within the normal range of values exhibited by nearby natural creeks, and not whether it was going to develop to resemble a particular, predesignated creek; and (2) to remain consistent with the symposium theme of assessment of success criteria for habitat restoration. The dynamics of the infaunal communities have been detailed in part in earlier reports (West, 1990b; Ambrose, 1992; Ambrose and Renaud, 1996) and will be dealt with more comprehensively in a future paper.

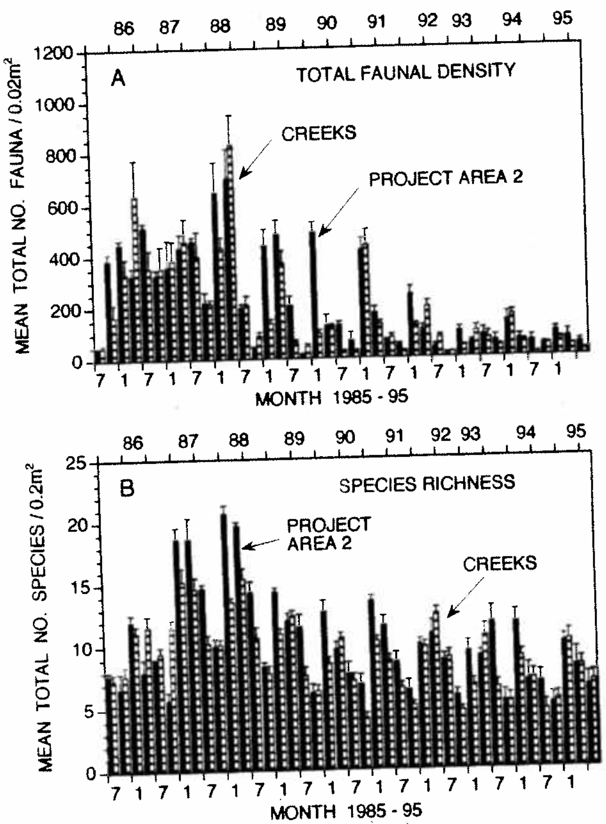


Fig. 3. Temporal variation in mean total faunal density (average total number of infauna/0.02 m^2 sample) and species richness (average total number of infaunal taxa/0.02 m^2 sample) at the downstream locations in Project Area 2 and the natural creeks between July 1985 and July 1995. Columns represent mean values + 1 S.E.

Total faunal density (mean total number of animals/unit area) varied markedly within and between years (Fig. 3A) in both the created and natural creeks. Within a given year, density peaked in the winter, declined sharply between spring and summer, and rose again during the late fall. Winter and spring values showed highly significant differences in all but 1 of the 10-year study (Table 2).

Annual differences in total faunal density were also pronounced. Winter and spring density values generally increased during 1986–1988, varied erratically between 1989 and 1991, and subsequently declined to values one-third to one-sixth of the 1986–1988 values. Summer and fall densities were similarly affected, with densities of individual species diminishing to near zero values in the summer months since 1992 (Fig. 3A).

The temporal and spatial patterns in total numbers of fauna described above were observed in both the Project Area 2 and the natural creeks (Fig. 3A). Summer and fall densities were occasionally significantly lower in the Project Area between 1985 and 1988. However, total densities of the Project Area have equaled or exceeded those of the natural creeks since 1988 (Fig. 3A; Table 2).

Similar annual and seasonal patterns in total faunal density occurred at the upstream and downstream stations in both the Project Area and the natural creeks. Within a single year, densities

Table 2
Selected significant ($P<0.015$) main effects and interactions of the three-way ANOVA's carried out on total faunal density and species richness in Project Area 2 (PA 2) and the natural creeks[a]

Year	Fauna	M	C	M×C×L
1986	Density	$\underline{1\ 4\ 7\ 10}$	n.s.	n.s.
1986	Richness	$\underline{1}\ \underline{4\ 7\ 10}$	n.s.	n.s.
1987	Density	$\underline{2\ 4\ 7}\ 10$	n.s.	n.s.
1987	Richness	$\underline{2\ 4}\ \underline{7\ 10}$	n.s.	n.s.
1988	Density	$\underline{1\ 5}\ \underline{7\ 10}$	P>N	n.s.
1988	Richness	$\underline{1\ 5}\ \underline{7\ 10}$	n.s.	n.s.
1989	Density	$\underline{1\ 4}\ 7\ 10$	n.s.	n.s.
1989	Richness	$\underline{1\ 4}\ 7\ 10$	P>N	n.s.
1990	Density	$1\ 5\ \underline{7\ 10}$	P>N	1 P Dn >1 N Dn
1990	Richness	$1\ 5\ \underline{7\ 10}$	n.s.	n.s.
1991	Density	$1\ 4\ \underline{7\ 10}$	P>N	n.s.
1991	Richness	$1\ 4\ \underline{7\ 10}$	P>N	n.s.
1992	Density	$1\ 4\ \underline{7\ 10}$	n.s.	n.s.
1992	Richness	$\underline{1\ 4}\ \underline{7\ 10}$	n.s.	n.s.
1993	Density	$\underline{1\ 4}\ \underline{7\ 10}$	P>N	n.s.
1993	Richness	$\underline{1\ 4}\ \underline{7\ 10}$	n.s.	n.s.
1994	Density	1 4 7 10	P>N	4 P Up >4 N Up
1994	Richness	1 4 7 10	P>N	4 P Up >4 N Up
1995	Density	1 4 7 10	P>N	4 M Up >4 N UP
1995	Richness	1 4 7 10	n.s.	n.s.

[a] Month (M) numbers underlined are not significantly different. Creek (C) differences are listed as an inequality (P, PA2; N, natural creeks). Significant three-way interactions are limited to those pertaining to the winter (1, 2) or spring (4, 5) months. L, station location; DN, downstream station; Up, upstream location; n.s., not significant.

were typically greater at the downstream stations in each creek.

Species richness (mean total number of species/unit area) showed the same within-year temporal and spatial patterns as described above for total faunal densities. Numbers of species were highest in the winter and fall, and lowest during the summer (Fig. 3B), and fewer species occurred upstream than downstream. However, the pattern of annual variation in species richness differed from that of total density. Species richness attained highest values during 1988 and 1989, but in the succeeding years did not show either the variability or the precipitous decline noted for faunal densities (Fig. 3B vs. A).

Numbers of species in the Project Area were initially lower than the natural creeks, particularly during the summer. However, species richness in both created and natural creeks has remained similar since 1988.

3.3. Community structure

Approximately 50 taxa comprise the infaunal communities of the created and natural creeks (Fig. 4). However, 10 of the 50 taxa accounted for 95% or more of all individuals collected during any year, season, creek, or location within a creek. These taxa consisted of, oligochaetes; the polychaetes *Mediomastus* sp.; *Hobsonia florida* Hartmann; *Laeonereis culveri* Webster; *Capitella* sp.; and *Streblospio benedicti* Webster; chironomid insect larvae; and the amphipod crustaceans *Corophium lacustre* Vanhoffen; *Gammarus tigrinus* Sexton; and *Leptocheirus plumulosus* Shoem. The bivalve *Macoma balthica* L. and the gastropod *Hydrobia* sp. occasionally occurred in high densities in the natural creeks and Project Area 2, respectively. Consequently, differences in community structure among the creeks were derived primarily from temporal and spatial differences in the relative abundance of these species, and not from the absence of particular species.

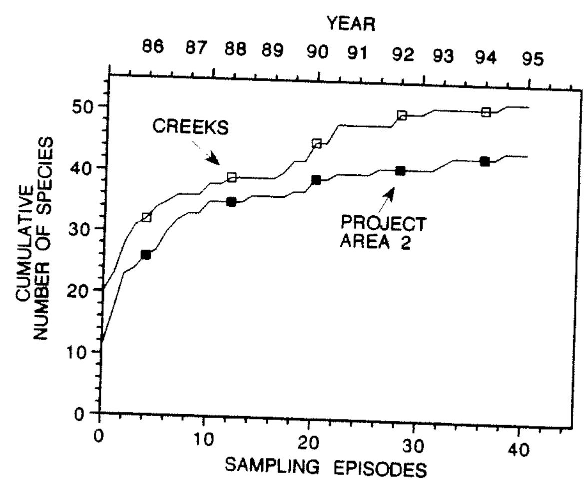


Fig. 4. Cumulative number of taxa collected in Project Area 2 vs. the pooled cumulative number of taxa of the natural creeks during the seasonal sampling schedule ('sampling episodes') between July 1985 and July 1995.

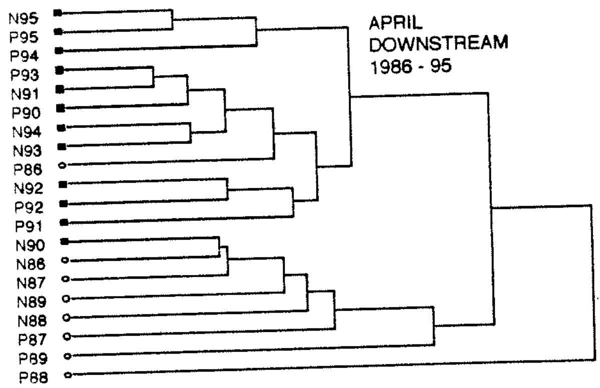


Fig. 5. Cluster analyses of spring infaunal communities of Project Area 2 and the natural creeks between April 1986 and April 1995. Codes indicate creek (*P*, Project Area; N, natural creeks) and year (open symbols, 1986–1989; closed symbols, 1990–1995).

Eight rare taxa were found only in the natural creeks. These taxa were insect larvae (three taxa of unidentified Coleoptera, Diptera), two unidentified crustacean taxa (Isopoda and Cumacea), the crab *Rhithropanopeus harrisii* Gould, and the polychaetes *Glycera dibranchiata* Ehlers and *Neanthes succinea* Frey and Leuckart. These taxa accounted for about 0.06% of the total faunal density for the natural creek fauna.

Cluster analyses of communities during seasons of highest faunal densities and species richness (winter and spring) show strong separation into a 1986–1989 group, and a 1990–1995 group (Fig. 5). This separation reflects the widespread reduction in species densities that occurred between these two time periods, and concomitant changes in the relative abundances of the numerically dominant species. The taxa showing large increases or decreases in relative abundance were virtually the same in the Project Area and the natural creeks. Chironomids, the amphipod *C. lacustre*, and the polychaetes *H. florida* and *S. benedicti* showed large gains in relative abundance, while oligochaetes, the amphipod *L. plumulosus*, and the polychaetes *Mediomastus* sp., and *S. benedicti* showed large declines in relative abundance (Table 3).

3.4. Abiotic variation

Salinity, temperature, and dissolved oxygen (DO) each evinced characteristic seasonal patterns. These patterns were the same in the Project Area and the natural creeks. Salinity usually fell sharply during the spring and rose during the summer to peak in the late fall or early winter (Fig. 6). Temperature was unimodal with a peak in July; values ranged from 6 to > 30°C. Dissolved oxygen varied inversely with temperature, with typical July values falling well below 25% saturation (West, 1990b; West and Ambrose, 1992).

Salinity also varied greatly among years. Three major episodes of salinity change occurred during the course of the study, resulting in fall–winter salinities exceeding 14 ppt during 1985–1986, 1988–1989, and 1994–1995 (Fig. 6). Late fall and early winter represent peak recruitment times for the infauna in the Project Area and natural Creeks (Ambrose, 1992). Canonical analyses were carried out on the relationship between salinity and infaunal density and species richness. The results did not reveal any important correlations and are therefore not presented here.

3.5. Colonization by aquatic vascular plants

M. spicatum (Eurasian watermilfoil) and *R. maritima* (widgeon grass) were first observed in the Project Area during 1989 and were abundant throughout the Pamlico estuary by 1990. Aboveground biomass of both species rose each spring, crested in June and July, and may have completely disappeared by the early fall (Fig. 7A and B). Biomass of both species was similar in the Drinkwater creek, but *M. spicatum* dominated in Project Area 2 (Fig. 7A vs. B).

Abnormally low DO readings (< 1–2 mg/l) became increasingly common during the spring and summer months following the invasion by the submersed aquatic plants, suggesting that the plants were influencing the DO levels. Continuous water quality recorders placed in Drinkwater creek and Project Area 2 during April and May 1995 showed a clear diurnal rhythm in DO concentration (Fig. 7C and D). Concentrations were lowest in the early morning (04:00–09:00) and rose steadily to the highest levels in the evening (17:00–21:00). The magnitude of the oscillation in oxygen content and the variance in diurnal highs and lows were greater during the May series of recordings, particularly in the Project Area (Fig. 7D vs. C). The relatively larger oscillations in DO in the Project Area during May coincided with a two-fold greater increase vascular plant biomass at this site (Fig. 7B vs. A). No diurnal pattern of variability was evident in specific conductivity during the same April and May time periods.

3.6. Features of the benthic sediments

Nearly 70% (by weight) of natural creek sediments consisted of silts and clays (< 0.074 mm), and approximately 30% consisted of sand-sized particles (0.074–0.84 mm; Table 4) in samples collected in 1992. This ratio was nearly reversed in the Project Area, where sand-sized particles accounted for about 60% of the sediment. Comparable particle size distributions were found in samples of natural creek and Project Area 2 sediments collected in 1984 (Craft et al., 1986; Table

Table 3
Changes in the relative abundances of the 12 numerically dominant taxa before (1985–1989) and after (1990–1995) colonization by *Myriophyllum spicatum* and *Ruppia maritima*

Project Area 2	1985–1989	Project Area 2	1990–1995
Taxon	Relative percent	Taxon	Relative percent
Mediomastus sp.	22.6	*Chironomida*	26.9
Hobsonia florida	13.2	*Hobsonia florida*	19.4
Chironomida	10.0	*Capitella* sp.	12.4
Hydrobia sp.	9.9	*Corophium lacustre*	11.3
Oligochaeta	9.4	*Laeonereis culveri*	7.0
Capitella sp.	8.7	*Mediomastus* sp.	4.9
Streblospio benedicti	5.6	*Gammarus tigrinus*	4.6
Laeonereis culveri	5.2	*Oligochaeta*	4.5
Corophium lacustre	3.5	*Polydora ligni*	2.1
Leptocheirus plumulosus	2.5	*Streblospio benedicti*	1.9
Polydora ligni	2.1	*Leptocheirus plumulosus*	1.1
Macoma balthica	2.1	*Macoma balthica*	0.7
Cumulative percent	94.8	Cumulative percent	96.9
Total number of fauna	39 713	Total number of fauna	34 530
Natural creeks	1985–1989	Natural creeks	1990–1995
Taxon	Relative percent	Taxon	Relative percent
Mediomastus sp.	22.8	*Chironomida*	28.3
Oligochaeta	22.6	*Mediomastus* sp.	12.4
Leptocheirus plumulosus	11.3	*Hobsonia florida*	12.2
Capitella sp.	9.6	*Corophium lacustre*	8.2
Hobsonia florida	8.9	*Gammarus tigrinus*	7.0
Chironomida	6.8	*Oligochaeta*	6.9
Streblospio benedicti	6.1	*Capitella* sp.	4.9
Laeonereis culveri	2.9	*Leptocheirus plumulosus*	4.2
Corophium lacustre	1.6	*Laeonereis culveri*	3.3
Macoma balthica	1.4	*Streblospio benedicti*	3.0
Polydora ligni	1.4	*Macoma balthica*	2.7
Macoma phenax	0.7	*Polydora ligni*	1.5
Cumulative percent	96.1	Cumulative percent	94.6
Total number of fauna	88 617	Total number of fauna	56 820

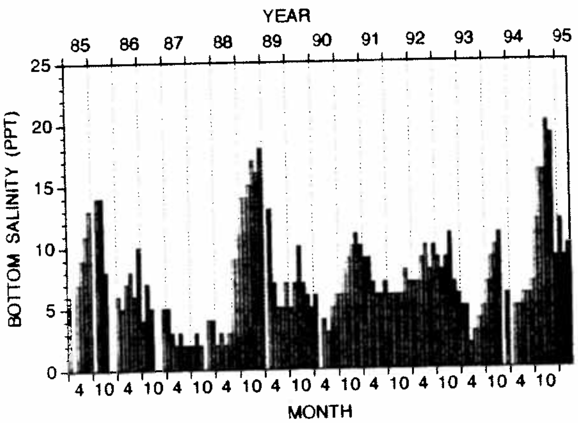


Fig. 6. Temporal variation in bottom salinity of the natural creeks. Samples were taken at approximately monthly intervals between July 1985 and July 1995.

4). Natural sediments also contained large amounts of peat and woody detritus, both of which were absent from the Project Area sediments.

Organic carbon normalized to per g dry weight of sediment was always at least an order of magnitude higher in natural sediments relative to the Project Area sediments (e.g. for the 0–1 cm interval, 13.94% C from Drinkwater creek vs. 0.93% C from Project Area 2 during January 1995; Fig. 8A and C). Samples collected intermittently between 1985 and 1992 showed similar differences in organic carbon levels among the natural creeks and Project Area 2, and the absence of any clear trend of increasing organic carbon content over time for the Project Area sediments (Fig. 9).

Drinkwater creek also contained approximately an order of magnitude more nitrogen than did Project Area 2 (e.g. for the 0–1 cm interval,

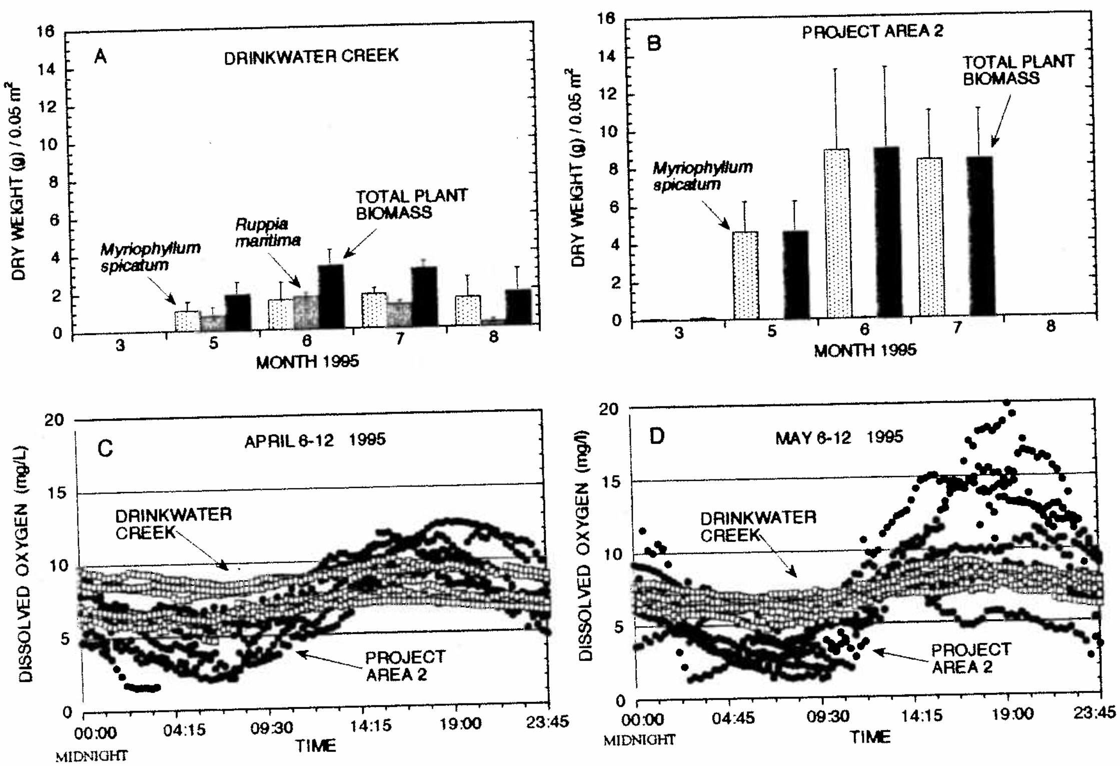


Fig. 7. Seasonal change in biomass of aquatic vascular plants, and diurnal variation in DO concentration, in Project Area 2 and Drinkwater creek. (A) and (B). Individual and combined mean biomass (+1 S.E.) of *Ruppia maritima* and *Myriophyllum spicatum* in Drinkwater creek (A) and Project Area 2 (B) during 1995. (C) and (D). Diurnal change in DO during April 1995 (C) and May 1995 (D).

Table 4
Relative percentage (by weight) of grain sizes of the subtidal sediments of Project Area 2 and the natural creeks

Year	Size class (mm)	Upstream creeks	Upstream PA 2	Reference
1984	>0.5 <2.0	5.85	0.48	Craft et al., 1986
	>0.05 <0.5	33.03	72.38	
	<0.05	60.62	27.12	
1992	>2.00	1.3	0.0	This study
	>0.84 <2.00	0.6	0.0	
	>0.074 <0.84	27.0	63.2	
	<0.074	71.8	35.9	
Year	Size class (mm)	Downstream creeks	Downstream PA 2	Reference
1992	>2.00	1.4	0.0	This study
	>0.84 <2.00	0.8	0.0	
	>0.074 <0.84	24.2	59.6	
	<0.074	73.2	41.0	

1.20% N in Drinkwater creek vs. 0.12% in Project Area 2 during January 1995; Fig. 8B and D). Project Area sediment showed the expected downcore decreases in both organic carbon and nitrogen, while organic carbon tended to increase with depth below the sediment–water interface in Drinkwater creek (Fig. 8A and D).

Sediment porosity and dry density also varied between the two locations. Average porosity of the Drinkwater sediments during January 1997 was 0.886, or approximately 90% water (by volume), while the coincident porosity of the Project Area sediments was only 0.673, or approximately 70% water (by volume). In addition, the natural sediments were less dense than the Project Area sediments (1.13 vs. 2.27 g/ml). Thus, in each ml of wet Project Area sediment there were many more particles than there were in each ml of wet Drinkwater sediment.

Normalizing organic carbon and nitrogen values to per g wet sediment has the effect of reducing the magnitude of differences in carbon and nitrogen levels between Drinkwater creek and Project Area 2 sediments relative to the percent dry weight values (Fig. 8E–H). For example, Drinkwater creek sediment contained only about three times the amount of organic carbon of Project Area sediment when normalized to wet volume (e.g. for the 0–1 cm interval, 17.95 vs. 6.87 mgC/ml during January of 1995; Fig. 8E vs. G). Relative differences in organic nitrogen decrease as well (e.g. for the 0–1 cm interval, 1.54 mg/ml for Drinkwater creek vs. 0.89 mg/ml in Project Area 2; Fig. 8F vs. H).

BAP was assessed to provide a better estimate of food quality than total organic carbon and nitrogen, given the large quantities of refractory material (e.g. peat) present in the natural creek sediments. BAP concentration normalized to per g dry sediment in Drinkwater creek was two times greater than in Project Area 2 (1.30 sediment vs. 0.60 mg BAP per g dry; Fig. 10A and B), reinforcing the patterns observed for organic carbon and nitrogen. However, Project Area 2 BAP values normalized to per wet ml of sediment equaled or exceeded those of Drinkwater (1.08 mg BAP per ml wet in Project Area 2 vs. 0.78 mg BAP per ml wet in Drinkwater creek; Fig. 10C and D). Both sites also showed the expected downcore decreases in BAP (Fig. 10).

4. Discussion and conclusions

4.1. Fish growth and survival experiments

The fundamental objective of this work was to determine whether created marshes could be a viable solution to the alteration of wetland and subtidal habitat by phosphate mining operations. A critical test in this regard concerned the capacity of the created habitat to emulate the nursery area functions of the ambient natural oligohaline creeks (Weinstein and Brooks, 1983; Miller et al., 1984; Ross and Epperly, 1985). We have presented two lines of evidence that argue for functional equivalence among the Project Area and the natural creeks. First, Project Area 2 developed an infaunal community of abundance and diversity rivaling that of the natural creeks. Second, growth and survival of spot were similar in the Project Area and the natural creeks.

Evidence of persistence of an infaunal community through time indicates utilization of the habitat in several dimensions, i.e. a place sufficient to permit survival, growth, and reproduction. The same cannot be said for motile fauna such as fish that use the habitat when conditions are favorable, but migrate elsewhere as conditions decline. Some form of direct assessment in addition to population surveys is therefore needed to evaluate utilization by the fish community, and we suggest experimentation is needed to accurately assess

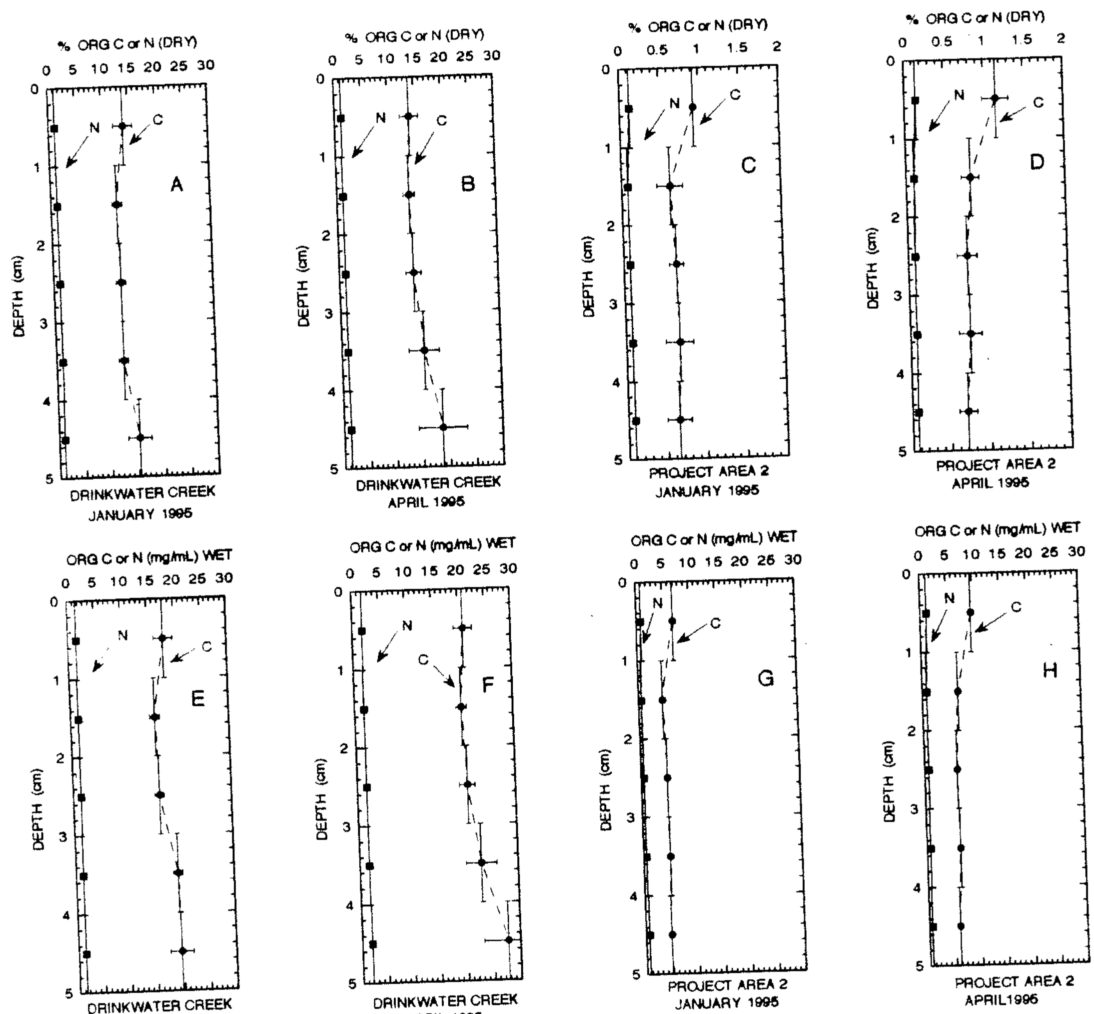


Fig. 8. Downcore distributions of organic carbon and total nitrogen. (A)–(D). Downcore concentrations expressed on a percent dry weight basis. Note order of magnitude differences in values for Drinkwater creek (A and B) and Project Area 2 (C and D). (E)–(H). Downcore concentrations of organic carbon and total nitrogen expressed as mg/ml wet weight sediment. Note that all values are on the same scale. Horizontal bars are +/− 1 S.D., vertical error bars indicate sampling depth interval.

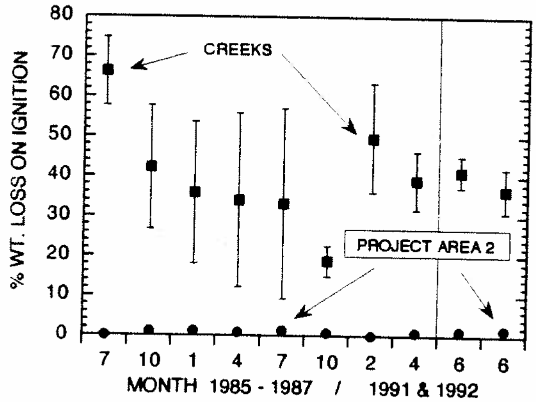


Fig. 9. Loss on ignition estimates of total organic carbon content of downstream sediments from Project Area 2 and the natural creeks. Values are mean + 1 S.D.

function from the perspective of this motile community.

Our fish growth experiments utilized enclosures to retain marked fish that could later be censused for measurements of growth. However, the presence of an enclosure can also alter the physical environment by reducing current flow and trapping sediment (Virnstein, 1977), acting as an attachment site for fouling organisms, and serving as a refuge for small crustacean predators (Peterson, 1979). These particular artifacts should be sensitive to some aspect of cage size (e.g. bottom surface area enclosed, cage surface area or volume), and we accordingly used enclosures of different diameter in an attempt to control for these artifacts. We found that a cage effect was important in fish growth but not survival. The effect was limited to the May experiment and was largely the result of an outlier in one of the small cages in Jacobs creek; therefore, it does not significantly detract from basic inference that all of

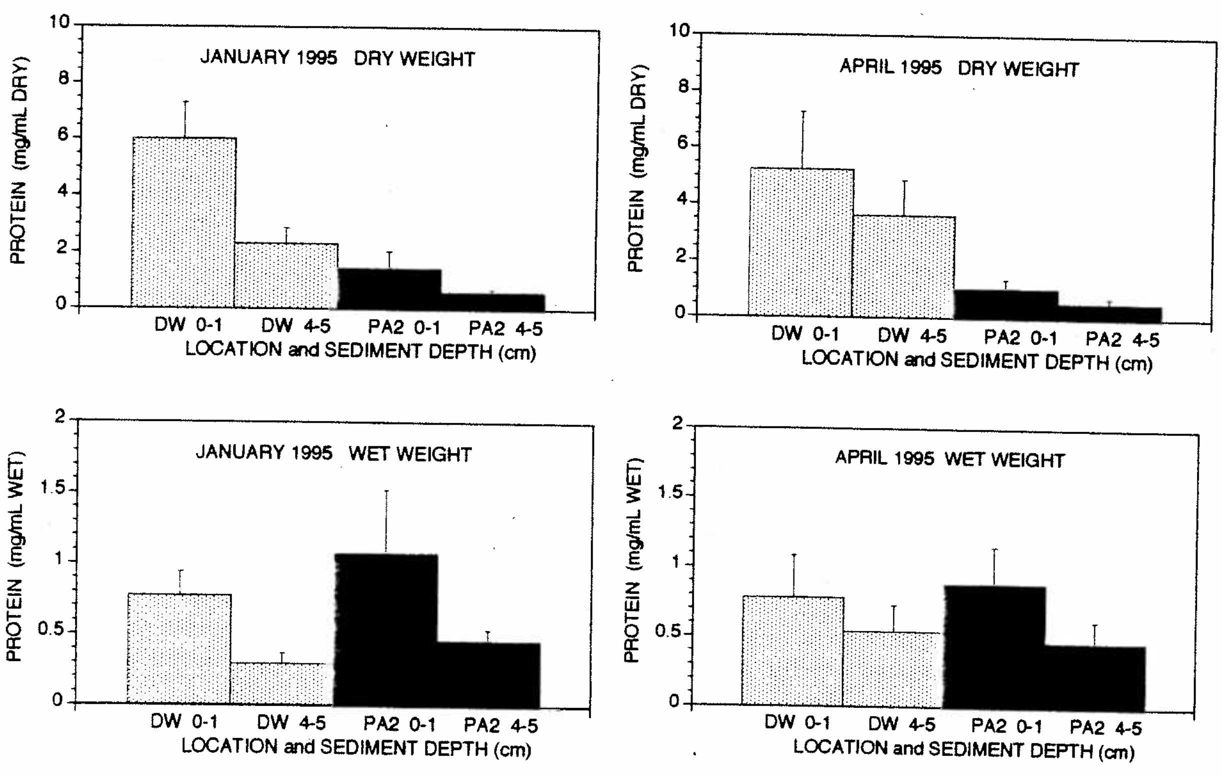


Fig. 10. Concentration of BAP in the surface interval (0–1 cm depth) and bottom interval (4–5 cm depth) of sediment cores taken from Project Area 2 and Drinkwater creek. (A)–(B). Concentrations of BAP expressed as mg/g dry weight. (C)–(D). Concentrations of BAP expressed as mg/ml wet sediment.

the creeks demonstrated a similar capacity to support the growth of *L. xanthurus*.

Enclosures may not accurately mimic normal competitive and predatory pressures encountered in the natural environment. We had no direct control for this kind of artifact. Growth of caged *L. xanthurus* equaled or exceeded that estimated for wild *L. xanthurus* trawled at comparable time intervals during the same months of the year. Our estimates of growth of wild *L. xanthurs* may not reflect true growth rates if foraging success and survival of juvenile *L. xanthurus* are size-dependent. However, the density of fish in the enclosures was within the range of natural densities (Rulifson, 1991), and there is no evidence of food limitation of juvenile spot in the Pamlico River estuary (Currin et al., 1984). We conclude that the use of the enclosures permitted a valid estimate of the relative ability of the created site and the natural creeks to support the growth of *L. xanthurus*.

4.2. Importance of time

The current work represents one of the longest continuous monitoring programs of a created or restored estuarine habitat (Zedler, 1988; Simenstad and Thom, 1996). The duration of the study is important in developing an accurate portrait of the faunal community. Numerically dominant species characteristic of the oligohaline environment were evident within the first 3 years of the study, and the continued increase in the species pools with time reflected the addition of rare species.

A more salient feature of time is the necessity to have a study duration be sufficient for the site to be exposed to a representative range of stochastic biotic and abiotic events characteristic of the local ecosystem, particularly those that constitute a potential stress to the biota. The long duration of this research has provided us with the opportunity to assess the response of the Project Area to both abiotic (salinity) and biotic (colonization by *M. spicatum* and *R. maritima*) stressors.

The magnitude of annual variation in salinity occurring during this work equaled that observed in the Pamlico River estuary during the past 20 years (Stanley, 1988). While it is evident that both the Project Area and the natural creeks responded similarly to salinity change, our understanding of the impact of salinity on community structure remains incomplete. Multivariate analyses of salinity and infaunal species did not explain more than 30% of the variation in abundance of any species, due to the persistent high variability in species densities. Similar results were also obtained for the relationship between salinity and abundance of ichthyofauna in other subtributaries of the Pamlico River estuary (West and Ambrose, 1992).

In contrast, the invasion by *M. spicatum* and *R. maritima* was accompanied by large and persistent reductions in faunal densities, and to a lesser extent, in species richness. The magnitude and character of these changes were similar in the Project Area and the natural creeks. The nature of the relationship between these plants and the infaunal community is unclear. It is possible that the plants affect the infauna indirectly by influencing water quality. Seasonal increases in plant biomass were accompanied by increasing diurnal variation in DO levels, and this phenomenon was most pronounced in the creek with the greatest plant biomass (Project Area 2). The smaller water volume of the Project Area, and the absence of significant water movement between it and south creek (as indicated by static water depth) may also have contributed to the more extreme fluctuations in DO observed at the Project Area.

Mortality of infauna could have resulted directly from exposure to hypoxia or to supersaturated levels of dissolved gases (see Au-Spearde, 1991), or indirectly from increased susceptibility to predation as infauna moved to the sediment surface in response to the low oxygen levels (Pihl et al., 1991, 1992). This interaction between the creek flora, water quality, and infauna could account for the low faunal densities in the summer, but not for the lowered densities during the winter when plant biomass is negligible.

4.3. Features of the benthic sediments

The sediments of the Project Area lacked the woody detrital covering, large peat component, and the predominance of silt and clay that characterized the natural creek sediments. Furthermore, there was no evidence of a trend in accretion of these materials in the Project Area during the 10 years of the study.

The persistent similarity of the species composition of the infaunal communities in the Project Area and the natural creeks suggests that gross features of the sediments such as grain size distribution, surface topography, and total organic carbon levels do not play key roles in the distribution of the species that dominate oligohaline sediments. Most of these species are widely distributed and are among the first to colonize new habitat (Tenore, 1972b; Santos and Simon, 1980; Marsh and Tenore, 1990). They are also prone to dramatic fluctuations in population size (Boesch et al., 1976), associated with sediments of high organic carbon content (Snelgrove and Butman, 1994), and occur in high densities in eutrophic and other stressed environments (Tenore, 1972b; Snelgrove and Butman, 1994; Grall and Glemarec, 1997).

The association of oligohaline fauna with organic-rich sediments and the order of magnitude greater concentrations of carbon and nitrogen in Drinkwater creek versus Project Area 2 might have led us to predict greater infaunal densities in the natural creek. However, faunal densities have proven to be consistently similar, not different. This apparent paradox suggests that (1) food is not limiting in either environment, or (2) measurements of total organic carbon and nitrogen do not accurately represent what actually constitutes food for the infauna.

At the present time, we cannot distinguish between these two hypotheses. In support of the first, a concentration of 1% organic carbon is certainly high compared with other regions of the world's oceans that are known to support infaunal populations (e.g. Lopez and Levinton, 1987). Direct manipulation of organic carbon concentration is needed to assess if and when food limitation occurs. In support of the second, we argue that the data obtained for BAP (but not organic C or N) negates the apparent paradox when considered on a per wet volume basis.

Inclusion of additional estimates of labile food quantities such as microbial and algal biomass will help to further refine our hypothesis that organic carbon does not accurately predict infaunal success in created oligohaline habitats. One possible solution is to use total organic carbon and nitrogen measurements as estimates of gross food quantity (i.e. if carbon contents are $>1\%$ infaunal populations should not be food limited), and more specific estimates of labile food sources such as BAP as estimates of food quality.

We emphasize the utility of collecting porosity data and food evaluations simultaneously. Normalizing to wet volume instead of dry weight allowed the observation that BAP concentration is actually higher in the restored habitat. This result was obtained because the sediments in the created and natural creeks were physically dissimilar. Currently the decision to normalize to wet volume or dry weight varies arbitrarily in accordance with the particular technique used to measure food quantity. For example, pigment concentrations are traditionally reported on a per wet volume basis, while organic carbon and nitrogen data are reported on a per dry weight basis. This problem is compounded because comparisons between these different data sets are routinely made as a part of habitat assessments. We accordingly recommend including porosity in all investigations of sedimentary food quality, enabling each investigator to normalize to either wet volume or dry weight as appropriate.

In view of the similarities in community structure between Project Area 2 and the natural creeks, we argue that the BAP normalized to per volume wet sediment more accurately represents true food availability in created and natural systems than does total carbon or nitrogen. We are currently investigating this hypothesis in both oligohaline and polyhaline habitats.

4.4. Functional equivalency and limitations of the study

Evidence accumulated to date for Project Area 2 on wetland vascular plant productivity (Broome et al., 1986; Broome, 1989), ichthyofauna (Rulifson, 1991), and benthic infauna (this study) contends that it supports nursery area functions and responds to local ecological processes in a manner similar to the natural creeks. These findings contrast with most of the other restoration work carried out in estuarine systems (Moy and Levin, 1991; Sacco et al., 1994; Simenstad and Thom, 1996).

The 'success' of the Project Area may be linked to four aspects of its location. First, the created habitat is surrounded by the aquatic environs it was intended to mimic, thereby providing proximity to sources of infaunal recruits (Cammen, 1976; Christensen, et al., 1996). Second, the Project Area and the adjacent natural creeks are part of a large expanse of undeveloped habitat (South creek) and therefore are remote from municipal (but not agricultural) anthropogenic influences known to impede restoration efforts (Zedler, 1988; Simenstad and Thom, 1996). Third, it is a non-tidal habitat and therefore not as subject to sedimentary erosional forces as are restored intertidal projects (Simenstad and Thom, 1996).

Finally, and perhaps most importantly, the oligohaline ecosystem of which the Project Area is a part is characterized by intensely variable abiotic factors (temperature, salinity, DO). This variability evidently limits faunal diversity to a small subset of resilient eurytolerant estuarine taxa (Boesch et al., 1976). The number of taxa collected in the Project Area and natural creeks is half to one-tenth that reported for polyhaline areas of North Carolina estuaries (Cammen, 1976; Chester et al., 1983; Summerson and Peterson, 1984; West, 1985, 1990b) and of other Atlantic coast estuaries (Watling, 1975; Virnstein, 1977). Population dynamics of this oligohaline system appear to be driven primarily by these abiotic factors, especially hypoxia or anoxia (Tenore, 1972b; West and Ambrose, 1992), and the majority of the taxa are short-lived, prolific, deposit-feeding opportunists that rapidly invade new or disturbed habitats (Grall and Glemarec, 1997; Sheridan, 1997). As a result, these oligohaline infaunal communities probably never reach a stable state before a seasonal disturbance initiates a new round of recruitment. Therefore, from the perspective of infaunal community structure, mitigation is likely to be more successful in oligohaline areas than in areas of more constant and benign abiotic factors, because the organisms in oligohaline regions are more tolerant of the disturbance inherent in the process of habitat creation and restoration.

A caveat to inferences of functional equivalency discussed above for the Project Area 2 is the limitation imposed by reliance on that single site as the primary basis for our comparisons of structural and functional attributes of local created and natural oligohaline creeks. A second site exists (Project Area 1), but was not included in the analyses because the data for Project Area 1 are limited to descriptions of the infaunal community, and are confined to a relatively small time period (1991–1994) beginning about 10 years after the site was created.

The lack of replication of created or restored habitats is a general feature of mitigation research, and has several causes. First, space for a mitigation site may be limited due to a history of extensive development, such as urban areas and properties with waterfront access (Clark, 1989; Willard and Hiller, 1989). Mitigation efforts at these sites may encounter an additional difficulty if development has proceeded to the point where no undisturbed reference habitats remain, and the original ecological functions of these habitats are not fully understood (Zedler, 1996). Second, experimental design concerns such as site replication may not be required to be addressed in the planning and permitting procedures. Mitigation planning has often been poorly organized, ad hoc, and lacking in appropriate, standardized guidelines for construction and assessment (Clark, 1989; Garbisch, 1989). State agencies need to develop a strategic vision of environmental protection, and the administrative means to implement it. Third, replication is not included in the project design because mitigation efforts can be costly. The cost can be high because the permitting process is time consuming, land is expensive, construction is labor intensive, and planning, monitoring, and assessment require special skills. Estimates of the cost of constructing and monitoring Project Area 2 exceed one million dollars (NCPC staff, pers. commun.).

Finally, mitigation plans have had the objective of building a site in such a way as to maximize its potential for success. Thus, there has been reluctance to systematically vary physical or biological features of a site in order to determine their respective importance in the outcome of the mitigation process (e.g. size of watershed; ratio of marsh surface to water surface area; amount and character of detrital cover) (e.g. Pacific Estuarine Research Laboratory, 1990). Similarly, reliance on single mitigation sites does not permit assessment of site performance relative to known key abiotic and biotic variables that vary in kind and intensity along a spatial gradient (e.g. Brinson and Rheinhardt, 1996). All of these concerns combine to complicate the interpretation of the results, limit the ability to make accurate predictions about the probability of success (or failure) of future mitigation efforts, and impede our understanding of the critical mechanisms governing successful habitat creation, restoration, and enhancement. We accordingly emphasize the importance of including appropriate experimental design in the all phases of the mitigation process.

Acknowledgements

This work was supported in its entirety by North Carolina Phosphate Corporation, Texasgulf Chemicals, Inc., and PCS Phosphate (Aurora, NC). Of the legion of technicians that carried out the work, we are especially indebted to the efforts of Ken Sholar, David Bronson, William Bell, Page Faulkner, Scott Wood, Jean Thomson, and Rainey Eason. Dr Steven Ross was kind enough to loan us the YSI continuous water quality recorders during 1995. We also are grateful for the helpful criticisms of two anonymous reviewers, and the editing provided by the NOAA staff at the Coastal Services Center, office.

References

Ambrose Jr., W.G., 1992. Macroinfaunal colonization in natural and man-made wetlands. Annual Report to Texasgulf Chemicals, Inc. 40 pp.

Ambrose Jr., W.G., Renaud, P.E., 1996. Macrofaunal colonization of natural and man-made wetlands. Annual Report to Texasgulf Chemicals, Inc. 59 pp.

Au-Spearde, D.J., 1991. Endothelial lesions associated with gas bubble disease in fish. J. Comp. Pathol. 104, 327–335.

Boesch, D.F., Wass, M.L., Virnstein, R.W., 1976. The dynamics of estuarine benthic communities. In: Wiley, M. (Ed.), Estuarine Processes. Uses, Stresses, and Adaptation to the Estuary, vol. 1. Academic Press, New York, pp. 177–196.

Brinson, M.M., Rheinhardt, R., 1996. The role of reference wetlands in functional assessment and mitigation. Ecol. Appl. 6, 69–76.

Broome, S.W., 1989. Creation and restoration of tidal wetland of the southeastern United States. In: Kusler, J.A., Kentula, M.E. (Eds.), Wetland Creation and Restoration: The Status of the Science. US Environmental Protection Agency/600/3-89/038, pp. 37–72.

Broome, S.W., Seneca, E.D., Woodhouse, W.W., 1986. Long-term growth and development of transplants of the salt-marsh grass *Spartina alterniflora*. Estuaries 9, 63–74.

Cammen, L., 1976. Macroinvertebrate colonization of *Spartina* marshes artificially established on dredge spoil. Estuar. Coast. Mar. Sci. 4, 357–372.

Chester, A., Ferguson, R., Thayer, G., 1983. Environmental gradients and benthic macroinvertebrate distributions in a shallow North Carolina estuary. Bull. Mar. Sci. 33, 282–295.

Christensen, N.L., Bartuska, A.M., Brown, J.H., Carpenter, S.C., D'Antonio, C., Francis, R., Franklin, J.F., MacMahon, J.A., Noss, R.F., Parsons, D.J., Peterson, C.H., Turner, M.G., Woodmansee, R.G., 1996. The report of the Ecological Society of America Committee on the scientific basis for ecosystem management. Ecol. Appl. 6, 665–691.

Clark, J.R, 1989. Regional aspects of wetland restoration and enhancement in the urban waterfront environment. In: Kusler, J.A., Kentula, M.E (Eds.), Wetland Creation and Restoration: The Status of the Science. Perspectives, vol. II. EPA/600/3-89/038, US EPA Environmental Research Lab, Corvallis, OR, pp. 85–103.

Currin, B.M., Reed, J.P., Miller, J.M., 1984. Growth, production, food consumption, and mortality of juvenile spot and croaker: a comparison of tidal and non-tidal nursery areas. Estuaries 7, 451–459.

Craft, C.B., Broome, S.W., Seneca, E.D., 1986. Carbon, nitrogen and phosphorus accumulation in man-initiated marsh soils. In: Amoozegar, A. (Ed.), Proceedings of the 29th Annual Meeting of Soil Science Society North Carolina. Soil Science Society of North Carolina, Raleigh, NC, pp. 117–131.

Folk, R.L., 1968. Petrology of Sedimentary Rocks. Hemphill, Austin, TX, p. 120.

Garbisch, E.W., 1989. Information needs in the planning process for wetland creation and restoration. In: Kusler, J.A., Kentula, M.E. (Eds.), Wetland Creation and Restoration: The Status of the Science. Perspectives, vol. II. EPA/600/3-89/038, US EPA Environmental Research Lab, Corvallis, OR, pp. 9–13.

Grall, J., Glemarec, M., 1997. Using biotic indices to estimate macrobenthic community perturbations in the Bay of Brest. Estuar. Coast. Shelf. Sci 44 (Suppl. A), 43–53.

Lopez, G.R., Levinton, J.S., 1987. The ecology of deposit-feeding animals in marine sediments. Q. Rev. Biol. 62, 235–260.

Marsh, A.G., Tenore, K.R., 1990. The role of nutrition in regulating the population dynamics of opportunistic, surface deposit feeders in a mesohaline community. Limnol. Oceanogr. 35, 710–724.

Mayer, L.M., Schick, L.L., Setchell, F.W., 1986. Measurement of protein in nearshore surface sediments. Mar. Ecol. Prog. Ser. 30, 159–165.

Miller, J.M., Reed, J.P., Pietrafesa, L.J., 1984. Patterns, mechanisms, and approaches to the study of migrations of estuarine-dependent fish larvae and juveniles. In: McCleave, J.D., Arnold, G.P., Dodson, J.J., Neill, W.H. (Eds.), Mechanisms of Migration in Fishes. Plenum Press, New York, pp. 209–225.

Mitsch, W.J., Wilson, R.F., 1996. Improving the success of wetland creation and restoration with know-how, time, and self-design. Ecol. Appl. 6, 77–83.

Moy, L.D., Levin, L.A., 1991. Are *Spartina* marshes a replaceable resource? A functional approach to evaluation of marsh creation efforts. Estuaries 14, 1–16.

North Carolina Phosphate Corporation, 1982. Wetlands mining and mitigation: A supplemental environmental impact report. NCPC, Beaufort County, NC.

Pacific Estuarine Research Laboratory, 1990. A manual for assessing restored and natural coastal wetlands with examples from southern California. California Sea Grant Report No. T-CSGCP-021, La Jolla, CA, 105 pp.

Peterson, C., 1979. Predation, competitive exclusion, and diversity in the soft-sediment benthic communities of estuaries and lagoons. In: Livingston, R. (Ed.), Ecological Processes in Coastal and Marine Systems. Plenum Press, New York, pp. 223–264.

Pietrafesa, L., Janowitz, G., Chao, T., Weisberg, R., Askari, F., Noble, E., 1986. The physical oceanography of pamlico sound. University of North Carolina Sea Grant Working Paper Publication No. 86-5, Raleigh, NC, 125 pp.

Pihl, L., Baden, S., Diaz, R.J., 1991. Effects of periodic hypoxia on distribution of demersal fish and crustaceans. Mar. Biol. 108, 349–360.

Pihl, L., Baden, S., Diaz, R.J., Schaffner, L.C., 1992. Hypoxia-induced structural changes in the diet of bottom-feeding fish and crustacea. Mar. Biol. 112, 349–361.

Race, M.S., Fonseca, M.S., 1996. Fixing compensatory mitigation: what will it take? Ecol. Appl. 6, 94–101.

Ross, S., Epperly, S., 1985. Utilization of shallow estuarine nursery area by fishes in Pamlico Sound, North Carolina, and adjacent tributaries. In: Yanez Arancibia, A. Jr (Ed.), Fish Community Ecology in Estuarine and Coastal Lagoons: Toward an Ecosystem Integration. Universidad Nacional Autonoma de Mexico, Mexico, pp. 207–232.

Rulifson, R.A., 1991. Finfish utilization of man-initiated and adjacent natural creeks of South creek estuary, North Carolina, using multiple gear types. Estuaries 14, 447–464.

Sacco, J.N., Seneca, E.D., Wentworth, T., 1994. Infaunal community development of artificially established salt marshes in North Carolina. Estuaries 17, 489–500.

Santos, S.L., Simon, J.L., 1980. Response of soft-bottom benthos to annual catastrophic disturbance in a south Florida estuary. Mar. Ecol. Prog. Ser. 3, 347–355.

Schink, J.C., Stockwell, J.H., Ellis, R.A., 1979. An improved device for gassometric determination of carbonate in sediment. J. Sed. Petrol. 49, 651–653.

Sheridan, P., 1997. Benthos of adjacent mangrove, seagrass, and non-vegetated habitats in Rookery Bay, Florida, USA. Estuar. Coast. Shelf. Sci. 44, 455–469.

Simenstad, C.A., Thom, R.M., 1996. Functional equivalency trajectories of the restored Gog-Le-Hi-Te estuarine wetland. Ecol. Appl. 6, 38–56.

Snelgrove, P.V.R., Butman, C.A., 1994. Animal–sediment relationships revisited: cause versus effect. Ann. Rev. Oceanogr. Mar. Biol. 32, 111–177.

Stanley, D., 1988. Water quality in the Pamlico River estuary, 1967–1986. Institute for Coastal and Marine Resources, East Carolina University, Technical Report 88-01, 199 pp.

Summerson, H., Peterson, C., 1984. Role of predation in organizing benthic communities of a temperate-zone seagrass bed. Mar. Ecol. Prog. Ser. 15, 63–77.

Tenore, K., 1972a. The importance of predation by crabs and fishes on benthic infauna in Chesapeake Bay. Ecology 58, 1199–1217.

Tenore, K., 1972b. Macrobenthos of the Pamlico River estuary, North Carolina. Ecol. Monogr. 42, 51–69.

Virnstein, R., 1977. The importance of predation by crabs and fishes on benthic infauna in Chesapeake Bay. Ecology 58, 1199–1217.

Watling, L., 1975. Analysis of structural variations in a shallow estuarine deposit-feeding community. J. Exp. Mar. Biol. Ecol. 19, 275–313.

Weinstein, M.P., Brooks, H.A., 1983. Comparative ecology of nekton residing in a tidal creek and adjacent seagrass meadow: community composition and structure. Mar. Ecol. Prog. Ser. 12, 15–27.

West, T.L., 1985. Abundance and diversity of benthic macrofauna in subtributaries of the Pamlico River estuary. J. Elisha Mitchell Sci. Soc. 101, 142–159.

West, T.L., 1990a. Growth and survival of *Leiostomus xanthurus* (spot) in man-made and natural wetlands. Annual report to Texasgulf Chemicals, Inc. Aurora, NC, 30 pp.

West, T. L., 1990b. Benthic invertebrate utilization of man-made and natural wetlands. Annual report to Texasgulf Chemicals, Inc. Aurora, NC, 100 pp.

West, T.L., Ambrose, W.G. Jr, 1992. Abiotic and biotic effects on population dynamics of oligohaline benthic invertebrates. In: Colombo, G., Ferrari, I., Ceccherelli, V., Rossi, R. (Eds.), Marine Eutrophication and Population Dynamics. Twenty-fifth European Marine Biology Symposium. Olsen and Olsen, Fredensborg, Denmark, pp. 189–194.

Willard, D.E., Hiller, A.K., 1989. Wetland dynamics: considerations for restored and created wetlands. In: Kusler,

J.A., Kentula, M.E. (Eds.), Wetland Creation and Restoration: The Status of the Science. Perspectives, vol. II. EPA/600/3-89/038, US EPA Environmental Research Lab, Corvallis, OR, pp. 47–54.
Zedler, J.B., 1988. Salt marsh restoration: lessons from California. In: Cairns, J. (Ed.), Rehabilitating Damaged Ecosystems, vol. 1. CRC Press, Boca Raton, FL, USA, pp. 123–138.
Zedler, J.B., 1996. Ecological issues in wetland mitigation: an introduction to the forum. Ecol. Appl. 6, 33–37.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

October 31, 2001

Colonel James W. Delony
District Engineer, Wilmington District
U.S. Army Corps of Engineers
Post Office Box 1890
Wilmington, North Carolina 28402-1890

Attention: Mr. Scott McLendon

Dear Colonel DeLony:

The U.S. Fish and Wildlife Service (Service) has reviewed Public Notice Action ID#200110096, dated October 4, 2001. The applicant, Potash Corp of Saskatchewan (PCS) Phosphate Company, has applied for a Department of the Army permit to impact 2,394 acres of waters of the United States (shown in the following table), including navigable waters, to continue its phosphate mining operation on Hickory Point, near NC Highway 306, adjacent to the Pamlico River, South Creek and its tributaries, north of Aurora, Beaufort County, North Carolina.

The proposed project wetland impacts are extensive in terms of wetland acreage and wetland diversity:

1. Creeks/Open Water	4 acres
2. Brackish Marsh Complex	35 acres
3. Bottomland Hardwood Forest	120 acres
4. Disturbed-Herbaceous Assemblage	207 acres
5. Disturbed Scrub-Shrub Assemblage	581 acres
6. Pine Plantation	745 acres
7. Hardwood Forest	209 acres
8. Mixed Pine-Hardwood Forest	314 acres
9. Pine Forest	100 acres
10. Ponds	19 acres
11."47 % wetland" area	60 acres
Total	2394 acres

In addition, 1,028 acres of upland habitat are included in the mine continuation for a total of 4,422 acres of disturbance.

The project will impact 4 acres of open waters, the majority of which are located in Huddles Cut, Tooleys Creek, and the unnamed tributary near Pamlico Aquaculture Center. In addition, Project Area II (marsh creation area) would be impacted by the proposed mine. Navigable waters of Jacks Creek, Jacobs Creek, and Tooleys Creek would be impacted by the proposed project. Impacts to submerged aquatic vegetation (SAV) including widgeon grass (Ruppia maritima), Eurasian water milfoil (Myriophyllum spicatum), horned pondweed (Zannichellia palustris), and hornwort, (Ceratophyllim demersum) will occur under the proposed action.

The coastal wetlands mentioned above as being impacted are important regulators of fresh water, suspended solids, nutrients, and contaminants. Ninety percent of the State's commercial fisheries harvest is composed of estuarine dependent species. The year 2000 value of North Carolina's commercial fishery was 108 million dollars and the recreational fishery is valued around one billion dollars annually. These values would be substantially higher except for environmental problems. The Service is very familiar with the lands being impacted and believes the type and scale of these losses will result in an unacceptable loss of fish and wildlife habitat and watershed function to the Albemarle-Pamlico Estuary. The Albemarle-Pamlico Estuary is the second largest estuary in the United States (only Chesapeake Bay is larger). A multi-agency study (Albemarle-Pamlico Estuary Study) led by the State of North Carolina and the US Environmental Protection Agency, and on which the Service and the US Army Corps of Engineers participated, reported the following in the Comprehensive Conservation and Management Plan:

- Eight percent of the freshwater rivers and streams in the Albemarle-Pamlico region are unfit for fish propagation or recreation. An additional 34 percent are only partially supporting these uses; 32 percent are threatened.
- 21,611 acres of prime shellfish habitat are closed because of pollution.
- Disease epidemics have been reported in finfish, blue crabs and oysters.
- Throughout the region, draining and filling of wetlands has contributed to the destruction of vital fish, plant, and wildlife habitats.

From this multi-agency study, it is apparent that water quality and natural resource management concerns in the watershed are will documented. It is also known that wetland losses of the magnitude proposed by this permit contribute significantly to water quality impairment. Clearly, wetland losses of this magnitude are of high concern.

The Service recommends that the district engineer not issue a permit for the project as proposed. In accordance with the procedural requirements of the 1992 404(q) Memorandum of Agreement, Part IV.3 (a), between our agencies, we are advising you that the proposed work may result in substantial and unacceptable impacts to aquatic resources of national importance. It is our opinion that the applicant has not satisfied the Environmental Protection Agency's 404(b)(1) guidelines especially in regards to avoidance and minimization of impacts, nor the 40 CFR § 230.10(c) guidelines.

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), requires that all federal agencies, in consultation with the Service, insure that any action authorized, funded , or carried out by such agency is not likely to jeopardize the continued existence of any federally-listed threatened or endangered species. The Service is concerned about the impacts associated with the proposed action for the following reasons:

1. We cannot accurately assess the impacts of the proposed action on federally-protected species because surveys for species with known occurrences are not included in the application package.

2. We are concerned about the loss of foraging habitat for the federally-endangered red-cockaded woodpecker (Picoides borealis) which has known populations on adjacent properties and are also concerned about potential for genetic isolation of these known populations by the removal of such large areas that may naturally serve as migrational corridors.

The Service has been an active participant of the permit review team for the project since its inception, and is hopeful that, ultimately, a solution that satisfies federal and state legal requirements and industry needs on Hickory Point can be found. Sending this permit application back to the applicant will underscore the seriousness of the issues being dealt with and, hopefully, set the stage for meaningful dialog.

We provide these comments in a constructive manner and are willing to provide substantial support to the permit review team if the stage can be set for serious discussion. We appreciate the opportunity to provide comments. If you have any questions please contact Mike Wicker at (919) 856-4520, extension 22.

Sincerely,

for Tom Augspurger

Garland B. Pardue, Ph.D.
Ecological Services Supervisor

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

January 8, 2001

Colonel James W. DeLony
District Engineer, Wilmington District
U.S. Army Corps of Engineers
Post Office Box 1890
Wilmington, North Carolina 28402-1890

Attention: David Lekson

Dear Colonel DeLony:

The U.S. Fish and Wildlife Service (Service) has reviewed correspondence dated December 6, 2000, referencing PCS Phosphate Company's application for a Department of the Army individual permit to continue its surface mining operations on a 3,604 acre tract of land located on the Hickory Point peninsula, adjacent to the Pamlico River, South Creek and associated tributaries, north of Aurora, in Beaufort County, North Carolina. The following comments are submitted pursuant to, and in accordance with, provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

We recognize that this is only the beginning of the process which must include the preparation of an Environmental Impact Statement but we offer the following points for your consideration.

- The Service will strongly oppose mining in tidal creeks or their buffer areas or activities that will damage area submerged aquatic vegetation.

- The Service has previously expressed concerns with high levels of cadmium in soils of reclaimed mined lands at PCS, concerns which remain relevant to the new permit application. We have worked successfully with the applicant, U.S. Army Corps of Engineers, and others to get data on the significance of this issue, and we anticipate working through the results of those studies and their land management implications soon.

- Many of the impacts in this request are estuarine and the Service believes that the area to be evaluated for potential mitigation should be commensurate in scale with the affected aquatic community. Because the estuarine community is composed of fish, shellfish and migratory birds that migrate on a large scale during their life cycle, we believe the area considered acceptable for mitigation should be larger than it would, if the impacts were more terrestrial in nature. Also, since this project is so large and invasive, mitigation should be very substantive. For example, for this project, the applicant should consider a tract such as Open Grounds Farm for mitigation after being purchased from a willing seller. A site such as Open Grounds Farm is farther from the site than might normally be considered; however, restoration on such a site would benefit the same assemblage of estuarine animals that are effected on this site, and the scale of that type of mitigation is commensurate with this type of impact.

- The Service considers this process very important and looks forward to being actively involved.

- The Service would like the U.S. Army Corps of Engineers to convene a meeting of the environmental agencies and organizations to discuss environmental concerns. Although this meeting would be a gathering of government agencies, PCS Phosphate can also attend, if desired. However, in an effort to provide an atmosphere which will allow free discussion, the environmental agencies/groups should convene a meeting *prior to* scheduling a meeting to include PCS Phosphate. That meeting would be a more efficient venue for discussing Service scoping comments on a project of this magnitude (e.g., wetland impact avoidance, minimization, compensation, endangered species section 7 consultation issues, etc.). We will be pleased to provide written scoping comments as a follow-up to such a meeting for the Corps' files on this project.

If you have any questions or comments, please contact Mike Wicker at (919) 856-4520 (Ext. 22) or via email at mike_wicker@fws.gov. Mike will have the lead for the office regarding this permit application.

Sincerely,

Garland B. Pardue

Garland B. Pardue
Ecological Services Supervisor

cc: Mr. William T. Cooper
Mr. William L. Cox
Mr. John Dorney
Mr. Jeffrey C. Furness
Mr. Larry Hardy
Mr. Doug Huggett
Mr. Terry Moore
Mr. Rob Perks
Mr. Ross Smith
Mrs. William Wescott
Mrs Katy West
Mr. Floyd Williams

FWS/R4:MWicker:1-5-2001:919.856.4520extension22:\PCSPhospahteonJan2001.wpd

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

July 16, 2001

Mr. Scott McLendon
Regulatory Project Manager
Department of the Army
Wilmington District, Corps of Engineers
P.O. Box 1890
Wilmington, North Carolina 28402-1890

Dear Mr. McLendon:

Thank you for your June 20, 2001, request for comments on the capping of cadmium enriched PCS Phosphate mine reclamation lands near Aurora, Beaufort County, North Carolina. The U.S. Fish and Wildlife Service (Service) greatly appreciates PCS Phosphate's interest in eliminating exposure of fish and wildlife to cadmium. Specifically the following comments address the type of material that is used, thickness of the cap, and establishment of grades and elevations.

- The cap should be topsoil, recognizing that in order to be practically accomplished with conventional mining equipment the topsoil grab may contain some depth of material underlaying the topsoil. The capping soil should be able support reasonable growth of the type of tree species native to the area prior to mining or in the case of sandier soils longleaf pine stands with growth characteristic of that species on sandy soils. Based on the observed greater diversity of vegetation in topsoil-capped areas at the site, the topsoil cap allows for a faster and more complete restoration of mined areas. Spatial variation with some areas with pure or almost pure topsoil and others with sand are preferable to complete homogeneity.

- The soil cap should be a <u>minimum</u> of 1-3 feet deep.

- The reclaimed land should be contoured so that after reclamation surface drainage would enter natural streams and creeks similar to natural drainage patterns prior to mining. After topsoil capping, reforestation and natural contouring, the reclaimed watershed would ultimately return as an environmental asset instead of a liability.

- Based on the cadmium risk evaluation, topsoil capping should also be considered for reclamation areas R-1, 2 and 3 and the clay ponds. We understand that the U.S. Army Corps of Engineers cannot require this, but we hope that capping solutions on these sites can be developed that are acceptable to all parties involved.

The Service appreciates the opportunity to provide these comments and we look forward to continued involvement with this process. Questions or comments should be directed to Mike Wicker at 919-856-4520, extension 22, or by e-mail at **mike_wicker@fws.gov.**

Sincerely,

for Tom Augspurger

Dr. Garland B. Pardue
Ecological Services Supervisor

FWS/R4/MWicker/July 11, 2001/919-856-4520, ext 22/pcs cadmium capping.wpd

FILE COPY

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

June 25, 2008

Tom Walker
U.S. Army Corps of Engineers
Project Manager, Wilmington Regulatory Division
Post Office Box 1890
Wilmington, NC 28402-1890

Reference: PCS Phosphate, Action ID # 200110096

Dear Mr. Walker:

This letter provides the comments from the United States Fish and Wildlife Service (Service) on the subject Public Notice dated May 22, 2008 under Corps Action ID #: 200110096 (review of the Final Environmental Impact Statement, FEIS, for the proposed Potash Corporation of Saskatchewan Mine Continuation near Aurora, Beaufort County, North Carolina). Service comments were sent previously on the Draft Environmental Impact Statement (DEIS) and the Supplement to the Draft Environmental Impact Statement (SDEIS). The Potash Corporation of Saskatchewan Phosphate Division, Aurora Operation (PCS) has applied for Department of the Army authorization pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act to advance its current mining operation. The proposed expansion (Alternative L) would impact 4,135 acres of waters of the United States including wetlands adjacent to the Pamlico River, South Creek and Durham Creek. These comments are submitted in accordance with the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661-667d). Comments related to the FWCA are to be used in your determination of compliance with 404(b)(1) guidelines (40 CFR 30) and in your public interest review (33 CFR 320.4) in relation to protection of fish and wildlife resources.

The PCS mine expansion is proposed adjacent to the Albemarle Pamlico Estuary Complex, the largest lagoonal estuary in the country and nationally significant estuarine resource. The fringe marshes, creeks, and beds of submerged aquatic vegetation in the Albemarle Pamlico Estuary Complex provide essential nursery habitat for most commercial and recreational fish and shellfish in the North Carolina coastal area (Street et al. 2005) and important habitat for waterfowl (http://www.fws.gov/birddata/databases/mwi/mwidb.html), shorebirds and other migratory birds. The importance of wetlands to coastal fish is not unique to North

Carolina. Over 95% of the finfish and shellfish species commercially harvested in the United States are wetland-dependent (Feierabend and Zelazny 1987). The estuary also provides important habitat for anadromous fish, including the endangered shortnose sturgeon (*Acipenser breviorostrum*). The Albemarle Pamlico Estuary Complex supports an important recreationally-based economy. According to the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau 2006) fishing expenditures for 2006 in North Carolina totaled over 1.1 billion dollars. Given that the proposed expansion would result in impacts to more than 4100 acres of wetlands and over 5.5 miles of streams located directly adjacent to the Pamlico River, such large-scale impacts would likely have direct effects on the environmental quality of the Albemarle Pamlico Estuary Complex. We are especially concerned about the potential for mine expansion and operation to be detrimental to the food webs of the Albemarle Pamlico Estuary Complex. Consequently, as stated in our January 5, 2007 letter, the Service continues to believe that the proposed PCS mine expansion will result in substantial and unacceptable impacts to aquatic resources of the Albemarle Pamlico Estuary Complex. Our concerns regarding the FEIS revolve around three specific issues discussed below.

1. <u>Proposed mining operations will negatively impact estuarine trophic structure through disruption of substrate inputs crucial to primary producers; reduction of energy sources that fuel estuarine productivity; and degradation of the nutrient sequestration capacity of the estuarine system</u>. Estuary productivity is dependent on the complex interactions among the various components of the aquatic food web; with epiphytes (attached to wetland macrophytes) and submerged aquatic vegetation; (SAV) forming the foundation of the estuarine food web (Odum 1971; Mitsch and Gosselink 2000; Wetzel 2001). SAV populations have recently declined by as much as 50%, possibly because of anthropogenic impacts (North Carolina Division of Marine Fisheries 2005). As a result, detritus supplied by wetland macrophytes has become more important as an epiphytic substrate. While phytoplankton are also important for productivity, the role of wetland plants and SAV detritus is of greater importance to the overall stability of shallow aquatic food webs (Rich and Wetzel 1978). It is our opinion that the proposed mining operations will negatively impact both types of epiphytic substrates, and adequate mitigation is not proposed in the FEIS. However, adequate restoration is available if PCS focuses their expansion and other operations on lands south of Hwy 33.

   Also of importance to estuarine food webs is the gradual and episodic release of dissolved organic matter (DOM) from the contributing basins and wetlands immediately adjacent to the Albemarle Pamlico Estuary Complex. This energy source fuels bacterial communities that, through mineralization, provide inorganic nitrogen, phosphorous and carbon, supporting productivity. In addition, DOM supported bacteria are an important component of the "microbial loop" (Pomeroy 1974; Sherr and Sherr 1988). This part of aquatic food webs links DOM (of autochthonous and/or allochthonous origin) to higher trophic levels, via bacteria-protist-metazoan-zooplankton interactions. The impacts associated with the proposed alternative would decrease the quantity and quality of allochthonous DOM supplied to the estuary because of the close proximity of PCS's proposed mining operations.

Marsh systems provide additional functions that can influence estuarine food webs. For example, carbon of wetland origin is also exported from marsh systems in the guts of migratory feeding fish and birds or cycled through the marsh to the upper ends of tidal creeks and back to the marsh (Mitsch and Gosselink 2000). Also, marshes act to sequester and process inorganic nutrients from flood waters. The major tributaries to the Pamlico Sound, the Neuse and Tar Rivers, have been found to be excessively polluted with nutrients and are currently being managed to reduce nutrient loads. Nutrient enrichment, or eutrophication, has promoted increased algal productivity, which had resulted in hypoxia, anoxia, and fish kills in the lower estuary. Removal of wetlands in the Pamlico Sound system acts to exacerbate the impacts of this loading by removing the system's nutrient uptake capability.

Most of the wetlands that would be subjected to impacts are wet forests, including bottomland hardwood forests. These areas are subjected to repeated periods of inundation and desiccation. This is important from a biogeochemical perspective as it allows for the accumulation of particulate organic matter and its subsequent processing (dissolution and mineralization). This leads to episodic exports of dissolved organic materials to the estuary. It also retains nutrient loads carried by high flow events, which are later sequestered into forest biomass. Such systems are also important for denitrification. These areas also provide refugia and nursery habitat for aquatic organisms during high flow periods. Productivity is high in such wetlands with pulsing hydroperiods (Mitsch and Gosselink 2000).

2. <u>Mining will directly affect the rate at which water is routed through the watershed.</u> As the mine expansion progresses, there is an ever increasing trend of diverting surface water drainage which once promoted estuarine productivity into National Pollutant Discharge Elimination System (NPDES) channels, pipes and outfalls. This redirection of surface flows contributes to estuarine degradation because it removes natural watershed drainage patterns that 1) promote infiltration and trapping of sediments and other pollutants, and 2) provide a beneficial diffuse source of water to the estuary. This critical watershed function is reflected in the DEIS (paragraph 3, A-91) "Mr. Wicker stated that the ... catchment basin is critically important for these streams, because rainfall is the stream's source of water. Dr. Skaggs replied that Mr. Wicker's summation was correct." In light of this concern, we are troubled that the rate of mine expansion far exceeds the rate of recovery completed. According to page 4-78 of the SDEIS between 1965 – 2005 a total of 7,729 acres were mined but only 1,101 were reclaimed. In short, reclamation (including vegetation and hydrology restoration) will allow the water quality benefits of natural drainage to return to the estuary over time; however,

the discrepancy in progress between mining and reclamation activities significantly limits the potential for system recovery.

Offsets to wetland plant community losses through the proposed mitigation schedule may not be adequate to maintain the wetland functions within the watershed. Replacing mature wetlands with immature restored or created wetlands will not provide the physical or chemical functions of existing wetland systems. Plant communities drive many physical and chemical processes within wetlands such as 1) sedimentation, and, because of adsorption, nutrient retention, 2) hydrological demand through transpiration, 3) nutrient (inorganic nitrogen and phosphorous) cycling, 4) soils for microbial communities responsible for denitrification and 5) flood mitigation because mature communities are stable sources of hydraulic roughness.

It is our opinion that the applicant should provide upfront mitigation for stream, riparian buffer and wetland impacts. By replacing mature watershed systems with restored wetlands, there will be significant lag time (several decades at least) before vegetation and soils can develop so they can adequately mitigate for the losses of DOM production and nutrient sequestration/processing provided by the present ecosystems. Given the estuary's designation as an aquatic resource of national importance, this large-scale loss of habitat quality for a period of decades is not acceptable. For these reasons, we suggest that the applicant mine in the area south of Hwy 33 because all of the other mining alternatives destroy large watersheds too close to the estuary to be adequately mitigated. In all areas other than south of Hwy 33, adequate compensatory mitigation was not proposed.

3. <u>Given the potential for significant hydrological and trophic impacts to estuarine resources highlighted above (bullets # 1 & 2), and the lack of adequate mitigation, proposed expansion of PCS mining operations north of Hwy 33 cannot be supported.</u> We note that the PCS plant facilities can operate independent of the mine (Section 2.6.2) and mining south of Hwy 33 could be supplemented with importation of phosphate rock to eliminate any shortfalls in supply. Therefore, the Service does not agree with the applicant's assertion of "purpose and need" requiring continued mining since the plant facilities can operate with importation of rock, thus avoiding degradation of the nationally significant Albemarle Pamlico Estuary Complex.

The Albemarle Pamlico Estuary Complex is a bar-built estuary (Odum 1971), enclosed by North Carolina's Outer Banks. These barrier islands create a lake-like, brackish water body with only small outlets connecting it to the Atlantic Ocean (Paerl et al. 2001). Such geomorphic character produces a relatively closed system with a hydrologic residence time of about one year (Giese et al. 1985). This means that the Albemarle Pamlico Estuary Complex is highly effective at retaining nutrients, sediments and organic matter conveyed by its freshwater sources. These sediments and organic materials have absorptive relationships with nutrients, heavy metals and other toxicants that may cause chronic ecosystem impacts during hydrologic events that resuspend benthic materials in the estuaries. Thus, the impacts represented by PCS Phosphate's mining expansion should be considered with considerable diligence, as such impacts are likely to produce a legacy of environmental effects that could last for years, affecting estuarine food webs.

The Service concludes that the proposed project will result in substantial and unacceptable adverse impacts to aquatic resources of national importance. Such large-scale wetland impacts located directly adjacent to the Pamlico River, as argued above, will act to exacerbate the impacts of eutrophication while altering local food web stability; both of which have important implications for estuarine productivity. Additionally, the proposed compensatory mitigation is insufficient to offset adverse impacts to the aquatic environment except in the area south of Hwy 33 (the applicant considers an alternative to only mine south of 33 as not practicable, Section 2.7.4). Further, the applicant has not demonstrated that adverse impacts have been avoided and minimized to the extent required by the Section 404(b)(1) Guidelines. Therefore, in accordance with our 1992 Interagency Memorandum of Agreement, the Service recommends that the request for a Department of the Army permit for this project be denied.

The Service appreciates the opportunity to provide comments on the FEIS. If you have any questions regarding this letter or previous Service correspondence relating to PCS Mine Continuation near Aurora, Beaufort County North Carolina under U.S. Army Corps of Engineers Action ID # 200110096 please contact Mike Wicker at 919-856-4520ext22 or by e-mail at mike_wicker@fws.gov.

Sincerely,

Pete Benjamin
Field Supervisor

References cited:

Feierabend, S.J. and J.M. Zelazny. 1987. Status report on our nation's wetlands. National Wildlife Federation, Washington, D.C., 50pp.

Giese, G.L., H.B. Wilder and G.G. Parker. 1985. Hydrology of major estuaries and sounds of North Carolina. USGS water-supply paper 2221.

Mitch, W. J. and J.G. Gosselink. 2000. *Wetlands*, 3rd Edition. John Wiley and Sons, New York. 936 pp.

North Carolina Division on Marine Fisheries. 2005. Chapter 4: Submerged Aquatic Vegetation. In: 2005 Coastal Habitat Protection Plan. http://www.ncfisheries.net/habitat/chppdocs/E_SAV.pdf

Odum, E.P. 1971. *Fundamentals of Ecology*, 3rd Edition. W.B. Sanders Company, Philadelphia. 574 pp.

Paerl, H.W., J.D. Bales, L.W. Ausley, C.P. Buzzelli, L.B. Crowder, L.A. Eby, J.M. Fear, M. Go, B.L. Peierls, T.L. Richardson and J.S. Ramus. 2001. Ecosystem impacts of three sequential hurricanes (Dennis, Floyd and Irene) on the United States' largest lagoonal estuary, Pamlico Sound, NC. Proceedings of the National Academy of Sciences 98:5655-5660.

Pomeroy, L.R. 1974. The ocean's food web: A changing paradigm. Bioscience 24:499-504.

Rich, P. H. and R. G. Wetzel. 1978. Detritus in the lake ecosystem. American Naturalist 112:57-71.

Sherr E.B. and B. Sherr. 1988. Role of microbes in pelagic food webs: A revised concept. Limnology and Oceanography 33: 1225-1227.

Street, M.W., A.S. Deaton, W.S. Chappell, and P.D. Mooreside. 2005. North Carolina Coastal Habitat Protection Plan. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries. Morehead City. 630 pp.

U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2006 National Survey of Fishing, Hunting and Wildlife-Associated Recreation.

Wetzel, R. G. 2001. *Limnology: Lake and River Ecosystems*, 3rd Edition. Academic Press. San Diego. 1006 pp.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1875 Century Boulevard
Atlanta, Georgia 30345

In Reply Refer To:
FWS/R4/ES

JAN 05 2007

Tom Walker
U.S. Army Corps of Engineers
Project Manager, Wilmington Regulatory Division
Post Office Box 1890
Wilmington, North Carolina 28402-1890

RE: Public Notice dated October 20, 2006, under Corps Action ID # 200110096 (review of the Draft Environmental Impact Statement, Potash Corporation of Saskatchewan Mine Continuation near Aurora, Beaufort County, North Carolina)

Dear Mr. Walker:

In accordance with the 1992 404(q) Memorandum of Agreement (MOA) between our agencies, the enclosed letter report provides the recommendations of the Department of the Interior in response to the above application for a Department of the Army Permit.

Pursuant to part IV.3(b) of the MOA, I have determined that the proposed work will have substantial and unacceptable impacts on aquatic resources of national importance if permitted as specified in the public notice, without incorporating our recommendations. I strongly encourage a mutual resolution of the identified wetland/wildlife concerns at the field level prior to your decision to issue the permit.

Sincerely yours,

Sam D. Hamilton

Sam D. Hamilton
Regional Director

Enclosure

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

December 20, 2006

Tom Walker
U.S. Army Corps of Engineers
Project Manager, Wilmington Regulatory Division
Post Office Box 1890
Wilmington, NC 28402-1890

Reference: PCS Phosphate, Action ID # 200110096

Dear Mr. Walker:

This letter provides the comments from the United States Fish and Wildlife Service (Service) on the subject Public Notice dated October 20, 2006 under Corps Action ID #: 200110096 (review of the Draft Environmental Impact Statement, DEIS, for the proposed Potash Corporation of Saskatchewan Mine Continuation near Aurora, Beaufort County, North Carolina). The Potash Corporation of Saskatchewan Phosphate Division, Aurora Operation (PCS) has applied for Department of the Army authorization pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act to advance its current mining operation into a 3,608 acre area east of its current mining operation located north of Aurora. The proposed expansion would impact 2,408 acres of waters of the United States including wetlands adjacent to the Pamlico River and South Creek. These comments are submitted in accordance with the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661-667d). Comments related to the FWCA are to be used in your determination of compliance with 404(b)(1) guidelines (40 CFR 30) and in your public interest review (33 CFR 320.4) in relation to protection of fish and wildlife resources. Additional comments are provided regarding the District Engineer's determination of project impacts pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543).

The PCS mine expansion is proposed adjacent to the Albemarle Pamlico Estuary Complex, the largest lagoonal estuary in the country and nationally significant estuarine resource. The fringe marshes, creeks, and beds of submerged aquatic vegetation in the Albemarle Pamlico Estuary Complex provide essential nursery habitat for most commercial and recreational fish and shellfish in the North Carolina coastal area (Street et al. 2005) and important habitat for waterfowl (http://www.fws.gov/birddata/databases/mwi/mwidb.html), shorebirds and other migratory birds. The importance of wetlands to coastal fish is not unique to North Carolina. Over 95% of the finfish and shellfish species commercially harvested in the United States are wetland-dependent (Feierabend and Zelazny 1987). The estuary also provides important habitat for anadromous fish, including the endangered shortnose sturgeon (*Acipenser breviorostrum*). The Albemarle Pamlico Estuary Complex supports an important recreationally-based economy. According to the 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (http://www.census.gov/prod/2003pubs/01fhw/fhw01-nc.pdf , see page 9) fishing expenditures for 2001 in North Carolina totaled 1.1 billion dollars. Given that the Applicant's Preferred alternative (AP) would result in impacts to more than 2,400 acres of wetlands and 7 miles of streams located directly adjacent to the Pamlico River, such large-scale impacts would likely have direct effects on the environmental quality of the Albemarle Pamlico Estuary Complex. We are especially concerned about the potential for mine expansion and operation to be detrimental to the food webs of the Albemarle Pamlico Estuary Complex. Consequently, the Service believes that the PCS mine expansion may result in substantial and unacceptable impacts to aquatic resources of the Albemarle Pamlico Estuary Complex.

1. <u>AP mining operations will negatively impact estuarine trophic structure through disruption of substrate inputs crucial to primary producers, 2) reduction of energy sources that fuel estuarine productivity, and 3) degradation of the nutrient sequestration capacity of the estuarine system</u>. Estuary productivity is dependent on the complex interactions among the various components of the aquatic food web; with epiphytes (attached to wetland macrophytes) and submerged aquatic vegetation; (SAV) forming the foundation of the estuarine food web (Odum 1971; Mitsch and Gosselink 2000; Wetzel 2001). SAV populations have recently declined by as much as 50%, possibly because of anthropogenic impacts (North Carolina Division of Marine Fisheries 2005). As a result, detritus supplied by wetland macrophytes has become more important as an epiphytic substrate. While phytoplankton are also important for productivity, the role of wetland plants and SAV detritus is of greater importance to the overall stability of shallow aquatic food webs (Rich and Wetzel 1978). It is our opinion that the AP mining operations will negatively impact both types of epiphytic substrates, and adequate mitigation is not proposed in the DEIS. However, adequate restoration is available if PCS focuses their expansion and other operations on lands south of Hwy 33.

   Also of importance to estuarine food webs is the gradual and episodic release of dissolved organic matter (DOM) from the contributing basins and wetlands immediately adjacent to the Albemarle Pamlico Estuary Complex. This energy source fuels bacterial communities that, through mineralization, provide inorganic nitrogen, phosphorous and carbon, supporting productivity. In addition, DOM supported bacteria are an important component of the "microbial loop" (Pomeroy 1974; Sherr and Sherr 1988). This part of aquatic food webs links DOM (of autochthonous and/or allochthonous origin) to higher trophic levels, via bacteria-protist-metazoan-zooplankton interactions. The impacts associated with the AP would decrease the quantity and quality of allochthonous DOM supplied to the estuary because of the close proximity of PCS's proposed mining operations.

Marsh systems provide additional functions that can influence estuarine food webs. For example, carbon of wetland origin is also exported from marsh systems in the guts of migratory feeding fish and birds or cycled through the marsh to the upper ends of tidal creeks and back to the marsh (Mitsch and Gosselink 2000). Also, marshes act to sequester and process inorganic nutrients from flood waters. The major tributaries to the Pamlico Sound, the Neuse and Tar Rivers, have been found to be excessively polluted with nutrients and are currently being managed to reduce nutrient loads. Nutrient enrichment, or eutrophication, has promoted increased algal productivity, which had resulted in hypoxia, anoxia, and fish kills in the lower estuary. Removal of wetlands in the Pamlico Sound system acts to exacerbate the impacts of this loading by removing the system's nutrient uptake capability.

Most of the wetlands that would be subjected to impacts are wet forests, including bottomland hardwood forests. These areas are subjected to repeated periods of inundation and desiccation. This is important from a biogeochemical perspective as it allows for the accumulation of particulate organic matter and its subsequent processing (dissolution and mineralization). This leads to episodic exports of dissolved organic materials to the estuary. It also retains nutrient loads carried by high flow events, which are later sequestered into forest biomass. Such systems are also important for denitrification. These areas also provide refugia and nursery habitat for aquatic organisms during high flow periods. Productivity is high in such wetlands with pulsing hydroperiods (Mitsch and Gosselink 2000).

2. Mining will directly affect the rate at which water is routed through the watershed. As the mine expansion progresses, there is an ever increasing trend of diverting surface water drainage which once promoted estuarine productivity into National Pollutant Discharge Elimination System (NPDES) channels, pipes and outfalls. This redirection of surface flows contributes to estuarine degradation because it removes natural watershed drainage patterns that 1) promote infiltration and trapping of sediments and other pollutants, and 2) provide a beneficial diffuse source of water to the estuary. This critical watershed function is reflected in the DEIS (paragraph 3, A-91) "Mr. Wicker stated that the ... catchment basin is critically important for these streams, because rainfall is the stream's source of water. Dr. Skaggs replied that Mr. Wicker's summation was correct." In light of this concern, we are troubled that the rate of mine expansion far exceeds the rate of recovery completed. According to page 4-78 of the DEIS, in the period between 1965 - 2005, a total of 7,729 acres were mined but only 1,101 were reclaimed. In short, reclamation (including vegetation and hydrology restoration) will allow the water quality benefits of natural drainage to return to the estuary over time; however, the discrepancy in progress between mining and reclamation activities significantly limits the potential for system recovery and should be addressed in the DEIS.

Offsets to wetland plant community losses through the proposed mitigation schedule may not be adequate to maintain the wetland functions within the watershed. Replacing mature wetlands with immature restored or created wetlands will not provide the physical or chemical functions of existing wetland systems. Plant communities drive many physical and chemical processes within wetlands such as 1) sedimentation, and, because of adsorption, nutrient retention, 2) hydrological demand through transpiration, 3) nutrient (inorganic nitrogen and phosphorous) cycling, 4) soils for microbial communities responsible for denitrification and 5) flood mitigation because mature communities are stable sources of hydraulic roughness.

It is our opinion that the applicant should provide upfront mitigation for stream, riparian buffer and wetland impacts. By replacing mature watershed systems with restored wetlands, there will be significant lag time (several decades at least) before vegetation and soils can develop so they can adequately mitigate for the losses of DOM production and nutrient sequestration/processing provided by the present ecosystems. Given the estuary's designation as an aquatic resource of national importance, this large-scale loss of habitat quality for a period of decades is not acceptable. For these reasons, we suggest that the applicant mine in the area south of Hwy 33 because all of the other mining alternatives destroy large watersheds too close to the estuary to be adequately mitigated. In all areas other than south of Hwy 33, adequate compensatory mitigation was not proposed.

3. <u>The Service has previously recommended that the applicant complete endangered species surveys.</u> We cannot concur with your endangered species determinations presented in the DEIS for bald eagle (*Haliaaetus leucocephalus*), or red-cockaded woodpecker (*Picoides borealis*) because both of these species occur in the area and no surveys have been completed within the last ten years. The Service also recommends surveys conducted on red wolf (*Canus rufus*) since it is also known to occur in the general area.

4. <u>The Service has been involved in reclamation soil quality issues described in subsection 4.1.3.1. While the four pages of text in this section present much useful information, four components are missing that are needed to capture the scope of the issues that should be considered for the DEIS;</u>

   - The subsection should be re-named Elemental Contaminant Issues and include a brief summary of other elements enriched in reclamation soils. For instance, average concentrations of arsenic at R2 were about 75-times background (maximum 110-times background), and concentrations in soils exceed some regulatory guidance values for polluted sites. Chromium concentrations at R2 also averaged about 75-times background (maximum 80-times background). Some additional summary statistics like this for the other elements evaluated by Drs. Trefry and Logan (e.g. specific constituents of concern other than Cd and As) would help readers see the scope of the elemental contaminant concerns in reclamation soils made from gypsum-clay waste blends.

- The Service draft report Significance of Cadmium in the Terrestrial Environment on and Adjacent to PCS Phosphate Mine Reclamation Lands (2001) is not referenced in this section and it should be summarized here. An appropriate place for inclusion would be just after the discussion of the earthworm bioaccumulation test (beginning on page 4-6 and ending at the top of page 4-7.

- The discussion of sources of elevated cadmium in South Creek and Pamlico River sediments is reasonable regarding historic inputs from a pipeline rupture and now-ceased wastewater discharges. The DEIS notes that these sources are gone. However, site run-off is also a plausible hypothesis for continued releases to these areas, and metals analyses of sediments collected recently would help clarify this issue. Most of the samples being discussed are over a decade old; if the historic spill and now eliminated discharge sources were the cause, then sediment metal concentrations should be lower now. We encourage some new sampling to address this issue.

- From the last paragraph on page 4-8 to the end of this section, the DEIS discusses the capping of reclamation soils. This section should include some information on the performance of the capping approach and whether PCS intends to continue with this approach based on their experience with capping thus far. We consider PCS's capping solution to be a very positive approach to ameliorating concerns with metals in reclamation soils, and we believe it should be continued. The effort is commendable, and if it is going well, PCS should let reviewers know the plan is working as anticipated. Because this section states several times that PCS may consider alternate approaches in the future, it would help readers if the performance of the existing approach was discussed along with the status of any studies on this or other options. Lastly, the section should be re-phrased to note that any alternative to capping would need to be effective in addressing arsenic, chromium and other metals enriched in reclamation soils in addition to cadmium.

5. <u>Given the potential for significant hydrological and trophic impacts to estuarine resources highlighted above (bullets # 1 & 2), and the lack of adequate mitigation, proposed expansion of PCS mining operations north of Hwy 33 cannot be supported.</u> We note that the PCS plant facilities can operate independent of the mine (Section 2.6.2) and mining south of Hwy 33 could be supplemented with importation of phosphate rock to eliminate any shortfalls in supply. Therefore, the Service does not agree with the applicant's assertion of "purpose and need" requiring continued mining since the plant facilities can operate with importation of rock, thus avoiding degradation of the nationally significant Albemarle Pamlico Estuary Complex

The Albemarle Pamlico Estuary Complex is a bar-built estuary (Odum 1971), enclosed by North Carolina's Outer Banks. These barrier islands create a lake-like, brackish water body with only small outlets connecting it to the Atlantic Ocean (Paerl et al. 2001). Such geomorphic character produces a relatively closed system with a hydrologic residence time of about one year (Giese et al. 1985). This means that the Albemarle Pamlico Estuary Complex is highly effective at retaining nutrients, sediments and organic matter conveyed by its freshwater sources. These sediments and organic materials have absorptive relationships with nutrients, heavy metals and other toxicants that may cause chronic ecosystem impacts during hydrologic events that resuspend benthic materials in the estuaries. Thus, the impacts represented by PCS Phosphate's mining expansion should be considered with considerable diligence, as such impacts are likely to produce a legacy of environmental effects that could last for years, affecting estuarine food webs.

The Service concludes that the proposed project may result in substantial and unacceptable adverse impacts to aquatic resources of national importance. Such large-scale wetland impacts located directly adjacent to the Pamlico River, as argued above, will act to exacerbate the impacts of eutrophication while altering local food web stability; both of which have important implications for estuarine productivity. Additionally, the proposed compensatory mitigation is insufficient to offset adverse impacts to the aquatic environment except in the area south of Hwy 33 (the applicant considers an alternative to only mine south of 33 as not practicable, Section 2.7.4). Further, the applicant has not demonstrated that adverse impacts have been avoided and minimized to the extent required by the Section 404(b)(1) Guidelines. Therefore, in accordance with Part IV.3.a of our 1992 Interagency Memorandum of Agreement, the Service recommends that the request for a Department of the Army permit for this project be denied.

The Service appreciates the opportunity to provide comments on the DEIS. If you have any questions please contact Mike Wicker at 919-856-4520ext22 or by e-mail at mike_wicker@fws.gov.

Sincerely,

Pete Benjamin
Field Supervisor

References cited:

Feierabend, S.J. and J.M. Zelazny. 1987. Status report on our nation's wetlands. National Wildlife Federation, Washington, D.C., 50pp.

Giese, G.L., H.B. Wilder and G.G. Parker. 1985. Hydrology of major estuaries and sounds of North Carolina. USGS water-supply paper 2221.

Mitch, W. J. and J.G. Gosselink. 2000. *Wetlands*, 3rd Edition. John Wiley and Sons, New York. 936 pp.

North Carolina Division on Marine Fisheries. 2005. Chapter 4: Submerged Aquatic Vegetation. In: 2005 Coastal Habitat Protection Plan. http://www.ncfisheries.net/habitat/chppdocs/E_SAV.pdf

Odum, E.P. 1971. *Fundamentals of Ecology*, 3rd Edition. W.B. Sanders Company, Philadelphia. 574 pp.

Paerl, H.W., J.D. Bales, L.W. Ausley, C.P. Buzzelli, L.B. Crowder, L.A. Eby, J.M. Fear, M. Go, B.L. Peierls, T.L. Richardson and J.S. Ramus. 2001. Ecosystem impacts of three sequential hurricanes (Dennis, Floyd and Irene) on the United States' largest lagoonal estuary, Pamlico Sound, NC. Proceedings of the National Academy of Sciences 98:5655-5660.

Pomeroy, L.R. 1974. The ocean's food web: A changing paradigm. Bioscience 24:499-504.

Rich, P. H. and R. G. Wetzel. 1978. Detritus in the lake ecosystem. American Naturalist 112:57-71.

Sherr E.B. and B. Sherr. 1988. Role of microbes in pelagic food webs: A revised concept. Limnology and Oceanography 33: 1225-1227.

Street, M.W., A.S. Deaton, W.S. Chappell, and P.D. Mooreside. 2005. North Carolina Coastal Habitat Protection Plan. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries. Morehead City. 630 pp.

Wetzel, R. G. 2001. *Limnology: Lake and River Ecosystems*, 3rd Edition. Academic Press. San Diego. 1006 pp.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

In Reply Refer To:
FWS/AFHC/HRC/DCN040619

The Honorable John Paul Woodley, Jr.
Assistant Secretary of the Army (Civil Works)
108 Army Pentagon
Room 3E446
Washington, DC 20310-0108

Dear Mr. Woodley:

The Fish and Wildlife Service (FWS) notified the Wilmington District Commander on March 20, 2009, that we are pursuing review by the Assistant Secretary of the Army (Civil Works) of the proposed Clean Water Act (CWA) Section 404 permit to the Potash Corporation of Saskatchewan, Phosphate Division, Aurora Operation, to be issued by the Corps of Engineers Wilmington District. That request for elevation was made pursuant to Part IV, paragraph 3(d) (2), of the Memorandum of Agreement (MOA) between the Department of the Interior and the Department of the Army to supplement Section 404(q) of the CWA. The Wilmington District issued a Notice of Intent to Proceed on this permit under a letter dated March 2, 2009, and received by our regional office on March 5, 2009. We have been preparing to request our Acting Assistant Secretary for Fish and Wildlife and Parks to seek review of the permit decision document by the Assistant Secretary of the Army (Civil Works) pursuant to paragraph 3(f)(2) of the MOA. Under the standard MOA timeline, that request must be made by April 9, 2009.

However, on Friday, April 3, 2009, the Wilmington District provided our Raleigh Ecological Services Field Office (and EPA) approximately 80 pages of new material regarding the project, including the District's draft Record of Decision and supporting maps. It is not clear why this material was not included with the District's March 2, 2009 Notice of Intent to Proceed (NOI) to FWS. Since receipt of the NOI, FWS has noticed the stream impacts are different in the new material than were reported in the NOI. If the District had transmitted this information along with its NOI, FWS would have had a total of 35 days under the MOA to review this material. Since it was shared so late in the process, USFWS has effectively been denied an opportunity to review and respond to this material prior to initiating the elevation process. In order for FWS to be afforded an appropriate amount of time to review this new material, I request that you allow FWS an additional 20 days to review the new material and decide whether or not to continue the process under paragraph 3(f)(2).

TAKE PRIDE IN AMERICA

I appreciate your prompt attention to this matter. Please feel free to contact me or Gary Frazer, Assistant Director for Fisheries and Habitat Conservation (202/208-6394) if you have questions or wish to discuss further.

Sincerely,

Acting DIRECTOR

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1875 Century Boulevard
Atlanta, Georgia 30345

In Reply Refer To
FWS/R4/ES

MAR 20 2009

Colonel Jefferson M. Ryscavage
District Engineer, Wilmington District
U.S. Army Corps of Engineers
69 Darlington Avenue
Wilmington, North Carolina 28403-1343

Subject: Recommendation to Request a Higher Level Review for Department of Army Permit AID 200110096, Potash Corporation of Saskatchewan Phosphate Division, Aurora Operation (PCS) Mine Continuation

Dear Colonel Ryscavage:

We have received your Notice of Intent to Proceed on the proposed Department of the Army Permit AID 200110096, The Aurora Operation (PCS) Mine Continuation, dated March 2nd and received at USFWS Region 4 on March 5, 2009. Pursuant to Paragraph 3(d)(2) of the Memorandum of Agreement (MOA) between the Department of the Interior and the Department of Army, under Clean Water Act Section 404 (q) Part IV, I am requesting a review of this permit by the Acting Assistant Secretary of Fish and Wildlife and Parks, Department of the Interior, and recommending that he request review of the permit by the Assistant Secretary of the Army for Civil Works. During this review, the permit should be held in abeyance pending completion of the review process pursuant to the MOA Part IV, Paragraph 3(e).

The USFWS remains concerned that the proposed project will result in unacceptable adverse impacts to aquatic resources of national importance, including direct and indirect impacts to waters of the U.S. which support the Albemarle Pamlico National Estuary Program area. The proposed project will have direct impacts to 3,953 acres of wetlands and 45,494 linear feet of stream, including a portion of a designated Significant Natural Heritage Area. The impacts also include a loss of approximately 70 percent of the watershed areas within the proposed project boundaries. The project will adversely affect the Albemarle Pamlico Complex and those effects have not yet been adequately addressed. In addition to the need to further avoid and minimize impacts to the site's high value aquatic resources, there are concerns regarding the adequacy of the proposed compensatory mitigation to offset any authorized impacts.

We recognize the desire for timely decision making on this permit. We have worked closely with your staff and have offered our comments throughout the Environmental Impact Statement and 404 permitting process, and we appreciate the efforts by both you and the applicant to address them. Still, critical issues about the impact of this project remain unresolved and based on the concerns cited above; we do not support issuance of the permit for the project as currently proposed. Therefore, pursuant to the procedures and timelines in the national 1992 Memorandum of Agreement with the Corps of Engineers, we are seeking review by Acting Assistant Secretary Fish and Wildlife and Parks, Department of the Interior and the Assistant Secretary for Civil Works.

Please contact Pete Benjamin, Field Supervisor, Raleigh Ecological Services, at (919) 856-4520, extension 11 for further information, and we look forward to continuing our dialogue as we move forward.

Sincerely Yours,

Linda A Kelsey

for / Sam D. Hamilton
Acting Regional Director

Mike_Wicker@fws.gov
04/16/2009 11:26 AM

To Rebecca Fox/R4/USEPA/US@EPA
cc
bcc
Subject USFWS will not be at onsite meeting

----- Forwarded by Mike Wicker/R4/FWS/DOI on 04/16/2009 11:24 AM -----

Mike Wicker/R4/FWS/DOI
04/16/2009 11:16 AM

To Jeff Weller/R4/FWS/DOI
cc Jack Arnold/R4/FWS/DOI, Pete Benjamin/R4/FWS/DOI@FWS
Subject Fw: PCS onsite visit

Jeff,

Here's the e-mail I had sent EPA earlier. Do not know where anyone got the impression I was going. Pete and I knew we were not invited.

I am off tommorrow and among other things plan on going fishing for American shad on the Neuse (one of my favorite things to do and the weekdays are best because on the weekends the best spots get competitive).

Have a nice weekend.

Thanks for all your help.

Mike

----- Forwarded by Mike Wicker/R4/FWS/DOI on 04/16/2009 11:06 AM -----

Mike Wicker/R4/FWS/DOI
04/15/2009 09:14 AM

To Fox.Rebecca@epamail.epa.gov
cc pace.wilber@noaa.gov, Pete Benjamin/R4/FWS/DOI@FWS
Subject Re: PCS onsite visit

Becky,

I talked with Pete. It was his understanding also that we we are not invited to attend the meeting since we did not get the elevation request in under the timeline. We will try to get our letter signed by the RD so that we can be there in proxy. Our absence at the meeting in no way reflects a lack of interest. It is a COE meeting and PCS is not public property so we can not go if we are not invited.

Mike
Fox.Rebecca@epamail.epa.gov

Fox.Rebecca@epamail.epa.gov

04/15/2009 07:49 AM

To pace.wilber@nmfs.gov, mike_wicker@fws.gov

cc

Subject PCS onsite visit

Pace/Mike,

Just checking to see if anyone from FWS or NMFS is planning to
attend
the PCS onsite this Friday with the Army. Jennifer Derby is now
going
to go so EPA will have someone there and now Army is saying this
will be
EPA's one and only time to make our case to Army -- that there
will be
no further discussions after this visit. It's all very strange
since we
were told they could not make our onsite date and this was the
only day
they could do it and we weren't even planning to have anyone
there
except my management decided it would be a good idea if we were
represented and now that we are going to have someone there --
Army is
saying this is EPA's only chance to make our verbal case to them.
Didn't know what your agencies' plans were but I'm sure it would
be
helpful for Jennifer to have some support if you all are planning
to
attend...

Mike, Palmer and I have reviewed your 3f1 letter and think it
looks good
-- just have a few small comments -- will get them to you later
this
morning. Stay tuned... b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531

Email: fox.rebecca@epa.gov

"Pace.Wilber" <Pace.Wilber@noaa.gov>

04/16/2009 02:29 PM

To Mike Wicker <Mike_Wicker@fws.gov>, Palmer Hough/DC/USEPA/US@EPA, Rebecca Fox/R4/USEPA/US@EPA

cc Ron Sechler <ron.sechler@noaa.gov>

bcc

Subject NMFS PCS letter

Hi everyone.

Attached is the draft letter that Ron and I prepared for the COE in response to the 3(c) letter sent us a few weeks ago. Our response is due tomorrow (April 17). As noted previously, we simply do not have the time to pursue this further. Hopefully in letting the COE know that, we are still supporting FWS and EPA. Any comments Ron and I get by 0830 tomorrow have a good chance of being added to the letter.

Thanks,
Pace

--

Pace Wilber, Ph.D.
Atlantic Branch Chief, Charleston (F/SER47)
Southeast Regional Office, NOAA Fisheries
PO Box 12559
Charleston, SC 29422-2559

843-953-7200
FAX 843-953-7205
pace.wilber@noaa.gov

http://sero.nmfs.noaa.gov/dhc/habitat.htm

Colonel Jefferson Ryscavage
District Engineer, Wilmington District
Department of the Army, Corps of Engineers
Regulatory Division
P. O. Box 1890
Wilmington, North Carolina 28402-1890

Attention: Tom Walker

Dear Colonel Ryscavage:

NOAA's National Marine Fisheries Service (NMFS) reviewed your letter dated March 30, 2009, which was received April 2, 2009, concerning the Wilmington District's Final Environmental Impact Statement (FEIS) "*Potash Company of Saskatchewan, Inc. (PCS) Phosphate Mine Continuation at Aurora in Beaufort County, North Carolina*" (Action ID No. 200110096). Your letter, which included a draft Record of Decision and draft permit conditions, indicates that you conclude that issuance of a permit for the modified Alternative L alignment would not result in substantial and unacceptable impacts to aquatic resources of national importance and, based on the compensatory mitigation that would be required by the permit, adverse impacts to essential fish habitat (EFH) would not occur from the project. The letter was provided to NMFS in accordance with Part IV, Section 3(c)(2) of the 1992 Memorandum of Agreement between the Departments of Commerce and Defense regarding Clean Water Act section 404(q) and in accordance with 50 CFR Part 600, which describes how federal agencies will coordinate to protect, conserve, and enhance EFH. Our comments below summarize our more important concerns, including where NMFS continues to differ with the Wilmington District regarding the impacts expected to result from the project, however, due to competing priorities for staff time, NMFS will not appeal your decision under the terms of the 1992 Memorandum of Agreement.

Previous letters from NMFS and the Wilmington District describe the project, list project authorities, review consultation history, and identify the expected impacts to EFH and fishery species. Throughout the review process, NMFS consistently focused on the project's likelihood of degrading the nationally significant fish and wildlife resources of the Albemarle-Pamlico Estuary Complex (APEC) within which the proposed mine expansion is located. In short, the Wilmington District concludes after examining at least 11 action alternatives that modified

Alternative L represents the least environmentally damaging practicable alternative (LEDPA) for PCS to expand its mine, and this alternative includes mining within three tracts referred to as NCPC, Bonnerton, and S33. Modified Alternative L would impact 11,909 acres, including approximately 3953 acres of jurisdictional wetlands and 25,727 feet of streams. In comparison to other alternatives, modified Alternative L would avoid direct impacts to 141 acres of EFH that includes wetlands associated with South Creek within the NCPC tract and Porter Creek within the Bonnerton tract. Our comments are divided into three sections: (1) identification of EFH, (2) sequential mitigation, and (3) monitoring and adaptive management.

Identification of EFH

The Bonnerton and NCPC tracts include tidally influenced forested wetlands, creeks, and salt marsh designated as EFH by the South Atlantic Fishery Management Council and Mid Atlantic Fishery Management Council for federally managed fishery species, including penaeid shrimp, gray snapper, summer flounder, and bluefish. A subset of the areas designated as EFH is recognized by the North Carolina Wildlife Resources Commission (NCWRC) as inland Primary Nursery Areas (PNAs), and this state designation also makes these areas a federally designated Habitat Area of Particular Concern (HAPC), the subset of EFH that warrants the highest protection under the Magnuson-Stevens Act. The PNAs within the project area are Porter Creek, Tooley Creek, Jacobs Creek, and Jacks Creek; the latter three creeks empty into South Creek, which is designated a Special Secondary Nursery Area by the State of North Carolina and also is an HAPC.

As acknowledged in past correspondence from both of our offices, the upper limits of PNAs has not been delineated in the field. In the absence of this delineation, the Wilmington District focuses on the North Carolina State Statute that defines PNAs, and the District concludes that the upper limit of the PNAs equates to the boundary between perennial and intermittent flows within the creeks named as PNAs. The modified Alternative L for the proposed mine expansion avoids direct impacts to PNAs under this definition. While NMFS believes that substantial ecological services are provided to fishery resources from the portions of the creeks that have intermittent flows and their headwater wetlands, we accept the Wilmington District's interpretation of the relevant North Carolina State Statute as reasonable and that as a result of close coordination between the applicant, resource agencies, and Wilmington District, direct impacts to HAPCs are no longer proposed.

Sequential Mitigation

Avoidance and Minimization of Impacts

The LEDPA must be identified before evaluating compensatory mitigation. The US Environmental Protection Agency (EPA) contends in its comments on the EIS and subsequently submitted materials that the S33 alternative is the LEDPA because it is least damaging to the environment. The Wilmington District contends that the S33 alternative is not practicable, and that Alternative L is the LEDPA. It is disconcerting that the EPA and the Wilmington District do not agree upon this point given its fundamental and critical importance to the review process. Both agencies maintain their economic analysis is thorough and appropriately peer reviewed within their respective agency. Given the large differences in the outcomes of these analyses and that the Wilmington District is proposing to authorize the largest wetland destruction within

North Carolina under the Clean Water Act, an external peer review is clearly needed to provide the public with assurance that the laws and programs put in place to protect public trust resources, such as APEC, were rigorously followed. We recommend the US Army Corps of Engineers pursue this review even if it is done after a final decision on the application from PCS is rendered because the different approaches that EPA and the Wilmington District took in their analysis will likely trigger substantive disagreements on future projects.

Relative to alternatives earlier promoted by the applicant, modified Alternative L reflects avoidance and minimization of direct impacts to wetlands that we believe represent the higher value to fishery species. While these steps are noteworthy, additional avoidance and minimization appear practicable. On March 30, EPA, NMFS, and the US Fish and Wildlife Service provided the Wilmington District and applicant with an alternative boundary for the mine. In addition to reducing impacts to habitats that support nursery areas, this alternative would provide opportunities for on-site compensatory mitigation to be pursued within PNAs, which NMFS believes would also benefit fishery resources within South Creek as well as the larger APEC. The applicant expressed a desire to review the new alternative and noted that its evaluation could take a month or longer. NMFS recommends the Wilmington District withhold its final determination on the application until the applicant's review is complete and vetted through resource agencies and stakeholders. At the very least, we continue to recommend exclusion from the mine seven areas that total approximately 50 acres and serve as headwaters of tidally influenced creeks that we believe are significant nursery areas for fishery species (aerial images with these seven exclusion areas were informally provided to the District in March, and GIS data can be provided upon request).

Functional Assessment of the Compensatory Mitigation

The mitigation plan (FEIS Appendix I) involves multiple sites and strategies to compensate for the ecosystem services lost over the life of the project. The proposed restoration efforts primarily focus on croplands and drained forested wetlands that are underlain by hydric soils and, therefore, expected to be good candidates for wetland restoration. The proposed mitigation would occur at sites south of the Pamlico River (primarily south, east, and west of the S33 tract) and at sites north of the Pamlico River. Under the plan, 7968, 756, and 2472 acres of wetlands would be restored, enhanced, and preserved, respectively. To guide their evaluation of the proposed compensatory mitigation, replacement to loss ratios used by Wilmington District are based on 2:1 for restoration, 3:1 for enhancement, and 8:1 to 10:1 for preservation. The replacement ratio used for examining stream replacement is 1.8:1. In this regard, it is important to note that 71 percent of the NCPC tract, 76 percent of the Bonnerton tract, and 20 percent of the S33 tract are wetlands. By 2011, the applicant plans to complete construction of all the compensatory mitigation projects needed to offset the losses from mining the NCPC and Bonnerton tracts. To implement this schedule, the applicant has expended considerable effort to identify, acquire, and develop off-site mitigation through restoration of previously impacted waters and wetlands.

The applicant's proposal to provide mitigation up front and on an ambitious schedule is commendable. While tallies summarizing the overall mitigation are persuasive, it is disconcerting that a quantitative, functional assessment, using a habitat equivalency analysis or a similar method, has not been performed. Decisions relying mostly upon best professional judgment are unavoidable for a project of this scale. While a formal, functional assessment would also rely upon best professional judgment, it would do so in a manner that greatly increases precision (in the sense of repeatability) and transparency, facilitates sensitivity analyses, includes benefits from reclamation, and identifies key milestones for focus in an adaptive management program that ultimately focuses on whether the compensatory mitigation yields ecological services to South Creek, Durham Creek, and Pamlico River on a scale comparable to the losses at Jack, Jacob, Tooley, Porter, and other creeks within the NCPC and Bonnerton tracts. A formal functional assessment would also bring into sharper focus that what has been achieved thus far the issue of whether wetlands within the subset of the Bonnerton tract that is a nationally significant Natural Heritage Area can be mitigated and, if so, at what relative cost.

Monitoring and Adaptive Management

Monitoring

NMFS remains concerned about the loss of headwater wetlands associated with PNAs under the modified Alternative L alignment. Based on input regarding the designation of these areas as HAPCs, PCS agreed to avoid direct impacts to these creeks. However, as noted by the Wilmington District, resource agencies, and NOAA's Center for Coastal Fisheries and Habitat Research (Beaufort Laboratory), substantial indirect impacts to PNAs and other tidal creeks would result from the proposed loss of headwater wetlands and intermittent streams on the NCPC and Bonnerton tracts. To address this concern, we recommended that prior to initiation of land clearing activities in the headwater wetlands of state designated nursery areas located along the NCPC shoreline of South Creek, PCS develop a plan of study to address the effects of a reduction in headwater wetlands on the utilization of these nursery areas by resident fish and invertebrates. In these systems, resident fish and invertebrate are important prey for estuarine dependent species that seasonally frequent estuarine creeks during sub-adult development stages. Monitoring changes in these populations should prove a reasonable indicator of the effect of losses of headwater wetland on changes in resident species that support the nursery area function of these creeks. NMFS is pleased to see that the draft permit conditions require within 6 months of permit issuance development of a detailed plan for such a monitoring program. We offer to continue to work with the Wilmington District, PCS, and other interested parties to further refine these conditions into a detailed plan.

Adaptive Management

The scales of the proposed mine and compensatory mitigation are large and the impacts and benefits that would actually accrue from these actions (as opposed to predicted to accrue) would be subject to variables that can only be generally forecasted at the time of a permit decision. Proper and timely execution of the monitoring programs followed by responsive adjustments of mining and mitigation plans would be essential to ensure expansion of the PCS mine under modified Alternative L is done in a manner that is in the public interest. Requiring the applicant to adhere to a process that allows the Wilmington District and resource agencies to substantively engage in the oversight of the project and in adjustments to project design is necessary for NMFS to have reasonable assurance that impacts to NOAA trust resources would be adequately compensated.

NMFS is pleased to see that the draft permit conditions require that the applicant establish an independent panel of scientists and engineers that would annually review the project and determine if direct and indirect impacts and benefits are accruing at the rates forecasted at the time of a project authorization. Data and reports should be placed in a publically accessible location, such as a website, and be freely available. The panel will also annually provide the Wilmington District and applicant with recommended changes to the mining and mitigation that are necessary to bring the project into alignment with expectations. We offer to continue to work with the Wilmington District, PCS, and other interested parties to further refine and implement the adaptive management plan, should a permit be issued.

Thank you for the opportunity to provide these comments. Related questions or comments should be directed to the attention of Mr. Ronald Sechler at our Beaufort Field Office, 101 Pivers Island Road, Beaufort, North Carolina 28516-9722, or at (252) 728-5090.

Robin Wiebler
<Robin.Wiebler@noaa.gov>

04/17/2009 04:30 PM

To NCCOE Tom Walker <William.T.Walker@usace.army.mil>, Mike_Wicker@fws.gov, Rebecca Fox/R4/USEPA/US@EPA, SAFMC Roger Pugliese <roger.pugliese@safmc.net>, NC

cc

bcc

Subject PCS response letter

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
(727) 824-5317; FAX (727) 824-5300
http://sero.nmfs.noaa.gov/

F/SER4:RS/pw

APR 17 2009

Colonel Jefferson Ryscavage
District Engineer, Wilmington District
Department of the Army, Corps of Engineers
Regulatory Division
P. O. Box 1890
Wilmington, North Carolina 28402-1890

Attention: Tom Walker

Dear Colonel Ryscavage:

NOAA's National Marine Fisheries Service (NMFS) reviewed the letter dated March 30, 2009, from the Corps of Engineers, Wilmington District (COE) which NMFS received April 2, 2009, concerning the COE's Final Environmental Impact Statement (FEIS) "*Potash Company of Saskatchewan, Inc. (PCS) Phosphate Mine Continuation at Aurora in Beaufort County, North Carolina*" (Action ID No. 200110096). The COE's letter, which included a draft Record of Decision and draft permit conditions, indicates that the COE concludes that issuance of a permit for the modified Alternative L alignment would not result in substantial and unacceptable impacts to aquatic resources of national importance, and based on the compensatory mitigation that would be required by the permit, adverse impacts to essential fish habitat (EFH) would not occur from the project. The letter was provided to NMFS in accordance with Part IV, Section 3(c)(2) of the 1992 Memorandum of Agreement between the Departments of Commerce and Defense regarding Clean Water Act section 404(q) and in accordance with 50 CFR Part 600, which describes how federal agencies will coordinate to protect, conserve, and enhance EFH. The comments below summarize NMFS' principal concerns, including areas where NMFS continues to differ with the COE regarding the impacts expected to result from the project. However, in light of factors described below as well as constraints on staff time, NMFS will not appeal the COE's decision under the terms of the 1992 Memorandum of Agreement. This letter therefore constitutes NMFS' response to the COE in accordance with Part IV, Section 3(d)(1) of the Memorandum of Agreement that NMFS will not request higher level review.

Previous letters from NMFS and the Wilmington District describe the project, list project authorities, review consultation history, and identify the expected impacts to EFH and fishery species. Throughout the review process, NMFS consistently focused on the project's likelihood of degrading the nationally significant fish and wildlife resources of the Albemarle-Pamlico Estuary Complex (APEC) within which the proposed mine expansion is located. The review process identified at least 11 action alternatives for consideration; the COE has concluded that Modified Alternative L represents the least environmentally damaging practicable alternative (LEDPA) for PCS to expand its mine. This alternative includes mining within three tracts referred to as NCPC, Bonnerton, and S33. Modified Alternative L would impact 11,909 acres, including approximately 3953 acres of jurisdictional wetlands and 25,727 feet of streams. In comparison to other alternatives, Modified Alternative L would avoid direct impacts to 141 acres of EFH that includes wetlands associated with South Creek within the NCPC tract and Porter Creek within the Bonnerton tract. NMFS' comments are divided into three sections: (1) identification of EFH; (2) sequential mitigation; and (3) monitoring and adaptive management.

Identification of EFH
The Bonnerton and NCPC tracts include tidally influenced forested wetlands, creeks, and salt marsh designated as EFH by the South Atlantic Fishery Management Council and Mid Atlantic Fishery Management Council for federally managed fishery species, including penaeid shrimp, gray snapper, summer flounder, and bluefish. A subset of the areas designated as EFH is recognized by the North Carolina Wildlife Resources Commission (NCWRC) as inland Primary Nursery Areas (PNAs). Pursuant to the designations of EFH by the Councils, PNAs are also designated as Habitat Area of Particular Concern (HAPC), the subset of EFH that warrants the highest protection under the Magnuson-Stevens Act. The PNAs within the project area are Porter Creek, Tooley Creek, Jacobs Creek, and Jacks Creek. The latter three creeks empty into South Creek, which is designated a Special Secondary Nursery Area by the State of North Carolina and is also designated as an HAPC.

As acknowledged in past correspondence from both of our offices, the upper limits of PNAs has not been delineated in the field. In the absence of this delineation, the COE referenced the North Carolina state statute that defines PNAs, and the COE concluded the upper limit of the PNAs equates to the boundary between perennial and intermittent flows within the creeks named as PNAs. The Modified Alternative L for the proposed mine expansion avoids direct impacts to PNAs under this definition. While NMFS believes that substantial ecological services are provided to fishery resources from the portions of the creeks that have intermittent flows and from their headwater wetlands, NMFS accepts the COE's interpretation of the relevant North Carolina state statute as reasonable. As a result of close coordination among the applicant, resource agencies, and the COE, NMFS has determined direct impacts to HAPCs are no longer likely.

Sequential Mitigation
Avoidance and Minimization of Impacts
The LEDPA must be identified before evaluating compensatory mitigation. The US Environmental Protection Agency (EPA) contends in its comments on the EIS and subsequently submitted materials that Alternative L/Modified Alternative L is not the

LEDPA because there are less environmentally damaging alternatives. The COE contends that the less environmentally damaging alternatives are not practicable, and that Alternative L (according to the FEIS) and Modified Alternative L (according to the ROD) is the LEDPA. Both agencies maintain their economic analysis is thorough and appropriately peer reviewed within their respective agency. Given the significant differences in the outcomes of these analyses and that the COE is proposing to authorize the largest wetland destruction within North Carolina under the Clean Water Act, an external peer review is clearly needed to provide the public with assurance that the laws and programs put in place to protect public trust resources, such as APEC, were rigorously followed. NMFS recommends the COE conduct this review even if it is done after a final decision on the application from PCS is rendered, because the different approaches that EPA and the Wilmington District took in their respective analysis will likely trigger substantive disagreements on future projects.

Relative to alternatives earlier promoted by the applicant, Modified Alternative L reflects avoidance and minimization of direct impacts to wetlands that NMFS believes represent the higher value to fishery species. While these steps are noteworthy, additional avoidance and minimization appear practicable. On March 30, EPA, NMFS, and the US Fish and Wildlife Service proposed to the COE and applicant an alternative boundary for the mine. In addition to reducing impacts to habitats that support nursery areas, this alternative would provide opportunities for on-site compensatory mitigation to be pursued within PNAs. NMFS believes this alternative would benefit fishery resources within South Creek as well as the larger APEC. The applicant expressed a desire to review the new alternative and noted that its evaluation could take a month or longer. NMFS recommends the COE withhold its final determination on the application until the applicant's review is complete and vetted through resource agencies and stakeholders. At the very least, NMFS continues to recommend exclusion from the mine seven areas totaling approximately 50 acres that serve as headwaters of tidally influenced creeks which NMFS believes are significant nursery areas for fishery species.

Functional Assessment of the Compensatory Mitigation

The mitigation plan (FEIS Appendix I) involves multiple sites and strategies to compensate for the ecosystem services lost over the life of the project. The proposed restoration efforts primarily focus on croplands and drained forested wetlands underlain by hydric soils which, therefore, are expected to be good candidates for wetland restoration. The proposed mitigation would occur at sites south of the Pamlico River (primarily south, east, and west of the S33 tract) and at sites north of the Pamlico River. Under the plan, 7968, 756, and 2472 acres of wetlands would be restored, enhanced, and preserved, respectively. To guide their evaluation of the proposed compensatory mitigation, replacement-to-loss ratios used by the COE are 2:1 for restoration, 3:1 for enhancement, and 8:1 to 10:1 for preservation. The replacement ratio used for determining stream replacement is 1.8:1. In this regard, it is important to note that 71 percent of the NCPC tract, 76 percent of the Bonnerton tract, and 20 percent of the S33 tract are wetlands. By 2011, the applicant plans to complete construction of all the compensatory mitigation projects needed to offset the losses from mining the NCPC and Bonnerton tracts. To implement this schedule, the applicant has expended considerable effort to identify, acquire, and develop off-site mitigation through restoration of previously impacted waters and wetlands.

The applicant's proposal to provide mitigation up front and on an ambitious schedule is commendable. While tallies summarizing the overall mitigation are persuasive, NMFS believes a quantitative, functional assessment, using a habitat equivalency analysis or a similar method, should be performed. Decisions relying mostly upon best professional judgment should be avoided for a project of this scale and significance of potential impacts. While a formal, functional assessment would also rely upon best professional judgment, it would do so in a manner that greatly increases precision (in the sense of repeatability) and transparency, identifies and quantifies uncertainties and assumptions, facilitates sensitivity analyses, includes benefits from reclamation, and establishes key milestones for use in an adaptive management program that ultimately focuses on whether the compensatory mitigation yields ecological services to South Creek, Durham Creek, and Pamlico River on a scale commensurate with the losses at Jack, Jacob, Tooley, Porter, and other creeks within the NCPC and Bonnerton tracts. A formal functional assessment would also clarify whether wetlands within the subset of the Bonnerton tract, which is a nationally significant Natural Heritage Area, can be mitigated and, if so, at what relative cost.

Monitoring and Adaptive Management

Monitoring

NMFS remains concerned about the loss of headwater wetlands associated with PNAs under the Modified Alternative L alignment. Based on input regarding the designation of these areas as HAPCs, PCS agreed to avoid direct impacts to these creeks. However, as noted by the COE, resource agencies, and NOAA's Center for Coastal Fisheries and Habitat Research (Beaufort Laboratory), substantial indirect impacts to PNAs and other tidal creeks would result from the proposed loss of headwater wetlands and intermittent streams on the NCPC and Bonnerton tracts. To address this concern, NMFS recommended that prior to initiation of land clearing activities in the headwater wetlands of state-designated nursery areas located along the NCPC shoreline of South Creek, PCS develop a plan of study to address the effects of a reduction in headwater wetlands on the utilization of these nursery areas by resident fish and invertebrates. In these systems, resident fish and invertebrates are important prey for estuarine-dependent species that seasonally frequent estuarine creeks during sub-adult development stages. Monitoring changes in these populations should prove a reasonable indicator of the effect of losses of headwater wetland on changes in resident species that support the nursery area function of these creeks. NMFS is pleased to see that the draft permit conditions require, within six months of permit issuance, development of a detailed plan for such a monitoring program. NMFS offers to continue to work with the COE, PCS, and other interested parties to further refine these conditions into a detailed plan.

Adaptive Management

The scales of the proposed mine and compensatory mitigation are large and the impacts and benefits that would actually accrue from these actions (as opposed to predicted to accrue) are subject to variables that can only generally be forecasted at the time of a permit decision. Proper and timely execution of the monitoring programs followed by responsive adjustments of mining and mitigation plans would be essential to ensure expansion of the PCS mine under Modified Alternative L is done in a manner that is in the public interest. Requiring the applicant to adhere to a process that allows the COE and resource agencies to substantively engage in the oversight of the project, and in adjustments to project design, is necessary for NMFS to have reasonable assurance that impacts to NOAA trust resources would be adequately compensated.

NMFS is pleased to see that the draft permit conditions require the applicant to establish an independent panel of scientists and engineers to annually review the project and determine if direct and indirect impacts and benefits are accruing at the rates forecasted at the time of a project authorization. Data and reports should be placed in a publicly accessible location, such as a website, and be freely available. The panel will also annually provide the COE and applicant with recommended changes to the mining and mitigation that are necessary to bring the project into alignment with expectations. NMFS offers to continue to work with the COE, PCS, and other interested parties to further refine and implement the adaptive management plan, should a permit be issued.

Thank you for the opportunity to provide these comments. Related questions or comments should be directed to the attention of Mr. Ronald Sechler at our Beaufort Field Office, 101 Pivers Island Road, Beaufort, North Carolina 28516-9722, or at (252) 728-5090.

Sincerely,

Roy E. Crabtree, Ph.D.
Regional Administrator

cc:

FWS, Mike_Wicker@usfws.gov
EPA, Becky.Fox@epa.gov
SAFMC, Roger.Pugliese@safmc.gov
NCDCM, Doug.Huggett@ncmail.net
NCDMF, Sara.Winslow@ncmail.net
F/SER4, Miles.Croom@noaa.gov
F/SER47, Ron.Sechler@noaa.gov, Pace.Wilber@noaa.gov

Jeff_Weller@fws.gov
04/18/2009 09:16 AM

To Palmer Hough/DC/USEPA/US@EPA, Mike_Wicker@fws.gov
cc "Pace.Wilber" <Pace.Wilber@noaa.gov>, Rebecca Fox/R4/USEPA/US@EPA, "Ron Sechler" <ron.sechler@noaa.gov>
bcc
Subject Re: USFWS PCS letter

Palmer - it was signed late Thursday, I was "out" Friday. I'll send you a copy 1st thing Monday morning.

J. Weller
(sent from my handheld wireless Blackberry)

----- Original Message -----
From: Hough.Palmer
Sent: 04/18/2009 09:05 AM AST
To: Mike Wicker
Cc: "Pace.Wilber" <Pace.Wilber@noaa.gov>; Fox.Rebecca@epamail.epa.gov; Ron Sechler <ron.sechler@noaa.gov>; Jeff Weller
Subject: Re: USFWS PCS letter

Mike:

Good letter. Please forward a signed copy ASAP. I would like to get this in the hands of the folks at Army/Corps HQ. They need to hear more about the limitations regarding the studies cited in the draft ROD.

Yesterday's site visit was very interesting. As expected without FWS, NMFS, and Becky it was a full court press from PCS and the District. Both were very well represented as was Army/Corps HQ. As I was the only one with some knowledge of the site and project history who was pushing for change the deck was clearly stacked against us. But I am still hopeful that we have opportunities to improve the project.

-Palmer

Palmer F. Hough
US Environmental Protection Agency
Wetlands Division
Room 7231, Mail Code 4502T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Office: 202-566-1374
Cell: 202-657-3114
FAX: 202-566-1375
E-mail: hough.palmer@epa.gov

Street/Courier Address
USEPA
Palmer Hough
EPA West -- Room 7231-L
Mail Code 4502T
1301 Constitution Avenue, NW

Washington, DC 20460

From: Mike_Wicker@fws.gov

To: Palmer Hough/DC/USEPA/US@EPA

Cc: Rebecca Fox/R4/USEPA/US@EPA, "Pace.Wilber" <Pace.Wilber@noaa.gov>, Ron Sechler <ron.sechler@noaa.gov>

Date: 04/16/2009 05:36 PM

Subject: Re: USFWS PCS letter

This is the latest draft that I saw of our letter. I think it has been or is being signed shortly. Copies will be sent of the final Monday.

(See attached file: 20090414_PCS_404qf1.doc) One date in error was changed although that is not evident in this file.
[attachment "20090414_PCS_404qf1.doc" deleted by Palmer Hough/DC/USEPA/US]

WCARY@brookspierce.com
04/20/2009 12:47 PM

To Brooke.Lamson@saw02.usace.army.mil, William.T.Walker@usace.army.mil, Palmer Hough/DC/USEPA/US@EPA, Stan
cc James Gregory <jim.gregory@wathydro.com>, RSmith@Pcsphosphate.com, GHOUSE@brookspierce.com, JFurness@Pcsphosphate.com
bcc
Subject PCS - 404 Permit; Gregory Summary

At the meeting in Aurora on 4/17/09, we distributed a summary of Dr. Gregory's findings. Dr. Gregory has informed me that in his haste to get his summary to us in time for our 4/17/09 meeting, he failed to catch an error in that summary (i.e., several references to swamp <u>white</u> oaks): the three indicator species used by NHP for NRWHF include swamp <u>chestnut</u> oak, not swamp <u>white</u> oak. His field observations and findings were based on application of the correct criteria, and his conclusions and opinions are therefore unaffected. His final report should be available later this week.
I do not have the e-mail addresses for the attendees, so if you receive this, please forward it as appropriate.
Bill Cary, Counsel to PCS Phosphate

Palmer Hough/DC/USEPA/US
04/20/2009 12:33 PM

To Wilber Pace <Pace.Wilber@noaa.gov>, Mike_Wicker <Mike_Wicker@fws.gov>, Jeff_Weller@fws.gov
cc Rebecca Fox/R4/USEPA/US@EPA
bcc
Subject Fw: PCS Phosphate 3(d) Letter

Information Redacted pursuant to
5 U.S.C. Section 552 (b)(5), Exemption 5,
Privileged Inter/Intra Agency Document
Specific Privilege: Deliberative Process Privilege

Palmer F. Hough
US Environmental Protection Agency
Wetlands Division
Room 7231, Mail Code 4502T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Office: 202-566-1374
Cell: 202-657-3114
FAX: 202-566-1375
E-mail: hough.palmer@epa.gov

Street/Courier Address
USEPA
Palmer Hough
EPA West -- Room 7231-L
Mail Code 4502T
1301 Constitution Avenue, NW
Washington, DC 20460
----- Forwarded by Palmer Hough/DC/USEPA/US on 04/20/2009 12:30 PM -----

From: Palmer Hough/DC/USEPA/US
To: "Smith, Chip R Mr CIV USA ASA CW" <Chip.Smith@HQDA.Army.Mil>
Cc: "Schmauder, Craig R SES CIV USA OGC" <craig.schmauder@us.army.mil>, "Dorsey, Garrett L NWP" <Garrett.L.Dorsey@usace.army.mil>, "Moyer, Jennifer A HQ02" <Jennifer.A.Moyer@usace.army.mil>, "Hurley, John S LTC MIL USA ASA CW" <John.Hurley@us.army.mil>, "Wood, Lance D HQ02" <Lance.D.Wood@usace.army.mil>, Meg.E.Gaffney-Smith@usace.army.mil, "Pfenning, Michael F COL MIL USA ASA CW" <Michael.Pfenning@us.army.mil>, "Morris, Patricia A Ms CIV USA OGC" <Patricia.Morris@us.army.mil>, Robert Wood/DC/USEPA/US@EPA, "Salt, Terrence C SES CIV USA ASA CW" <rock.salt@us.army.mil>, "Chubb, Suzanne L Ms CIV USA ASA CW" <Suzanne.L.Chubb@us.army.mil>, William.L.James@usace.army.mil, Ann Campbell/DC/USEPA/US@EPA, Brian Frazer/DC/USEPA/US@EPA
Date: 04/20/2009 12:25 PM
Subject: Re: PCS Phosphate 3(d) Letter

Chip:

Thanks for sharing the NMFS letter. Like NMFS, EPA also believes that Mod Alt L avoids directly impacting wetlands that provide the highest value to fisheries resources (i.e., the tidal creeks). As NMFS, FWS and EPA have highlighted, we are concerned regarding the indirect impacts to these wetlands systems that would result when 70-85 % of the watersheds of these tidal creeks are impacted by mining. As NMFS, FWS and EPA have highlighted, studies cited in the FEIS and draft ROD do not allay these concerns and it is not clear that the proposed compensatory mitigation would reduce these indirect impacts down to an acceptable level. On this point, the NMFS letter notes that:

"While tallies summarizing the overall mitigation are persuasive, NMFS believes a quantitative, functional assessment, using a habitat equivalency analysis or a similar method, should be performed. Decisions relying mostly upon best professional judgment should be avoided for a project of this scale and significance of potential impacts."

Also, I have attached a 4-16-09 letter from USFWS stating its continued concerns regarding the proposed project. Although FWS will not be elevating, its letter echoes the concerns raised by EPA and NMFS. A full read of both the NMFS and FWS letters is very helpful for understanding their perspectives.

Thanks, Palmer

FWS_20090416_3f1_withdraw_no_attachments.pdf

Palmer F. Hough
US Environmental Protection Agency
Wetlands Division
Room 7231, Mail Code 4502T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Office: 202-566-1374
Cell: 202-657-3114
FAX: 202-566-1375
E-mail: hough.palmer@epa.gov

Street/Courier Address
USEPA
Palmer Hough
EPA West – Room 7231-L
Mail Code 4502T
1301 Constitution Avenue, NW
Washington, DC 20460

"Smith, Chip R Mr CIV USA ASA CW" Sir: Attached is an April 17,... 04/20/2009 11:38:32 AM

From: "Smith, Chip R Mr CIV USA ASA CW" <Chip.Smith@HQDA.Army.Mil>
To: "Salt, Terrence C SES CIV USA ASA CW" <rock.salt@us.army.mil>
Cc: "Schmauder, Craig R SES CIV USA OGC" <craig.schmauder@us.army.mil>, "Morris, Patricia A Ms CIV USA OGC" <Patricia.Morris@us.army.mil>, "Chubb, Suzanne L Ms CIV USA ASA CW" <Suzanne.L.Chubb@us.army.mil>, <Meg.E.Gaffney-Smith@usace.army.mil>, <William.L.James@usace.army.mil>, "Moyer, Jennifer A HQ02" <Jennifer.A.Moyer@usace.army.mil>, "Dorsey, Garrett L NWP" <Garrett.L.Dorsey@usace.army.mil>, Palmer Hough/DC/USEPA/US@EPA, Robert Wood/DC/USEPA/US@EPA, "Pfenning, Michael F COL MIL USA ASA CW" <Michael.Pfenning@us.army.mil>, "Hurley, John S LTC MIL USA ASA CW" <John.Hurley@us.army.mil>, "Wood, Lance D HQ02" <Lance.D.Wood@usace.army.mil>
Date: 04/20/2009 11:38 AM

Subject: PCS Phosphate 3(d) Letter

Sir:

Attached is an April 17, 2009, letter from NOAA/NMFS providing their final comments and informing the Corps that they will NOT request higher level review under the 404q MOA. NOAA/NMFS is the Federal government's expert on marine fisheries and fishery issues. I have summarized the main points of their letter below.

Primary Nursery Areas - NMFS concludes that "as a result of close coordination among the applicant, resource agencies, and the COE, NMFS has determined direct impacts to Habitat Areas of Particular Concern are no longer likely".

Sequential Mitigation - "Modified Alternative L reflects avoidance and minimization of direct impacts to wetlands that NMFS believes represent the higher value to fishery species". The letter goes on to encourage the Corps to continue to consider opportunities to further avoid and minimize impacts.

Functional Assessment of the Compensatory Mitigation - NMFS notes that "the applicant has expended considerable effort to identify, acquire, and develop off-site mitigation through restoration of previously impacted waters and wetlands". While NMFS would prefer a functional assessment, they accept the approach used by the applicant and Corps.

Monitoring and Adaptive Management - NMFS is pleased to see that draft permit conditions require, within six months of permit issuance, development of a detailed plan for such a monitoring program. NMFS offers to continue to work with the COE, PCS, and other interested parties to further refine these conditions into a detailed plan". "NMFS is pleased to see that the draft permit conditions require the applicant to establish an independent panel of scientists and engineers to annually review the project and determine if direct and indirect impacts and benefits are accruing at the rates forecasted at the time of project authorization".

Chip Smith
Office of the Assistant Secretary of the Army (Civil Works)
Assistant for Environment, Tribal and Regulatory Affairs
108 Army Pentagon 3E427
Washington, D.C. 20310-0108
703-693-3655 Voice
703-839-0389 Cell
703-697-8433 Fax

[attachment "PCSPhosphateCorp_200110096_3(d) NMFS.pdf" deleted by Palmer Hough/DC/USEPA/US]

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1875 Century Boulevard
Atlanta, Georgia 30345

In Reply Refer To:
FWS/R4/ES

APR 16 2009

Colonel Jefferson M. Ryscavage
District Engineer, Wilmington District
U.S. Army Corps of Engineers
69 Darlington Avenue
Wilmington, North Carolina 28403-1343

RE: Department of Army Permit AID 200110096, Potash Corporation of Saskatchewan Phosphate Division, Aurora Operation (PCS) Mine Continuation

Dear Colonel Ryscavage:

This letter is provided under Part IV, paragraph 3(f)(1), of the 1992 Memorandum of Agreement (MOA) between the Department of the Interior and the Department of Army, under Clean Water Act (CWA) Section 404(q). The Fish and Wildlife Service (Service) has decided not to seek higher level review of the proposed decision by the Army Corps of Engineers' Wilmington District to issue a CWA Section 404 permit to the Potash Corporation of Saskatchewan, Phosphate Division, Aurora Operation. Nonetheless, the Service has substantial unresolved concerns regarding the proposed project and our decision to not seek higher level review is not an indication that these concerns have been resolved. The Service fully concurs with and supports the concerns expressed by the U.S. Environmental Protection Agency in their letter to the Assistant Secretary of the Army (Civil Works)(ASA (CW)) dated April 3, 2009.

The Wilmington District (District) issued a Notice of Intent to Proceed letter regarding this permit under paragraph 3(c)(3) of the MOA on March 2, 2009; this letter was received by our Southeast Regional Office on March 5, 2009. The proposed project is an expansion of the mine's 1997 CWA permit. The expansion, as currently proposed, will impact 3,953 acres of wetlands and 25,727 linear feet of streams, including a portion of a Significant Natural Heritage Area designated as "nationally significant." In addition, the project is adjacent to the Pamlico River and will result in a loss of approximately 70 percent of the watersheds of the project area streams which drain to the Albemarle-Pamlico Estuary Complex.

The March 2, 2009, Notice of Intent to Proceed letter included some provisions intended to minimize impacts through project footprint reduction and increase compensatory mitigation. The Wilmington District concluded that these provisions would adequately address our concerns for the project. Both the Service's Raleigh, North Carolina Field Office and Southeast Regional Office staff carefully considered these measures, and responded on March 20, 2009, pursuant to

Part IV, paragraph 3(d)(2) of the 1992 MOA. That response stated that the Service does not concur that our concerns have been adequately addressed.

Pursuant to Part IV, paragraph 3(f) of the 1992 MOA, the Department of the Interior had until April 9, 2009, to notify the ASA (CW) that the Department of the Interior was requesting higher level review. On April 3, 2009, the District provided the Service with an 80-page draft Record of Decision containing information not previously reviewed by the Service. In response the Service requested, via a letter dated April 8, 2009, an extension of the MOA timeframe in order to allow a review of the new information. The Corps denied that request, and the Service was unable to complete its review within the timeframe prescribed by the MOA.

In our continuing effort to assist the Corps in making a timely decision in this matter, we have completed an expedited review of the draft Record of Decision. We note the draft Record of Decision contains the same flaws the Service previously noted in the Final Environmental Impact Statement (FEIS). Specifically, it is our opinion that the Corps has consistently drawn inappropriate conclusions from limited data that are contrary to, and not supported by, the vast body of knowledge regarding the functioning of estuarine systems.

The FEIS, the March 2, 2009, Notice of Intent to Proceed letter, and the draft Record of Decision rely heavily on monitoring data and studies of local estuaries to support the conclusion that project-related reductions of approximately 70 percent of the watersheds of project area streams would not substantially impair the functioning of those stream or their associated estuaries. The Service has consistently noted the limitations of these analyses.

To summarize, it has been pointed out by the Service and others that these studies are of insufficient scope, duration, and design to provide a basis for determining the effects of project-related drainage basin reduction on the creeks and estuaries of the project area. The Corps appears to acknowledge this in the FEIS with statements such as those appearing on page 4-14 of the FEIS: "...although a definitive conclusion cannot be made because the pre-drainage basin reduction monitoring data on flow and salinity for this creek covers less than a year." The FEIS further states (page 4-16) "it is difficult to draw any definite conclusions because there was no control site for Stanley's 1990 statistical study and there was only one year of baseline water quality and flow data for Jacks Creek." Also in Appendix J.II-7 of the FEIS it is stated in reference (in part) to a report by Entrix: "Although the Corps does not endorse or agree with all of the conclusions and statements found in either of these reports, both have been included in Appendix F in their entirety and the relevant information from these reports has been used as appropriate in the discussion of potential impacts found in Section 4.0 of the FEIS. Additionally, the Entrix report was supplied to the Review Team and their comments have been considered." We note that this is apparently in response (at least in part) to a critique of the Entrix study provided by NMFS following the February 12, 2008, interagency meeting (see enclosed). We concur completely with the NMFS comments, and note that although the Corps states that these comments were "considered" we can find no specific evidence of such consideration in the FEIS or draft Record of Decision.

Despite acknowledgement of the limitations of these studies, the Corps consistently overlooks these limitations and draws definitive conclusions that the project will not result in substantial adverse impacts to the Albemarle-Pamlico Estuary. We view this as an inappropriate use of the available information. We point again to the comments submitted throughout the process by the state and Federal agencies responsible for the management and conservation of the Albemarle-Pamlico Estuary including the Service, NMFS, EPA, NC Wildlife Resources Commission, and NC Division of Marine Fisheries (see enclosed comments of the NC WRC and NC DMF) that have noted the limitations of these studies, and drawing on their accumulated expertise and the vast body of available scientific information have concluded that one cannot deprive a waterbody of 70 percent of its watershed and expect it to function normally.

We remain committed to working with the Corps to effectively address our concerns. We are hopeful that a reasonable outcome can be achieved that satisfies the economic interests of the applicant while sustaining the ecologically and economically vital resources of the Albemarle-Pamlico Estuary.

Thank you for your consideration in this matter. Should you have any questions regarding these comments or wish to discuss this matter further, please contact Pete Benjamin, Supervisor of the Raleigh Field Office, at (919) 856-4520 extension 11.

Sincerely yours,

Sam D. Hamilton

Sam D. Hamilton
Regional Director

Enclosures

"Schafale, Michael" <michael.schafale@ncdenr.gov>

04/23/2009 09:36 AM

To Rebecca Fox/R4/USEPA/US@EPA

cc

bcc

Subject RE: Draft Gregory assessment of SNHA

Hi Becky,

Here is my response, hopefully in time for your briefing. This is probably complete, but I will go over it again before calling it final.

-----Original Message-----
From: Fox.Rebecca@epamail.epa.gov [mailto:Fox.Rebecca@epamail.epa.gov]
Sent: Wednesday, April 22, 2009 7:47 PM
To: Schafale, Michael
Subject: RE: Draft Gregory assessment of SNHA

That's about the reaction I expected. I feel about the same. Pretty amazing... Sorry you have to endure this type of thing -- hopefully we will get some more avoidance out of it...

I will try to give you a call around 9 tomorrow -- have a briefing at 9:45. Will be here all afternoon, if we do not hook up earlier, you can give me a call.

If you are going to respond -- the sooner the better. Army is making their decision this week and hope to have an internal draft by Monday (4-27) so we would like to get them something before then -- not much time, eh? Thanks very much for your help in this Mike and once again I'm sorry it has gotten so dirty. bf

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

"Schafale, Michael" <michael.schafale@ncdenr.gov>

04/22/2009 06:35 PM

To Rebecca Fox/R4/USEPA/US@EPA

cc

Subject RE: Draft Gregory assessment of SNHA

Hi Becky,

I'll have to digest this report before I have anything really to say. My first reaction is incredulity, but I presume you need something more substantial.

I'll be doing some combination of working at home tomorrow and taking time off tomorrow. I may be hard to reach but you're welcome to try. The number is 919-567-1098. The earlier morning is the most likely time for me to be there - after 7:00 till 9:00 or 10:00, though it's worth a try if you can't try till later. Or, if you want to tell me a time range you're available, I'll try to call some time during it. I'll be back in the office Friday, at 919-715-8689, but will be in a meeting at 10:00 and maybe one at 3:00.

From: Fox.Rebecca@epamail.epa.gov [Fox.Rebecca@epamail.epa.gov]
Sent: Tuesday, April 21, 2009 2:41 PM
To: Schafale, Michael
Subject: Fw: Draft Gregory assessment of SNHA

Hi Mike,

Just wanted to share with you this report on Bonnerton SNHA prepared for PCS by Jim Gregory. Your thoughts on this would be greatly appreciated. Also, would you send me your phone # again. I would like to have it so I can call and talk to you about another aspect of this. PCS is claiming that DWQ had total buy in by NHP that is was ok to go ahead and mine the NW part of SNHA -- I know you and John talked about this but to hear it from them you were there at the table negotiating -- that may be true but just wanted to clarify. They are hitting us with -- why does EPA think this area is so important when NHP themselves said it was ok to mine... Thanks! bf See Gregory report attached below.

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov
----- Forwarded by Rebecca Fox/R4/USEPA/US on 04/21/2009 02:33 PM -----

Palmer Hough/DC/USEPA/US	To	Rebecca Fox/R4/USEPA/US@EPA
04/20/2009 11:04 AM	cc	
	Subject	Draft Gregory assessment of SNHA

Becky:

Here is the draft Gregory assessment of the SNHA. Would be interesting to get the NC NHP's perspective.

-Palmer

(See attached file: 4-16-09 draft forestry report-SNHA_Jim Gregory.pdf)

Palmer F. Hough
US Environmental Protection Agency
Wetlands Division
Room 7231, Mail Code 4502T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Office: 202-566-1374
Cell: 202-657-3114
FAX: 202-566-1375
E-mail: hough.palmer@epa.gov

Street/Courier Address
USEPA
Palmer Hough
EPA West -- Room 7231-L
Mail Code 4502T
1301 Constitution Avenue, NW
Washington, DC 20460

Response to Jim Gregory's letter of April 16, 2009, regarding the PCS Bonnerton Nonriverine Wet Hardwood Forest site.

Mike Schafale, North Carolina Natural Heritage Program
April 23, 2009

Dr. Gregory's primary assertion is that the area does not meet the definition of a Nonriverine Wet Hardwood Forest and that, because of past land use, it is not a significant example of a Nonriverine Wet Hardwood Forest.

As Dr. Gregory notes, Nonriverine Wet Hardwood Forest was first defined as a type by the Natural Heritage Program. The name was first used in the program's classification of natural communities, based on concepts that had been used previously by program contractors and likely earlier in the scientific community. Dr. Gregory refers to Schafale and Weakley (1990), the program's official classification of natural communities, and Schafale (2008), a recent manuscript on status and trends of Nonriverine Wet Hardwood Forests. However, neither of these documents define Nonriverine Wet Hardwood Forests as having to be dominated by swamp chestnut oak, cherrybark oak, and laurel oak. Schafale and Weakley (1990) describe them as being dominated by various hardwood trees, with these three species named first but with sweetgum, tulip poplar, red maple, and several other species also named. Many of the earliest qualitative descriptions of specific sites described them as dominated by these oaks, but later quantitative study of some of the same sites found that, while abundant, they did not dominate.

Schafale (2008) does not define Nonriverine Wet Hardwood Forest as having to be dominated by the three oak species. In fact, it specifically discusses the fact that, while the *presence* of wetland oaks is important, these species often do not dominate in the best remaining examples and that their dominance is not crucial to recognition of the type. Nowhere is there a suggestion that all three species must be present to recognize the type. Because swamp chestnut oak, cherrybark oak, and laurel oak are collectively the most frequent oak species in these communities, they are often emphasized in other descriptions of the type. Abundant presence of other wetland oaks would also potentially support recognition as Nonriverine Wet Hardwood Forest. However, a forest that had no oaks and consisted only of the other trees mentioned in descriptions would not be considered an extant example of the type, but would be either a degraded example or a successional forest of some other type.

The fact that the Bonnerton site shows evidence of human action and past land use does not disqualify it from being a significant example and from being regarded as a Significant Natural Heritage Area. Indeed, there could be no Significant Natural Heritage Areas at all under such a definition. The Natural Heritage Program seeks the least altered, closest-to-natural examples remaining for each community type, and those closest to this ideal are regarded as the most significant. While I noted the evidence of past logging that Dr. Gregory cites, such evidence is common even in our best natural areas. There are no Nonriverine Wet Hardwood Forests that have not been logged, and selective logging of the sort noted by Dr. Gregory is the least alteration we can expect to find in any remnants of these communities. The Bonnerton site is in better condition than most remaining examples despite these impacts. Its condition and relatively large size and condition are among the best examples of this community type known to remain.

I am not sure how relevant Dr. Gregory's other observations on hydrology and soils are. He notes that the soils have hydric indicators. Most of the site has wetland vegetation, though there are minor marginal upland inclusions. The southern red oaks he reported may have been in such upland inclusions, which are also marked by beech trees. I visited the site with a number of people experienced in delineating wetlands, and there was no dispute that the area was jurisdicational wetland. Standing water does not always occur in Nonriverine Wet Hardwood Forests, though sporadic ponded water, along with seasonal saturated soil and widespread hydric indicators, would be expected.

"Schafale, Michael" <michael.schafale@ncdenr.gov>

04/23/2009 10:26 AM

To Rebecca Fox/R4/USEPA/US@EPA

cc

bcc

Subject RE: Draft Gregory assessment of SNHA

History: This message has been forwarded.

Here is the final version. A few modifications since the draft I sent you.

-----Original Message-----
From: Fox.Rebecca@epamail.epa.gov [mailto:Fox.Rebecca@epamail.epa.gov]
Sent: Tuesday, April 21, 2009 2:41 PM
To: Schafale, Michael
Subject: Fw: Draft Gregory assessment of SNHA

Hi Mike,

Just wanted to share with you this report on Bonnerton SNHA prepared for PCS by Jim Gregory. Your thoughts on this would be greatly appreciated. Also, would you send me your phone # again. I would like to have it so I can call and talk to you about another aspect of this. PCS is claiming that DWQ had total buy in by NHP that is was ok to go ahead and mine the NW part of SNHA -- I know you and John talked about this but to hear it from them you were there at the table negotiating -- that may be true but just wanted to clarify. They are hitting us with -- why does EPA think this area is so important when NHP themselves said it was ok to mine... Thanks! bf See Gregory report attached below.

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

----- Forwarded by Rebecca Fox/R4/USEPA/US on 04/21/2009 02:33 PM -----

Palmer Hough/DC/USEPA/US

04/20/2009 11:04 AM

To Rebecca Fox/R4/USEPA/US@EPA

cc

Subject Draft Gregory assessment of SNHA

Becky:

Here is the draft Gregory assessment of the SNHA. Would be interesting to get the NC NHP's perspective.

-Palmer

(See attached file: 4-16-09 draft forestry report-SNHA_Jim Gregory.pdf)

Palmer F. Hough
US Environmental Protection Agency
Wetlands Division
Room 7231, Mail Code 4502T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Office: 202-566-1374
Cell: 202-657-3114
FAX: 202-566-1375
E-mail: hough.palmer@epa.gov

Street/Courier Address
USEPA
Palmer Hough
EPA West -- Room 7231-L
Mail Code 4502T
1301 Constitution Avenue, NW
Washington, DC 20460

Response to Jim Gregory's letter of April 16, 2009, regarding the PCS Bonnerton Nonriverine Wet Hardwood Forest site.

Mike Schafale, North Carolina Natural Heritage Program
April 23, 2009

Dr. Gregory's primary assertion is that the area does not meet the definition of a Nonriverine Wet Hardwood Forest and that, because of past land use, it is not a significant example of a Nonriverine Wet Hardwood Forest.

As Dr. Gregory notes, Nonriverine Wet Hardwood Forest was first defined as a type by the Natural Heritage Program. The name was first used in the program's classification of natural communities, based on concepts that had been used previously by program contractors and likely earlier in the scientific community. Dr. Gregory refers to Schafale and Weakley (1990), the program's official classification of natural communities, and Schafale (2008), a recent manuscript on status and trends of Nonriverine Wet Hardwood Forests. However, neither of these documents define Nonriverine Wet Hardwood Forests as having to be dominated by swamp chestnut oak, cherrybark oak, and laurel oak. Schafale and Weakley (1990) describe them as being dominated by various hardwood trees, with these three species named first but with sweetgum, tulip poplar, red maple, and several other species also named. Many of the earliest qualitative descriptions of specific sites described them as dominated by these oaks, but later quantitative study of some of the same sites found that, while abundant, oaks did not dominate.

Schafale (2008) does not define Nonriverine Wet Hardwood Forest as having to be dominated by the three oak species. In fact, it specifically discusses the fact that, while the *presence* of wetland oaks is important, these species often do not dominate in the best remaining examples and that their dominance is not crucial to recognition of the type. Nowhere is there a suggestion that all three species must be present to recognize the type or for an occurrence to be a good example. Because swamp chestnut oak, cherrybark oak, and laurel oak are collectively the most frequent oak species in these communities, they are often emphasized in other descriptions of the type. Abundant presence of other wetland oaks would also potentially support recognition as Nonriverine Wet Hardwood Forest. However, a forest that had no oaks and consisted only of the other trees mentioned in descriptions would not be considered an extant example of the type, but would be either a degraded example or a successional forest of some other type.

The fact that the Bonnerton site shows evidence of human action and past land use does not disqualify it from being a significant example and from being regarded as a Significant Natural Heritage Area. Indeed, there could be no Significant Natural Heritage Areas at all under such a definition that required no human influence. The Natural Heritage Program seeks the least altered, closest-to-natural examples remaining for each community type, and those closest to this ideal are regarded as the most significant. While we have not formalized definitions for mature forests, in our experience, any hardwood forest that has most trees 12 inches dbh or over and has some many trees 18-20 inches is unusually mature. While forestry books may suggest trees should be 20 inches to be considered mature, this does not appear to match the practice in that field, as most stands are harvested well before trees reach that size. While I noted the evidence of past logging that Dr. Gregory cites, such evidence is common even in our best natural areas. There are no Nonriverine Wet Hardwood Forests that have not been logged, and selective logging of the sort noted by Dr. Gregory is the least alteration we can expect to find in any remnants of these communities. The Bonnerton site is in better condition than most remaining examples despite these impacts. Its condition and relatively large size place it among the best examples of this community type known to remain.

I am not sure how relevant Dr. Gregory's other observations on hydrology and soils are. He notes that the soils have hydric indicators. Most of the site has wetland vegetation, though there are minor marginal upland inclusions. The southern red oaks he reported may have been in such upland inclusions, which are also marked by beech trees. I visited the site with a number of people experienced in delineating wetlands, and there was no dispute that the area was jurisdicational wetland. Standing water does not always occur in Nonriverine Wet Hardwood Forests, though sporadic ponded water, along with seasonal saturated soil and widespread hydric indicators, would be expected.

"Schafale, Michael" <michael.schafale@ncdenr.gov>

04/23/2009 12:21 PM

To Rebecca Fox/R4/USEPA/US@EPA

cc "Dorney, John" <john.dorney@ncdenr.gov>

bcc

Subject RE: PCS - 404 Permit; Gregory Summary

Oh. I should have figured there was more coming. This will take longer to work through. I won't get it done today, and tomorrow is questionable too. Sorry.

-----Original Message-----
From: Fox.Rebecca@epamail.epa.gov [mailto:Fox.Rebecca@epamail.epa.gov]
Sent: Thursday, April 23, 2009 11:20 AM
To: Schafale, Michael
Subject: Fw: PCS - 404 Permit; Gregory Summary

Mike,

Just received a final copy of Gregory report. Earlier version I sent you was a draft. Haven't had a chance to review yet but wanted to forward on to you -- not sure how it is changed. Let me know if you want to revise the information you sent me earlier. Thanks! b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov
----- Forwarded by Rebecca Fox/R4/USEPA/US on 04/23/2009 11:17 AM -----

WCARY@brookspierce.com

04/23/2009 10:10 AM

To
Brooke.Lamson@saw02.usace.army.mil, William.T.Walker@usace.army.mil, Palmer Hough/DC/USEPA/US@EPA, Stan Meiburg/R4/USEPA/US@EPA, Jim Giattina/R4/USEPA/US@EPA, Tom Welborn/R4/USEPA/US@EPA, Jennifer Derby/R4/USEPA/US@EPA, Gregory Peck/DC/USEPA/US@EPA, Suzanne Schwartz/DC/USEPA/US@EPA, David Evans/DC/USEPA/US@EPA, Brian Frazer/DC/USEPA/US@EPA, Rebecca Fox/R4/USEPA/US@EPA

cc
James Gregory <jim.gregory@wathydro.com>, RSmith@Pcsphosphate.com, GHOUSE@brookspierce.com, JFurness@Pcsphosphate.com, RTINSLEY@brookspierce.com

Subject
PCS - 404 Permit; Gregory Summary

Attached is Dr. Gregory's report on his initial assessment of the portion of the Bonnerton tract listed by NHP along with the two maps referenced in that report. Please review the list of recipients and forward this to anyone in your agency who should have received it (these are the only addresses I have).

6-19-08 map
1-6-09 Biotic Communities

(See attached file: Gregory report NRWH stands 4-22-09.pdf)(See attached file: 20090422220441160.pdf)(See attached file: 20090422220446795.pdf)

Rebecca Fox/R4/USEPA/US
04/24/2009 01:36 PM

To mike_wicker@fws.gov, pete_benjamin@fws.gov, pace.wilber@noaa.gov, ron.sechler@noaa.gov
cc
bcc
Subject Fw: PCS Phosphate mine permit elevation - Permit AID 200110096

here is SELC letter. enjoy... b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov
----- Forwarded by Rebecca Fox/R4/USEPA/US on 04/24/2009 01:31 PM -----

Geoff Gisler
<ggisler@selcnc.org>
04/24/2009 12:40 PM

To "'rock.salt@us.army.mil'" <rock.salt@us.army.mil>, Mike Shapiro/DC/USEPA/US@EPA
cc "'Chip.Smith@HQDA.Army.Mil'" <Chip.Smith@HQDA.Army.Mil>, "'craig.schmauder@us.army.mil'" <craig.schmauder@us.army.mil>, "'Patricia.Morris@us.army.mil'" <Patricia.Morris@us.army.mil>, "'Suzanne.L.Chubb@us.army.mil'" <Suzanne.L.Chubb@us.army.mil>, "'Meg.E.Gaffney-Smith@usace.army.mil'" <Meg.E.Gaffney-Smith@usace.army.mil>, "'William.L.James@usace.army.mil.'" <William.L.James@usace.army.mil>, "'Jennifer.A.Moyer@usace.army.mil'" <Jennifer.A.Moyer@usace.army.mil>, "'Garrett.L.Dorsey@usace.army.mil'" <Garrett.L.Dorsey@usace.army.mil>, "'Michael.Pfenning@us.army.mil'" <Michael.Pfenning@us.army.mil>, "'John.Hurley@us.army.mil'" <John.Hurley@us.army.mil>, "'Lance.D.Wood@usace.army.mil'" <Lance.D.Wood@usace.army.mil>, Stan Meiburg/R4/USEPA/US@EPA, Jim Giattina/R4/USEPA/US@EPA, Gregory Peck/DC/USEPA/US@EPA, Suzanne Schwartz/DC/USEPA/US@EPA, Palmer Hough/DC/USEPA/US@EPA, Tom Welborn/R4/USEPA/US@EPA, David Evans/DC/USEPA/US@EPA, Robert Wood/DC/USEPA/US@EPA, Dawn Messier/DC/USEPA/US@EPA, Jennifer Derby/R4/USEPA/US@EPA, Rebecca Fox/R4/USEPA/US@EPA, Derb Carter <derbc@selcnc.org>
Subject PCS Phosphate mine permit elevation - Permit AID 200110096

Mr. Salt and Mr. Shapiro,
Please accept the attached letter providing comments on the PCS Phosphate's permit

application requesting authorization to expand its phosphate mine near Aurora, North Carolina (Permit AID 20010096). In sum, the letter identifies substantial information within the administrative record that demonstrates that:

- EPA has properly elevated the permit decision;
- EPA's proposed alternative is practicable;
- The Wilmington District's modifications to the practicability analysis in the FEIS are arbitrary;
- Alternative L would result in unacceptable adverse effects on aquatic resources of national importance; and
- PCS's proposed mitigation will not offset the proposed impacts.

We appreciate the opportunity to submit this information for your consideration.

Sincerely,

Geoff Gisler
Staff Attorney
Southern Environmental Law Center
200 W. Franklin St. Suite 330
Chapel Hill, NC 27516
Ph: (919) 967-1450
Fax: (919) 929-9421
www.southernenvironment.org

04-24-09 PCS Phosphate expansion comment letter.pdf

SOUTHERN ENVIRONMENTAL LAW CENTER

200 WEST FRANKLIN STREET, SUITE 330
CHAPEL HILL, NC 27516-2559

Telephone 919-967-1450
Facsimile 919-929-9421
selcnc@selcnc.org

Charlottesville, VA
Chapel Hill, NC
Atlanta, GA
Asheville, NC
Sewanee, TN

April 24, 2009

Terrence C. "Rock" Salt
Principal Deputy Assistant Secretary of the Army
108 Army Pentagon
Room 3E446
Washington, D.C. 20310-0108

Michael H. Shapiro
Acting Assistant Administrator
U.S. Environmental Protection Agency
Office of Water (4101M)
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Re: Region 4 Environmental Protection Agency elevation of Wilmington District, COE permit decision on PCS Phosphate Mine in Beaufort County, North Carolina

Dear Mr. Salt and Mr. Shapiro:

Region 4 of the Environmental Protection Agency has elevated to EPA headquarters under the 404(q) MOA a decision by the Wilmington District of the U.S. Army Corps of Engineers to proceed with the issuance of a Section 404 permit to PCS Phosphate, Inc. to mine 3,953 acres of wetlands and approximately five miles of streams adjacent to the Pamlico River and estuary in coastal North Carolina. EPA has concluded that issuance of the permit would result in unacceptable adverse effects to aquatic resources of national importance. EPA is advocating for additional wetland avoidance to prevent significant degradation of aquatic resources and an improved mitigation plan for unavoidable wetland impacts. EPA's proposal would allow uninterrupted mining for at least 29 years. PCS Phosphate has responded to the elevation of the permit decision and to EPA's proposal.

This letter is submitted on behalf of the Pamlico-Tar River Foundation, Environmental Defense Fund, North Carolina Coastal Federation, and Sierra Club in response to PCS's contentions that its proposed mining plan would not result in unacceptable adverse effects to aquatic resources, that additional avoidance of wetlands and streams is not practicable, and certain procedural issues. The response below includes appropriate reference to the permit administrative record, PCS Phosphate documents, and applicable laws and regulations.

In summary, it provides support for the following conclusions:

- **The EPA is not required to refer its objections to PCS's unacceptable environmental impacts to the Council on Environmental Quality under Clean Air Act Section 309.**
- **PCS has delayed the permitting process by insisting that the AP Alternative – an alternative that cannot be permitted under state law – was the only practicable alternative.**
- **EPA's Proposed Alternative Is Practicable Under the Wilmington District's Practicability Analysis in the DEIS, SDEIS, and FEIS.**
- **The Wilmington District's determination that all practicable alternatives must provide 15 years of mining north of highway 33 is arbitrary and indefensible.**
- **The Albemarle-Pamlico Sound estuary and associated wetlands are aquatic resources of national importance.**
- **PCS proposes to mine substantial parts of the watersheds of five fishery nursery areas and impair the functions of these vital, priority habitats and aquatic resources of national significance.**
- **PCS's proposed mitigation will not offset the unacceptable adverse impacts to aquatic resources of national importance.**

We appreciate the opportunity to submit this information for your consideration.

Sincerely,

Derb S. Carter, Jr.
Senior Attorney-NC/SC Office Director
Southern Environmental Law Center

Geoffrey R. Gisler
Staff Attorney
Southern Environmental Law Center

EPA PROPERLY ELEVATED PCS'S PERMIT APPLICATION

The EPA is not required to refer its objections to PCS's unacceptable environmental impacts to the Council on Environmental Quality under Clean Air Act Section 309.

- PCS's contention that EPA "has not complied with requirements to refer any 'unsatisfactory' environmental effects to CEQ" has no merit because the 309 referral process is not relevant to the Section 404 Clean Water Act permit application elevation.

- The Memorandum of Agreement between the EPA and Corps establishes the procedure for proceedings under Clean Water Act Section 404(q) and PCS does not contest that the EPA has not complied with that procedure.

- Section 309 of the Clean Air Act, 42 U.S.C. §7609, may impose requirements on EPA during review of Clean Air Act permits, but does not require the EPA to refer objections to Clean Water Act projects to the Council on Environmental Quality. Regulations promulgated under Clean Air Act Section 309, i.e. 40 C.F.R. § 1504.3, are irrelevant to the Section 404(q) process.

PCS has delayed the permitting process by insisting that the AP Alternative – an alternative that cannot be permitted under state law – was the only practicable alternative.

- PCS and the Wilmington District have consistently compared all potentially practicable alternatives to the AP Alternative, a 15-year alternative that would illegally mine salt marsh.

- The state announced early in the permitting process that it could not and would not issue a permit for the AP Alternative:
  - "Mr. Dorney [from the N.C. Division of Water Quality] stated that mining of the creeks will never be permitted, and that proposing such an action as a 'straw man' is a waste of time." Meeting Notes from 28 February 2001, DEIS Appx. A-5.

- PCS objected, insisting on pursuing the AP Alternative:
  - "Mr. Smith [PCS Environmental Affairs Manager] reminded the group that the current proposal is appropriate to PCS Phosphate's stakeholders, considering the high value of the ore body on the NCPC Tract." *Id.*

- Rather than altering the mine plan, PCS sued the State of North Carolina to defend the illegal mining. *See* Meeting Notes from 26 February 2003, DEIS Appx. A-72. That case did not settle until October 2006, delaying the permitting process for years.

- Even after the lawsuit, PCS continued to push for the AP Alternative in spite of the Division of Water Quality's refusal to issue a permit for it:
  - "[T]he applicant preferred alternative is not acceptable to DWQ since (as outlined in our September 14, 2006 letter to PCS Phosphate and repeated at several meetings with

the company), this alternative proposes to mine through about 34 acres of salt marsh." 31 January 2007 comments of North Carolina Division of Water Quality, FEIS J-IV.A.4.

  - "[W]e strongly urge the company to present an applicant preferred alternative which is permittable by the Division of Water Quality in order to move this important project forward." *Id.*

- The Wilmington District continued to ignore the state permitting agency's comments rejecting the AP Alternative as not permittable under state law, delaying the permitting process by postponing serious consideration of reasonable alternatives:

  - "[T]o the Corps' knowledge, neither the NCDWQ nor the NCDCM have formally refused to process or denied any permit or certification." Wilmington District's response to comments, FEIS J.II-22.

- PCS insisted that Alternative L was impracticable as recently as December 19, 2007, delaying consideration of reasonable alternatives to Alternative L. PCS comments on SDEIS, FEIS J-VII.B.1.

- PCS modified its permit application on April 25, 2008 – less than one year ago – to request the 37-year Alternative L as its preferred alternative in place of the 15-year AP Alternative that it insisted on, and sued to defend, for the first 7.5 years of the permitting process.

- Yet PCS still uses the clearly unlawful AP Alternative to compare its claimed "concessions" on reducing wetland impact.

EPA'S PROPOSED ALTERNATIVE IS PRACTICABLE

EPA's Proposed Alternative is Practicable Under the Wilmington District's Practicability Analysis in the DEIS, SDEIS, and FEIS.

- The DEIS and SDEIS found that the SCRB Alternative is practicable. DEIS 2-19, *see* SDEIS at 2-3 (stating no change in economic analysis).

- "The . . . SCRB . . . alternative[] provide[s] for approximately 15 years of mining at operating costs similar to the current national averages and PCS's historic mine operating costs." DEIS 2-19, *see* SDEIS at 2-3, FEIS at 2-30.

- The SCRB Alternative provides approximately 7.5 years of mining north of Hwy 33 before requiring relocation to the South of Hwy 33 ("S33") tract. FEIS Appendix D. The EPA Alternative provides 8 years of mining north of Hwy 33 before requiring relocation to the S33 tract.

- The EPA Alternative provides more mining north of Hwy 33 than SCRB and allows more expansive mining than SCRB in the S33 Tract. Therefore it is practicable under the DEIS and SDEIS economic practicability analysis.

- The Wilmington District stated in response to comments in the FEIS that "[t]he Corps has not altered the economic analysis." Wilmington District's response to comments, FEIS J-V.B.2(R71). To clarify, the Wilmington District confirmed that "[t]he Corps has continued to use the DEIS approach in the FEIS." *Id.*

- Thus, any alternative that was practicable in the DEIS and SDEIS must be practicable under the analysis in the FEIS since the "[t]he Corps has not altered the economic analysis." *Id.*

- Since the EPA Alternative is practicable under the DEIS analysis and is practicable under the SDEIS analysis and "the Corps' approach to determining practicability have remained consistent throughout the DEIS, the SDEIS and the FEIS," the EPA Alternative must be practicable under the FEIS's practicability analysis. Wilmington District's response to comments of Dr. Douglas Wakeman, FEIS J-V.B.2 Exh.F(R1).

The Wilmington District's determination that all practicable alternatives must provide 15 years of mining north of highway 33 is arbitrary and indefensible.

- As discussed above, based on the economic practicability analysis in the DEIS, SDEIS, and FEIS, the Wilmington District concluded that 7.5 years of mining north of NC Highway 33 during the initial 15 years of mining is practicable. In the FEIS, however, the Wilmington District introduced an arbitrary and indefensible requirement that alternatives must – in addition to providing 15 years of mining within PCS's historical operating cost – include at least 15 years of mining north of NC Highway 33 to be considered practicable. This requirement was not introduced or discussed in any of the discussions of the Review Team or in the DEIS or SDEIS.

- The decision to require 15 years of mining north of Hwy 33 is critical to the assessment of impacts on the aquatic ecosystem. Not only is the area north of Hwy 33 adjacent to the tidal creeks, primary nursery areas, a secondary nursery area, and the Pamlico River estuary, it includes more than 3,400 of the 3,953 acres of wetlands that PCS proposes to mine.

- The 15-year requirement added to the economic analysis in the FEIS is erroneously and arbitrarily based on the applicant's decision to initially apply for a 15 year permit.

    - The purpose and need only requires a long-term mine expansion, the Wilmington District has failed to explain why less than 15 years is not long-term.

    - The FEIS states that "the applicant demonstrated that . . . 15 years presents an adequate planning horizon," but does not demonstrate that less than 15 years is not an adequate planning horizon. FEIS 2-31.

    - PCS's current permit was issued in 1997 and the company has stated it will exhaust all ore under that plan in 2009. This conclusively demonstrates that the company can operate on a 12-year planning horizon.

- Alternative L is not the "least environmentally damaging practicable alternative" because the company can – at a minimum – operate on a 12-year planning horizon and has not demonstrated that less than 12 years is not sufficiently long term to meet the purpose and need.

- The 15-year requirement introduced in the FEIS is erroneously and arbitrarily based on the "cash cost model" that was specifically rejected by the Wilmington District in responses to comments in the FEIS.

  - Following the DEIS, PCS submitted a new "cash cost" model that "eliminates the amortization of [costs]" and posts those costs in "the actual years of expenditures." PCS comments on DEIS, FEIS J-VII.A.1.

  - The Wilmington District incorporated the "cash cost" model's findings into the FEIS's practicability analysis, adopting the applicant's contention that "an alternative must not involve the incurring of costs that are not recouped [within the first 15 years]." FEIS 2-30. To further clarify, the FEIS states "[t]he key factors that make AP practicable are that all costs associated with mining the 15-year period are recouped within the same 15 years and that the 15 years does not involve mining at unreasonable costs." FEIS 2-29.

  - The Wilmington District clearly used the "cash cost" model as the basis for Alternative L: "Alternative L was developed to . . . provide 15 years of mining with no substantial capital and/or development costs that was not recovered in the same period." Wilmington District's response to comments, FEIS J-V.B.2(R51).

  - In response to comments criticizing the "cash cost" model, the Wilmington District denounced the model as inappropriate and uninformative, but then admitted using it. The response states "the Corps determined that the [cash cost model] was not informative or appropriate; however, some information was relevant in the Corps approach to practicability . . . this information was used in the Corps approach to determining practicability." Wilmington District's response to comments, FEIS J-V.B.2(R71).

  - The Wilmington District repeatedly rejected the "cash cost" model that formed the basis for the 15-year requirement in the FEIS, stating:

    - "The Corps agrees that there is no rationale or benefit in adopting the 'Cash Cost' model." Wilmington District's response to comments J-V.B.3(R12).

    - "The Corps agrees that the 'cash cost' analysis further complicates the economic analysis of alternatives. The Corps has not used the cash cost analysis in its approach to determining alternative practicability." Wilmington District's response to comments, FEIS J-V.B.2(R50).

    - "After fully considering the appropriateness and relevance of the cash cost model data . . . the Corps finds that . . . the results are, at best uninformative in determining the practicability of alternatives." Wilmington District's response to comments of Dr. Douglas Wakeman, FEIS J-V.B.2 Exh.F(R1).

- "The Corps finds the use of the "cash-cost" model data to be, at best, uninformative in determining alternative practicability." Wilmington District's response to comments of Dr. Douglas Wakeman, FEIS J-V.B.2 Exh.F(R5).

- "The Corps has not used the cash cost analysis in its approach to determining alternative practicability therefore, we do not attempt to justify, clarify or defend its use." Wilmington District's response to comments of Dr. Douglas Wakeman, FEIS J-V.B.2 Exh.F(R1).

  - The Wilmington District's FEIS analysis ultimately relies on an indefensible, arbitrary finding that "there is no rationale or benefit in adopting the 'Cash Cost' model" yet that "some information" from that model "was relevant" and "was used in the Corps approach to determining practicability." This internally contradictory treatment of the "cash cost" model cannot be supported.

  - Further, the Wilmington District refused to respond to substantive comments on the economic practicability analysis used in the DEIS and SDEIS based on the premise that it had not altered the analysis:

    - "This comment letter contains several manipulations of cost data using cash cost and discounting techniques. The Corps has not used the cash cost analysis in its approach to determining alternative practicability therefore, we do not attempt to justify, clarify or defend its use. Comments relevant to the overall approach and NEPA/CWA are addressed." Wilmington District's response to comments of Dr. Douglas Wakeman, FEIS J-V.B.2 Exh.F(R1).

- The 15-year requirement introduced in the FEIS is erroneously and arbitrarily based on the Wilmington District's contradictory treatment of the practicability of mining in the S33 tract.

  - Mining in S33 was included in the development of alternatives because PCS contends that mining there will be practicable in the future.

    - "The applicant has also indicated that it believes the market will eventually become favorable [for mining in S33]; a reasonable position based on USGS information regarding the rate of depletion of domestic production capacity and the applicant's future shift to higher margin products. The Corps has determined that it is therefore appropriate to include [S33] in the evaluation." FEIS 2-26.

    - "The applicant has made clear its desire to mine the entire project area if suitable market conditions exist. The applicant has developed a master plan which details their preferred sequential progression for the accomplishment of this goal. The applicant has also made clear that, if granted a permit for the AP Alternative, it would then seek a permit to mine Bonnerton and S33." FEIS 2-9.

    - The Wilmington District even added areas adjacent to S33 to alternatives because mining in S33 was presumed to be practicable: "The Corps, the Review Team and the applicant agreed that it was reasonable to include these areas since they were readily accessible from the S33 area and they increased the minable area without a significant increase in environmental or socioeconomic impact." FEIS 2-9.

- The Wilmington District's FEIS analysis rejects the very assumption that justified including mining in S33 in any alternative – that mining in S33 will be practicable – and arbitrarily concludes that future mining in S33 is impracticable. Although previously describing that assumption as "a reasonable" position – and relying on it to include S33 in Alternative L – the Wilmington District eliminated less environmentally damaging practicable alternatives based on an arbitrary, contradictory finding.

    - "[T]he lower cost depicted for the initial 6-7 years of mining in the S33 Tract are only realized if the entire alternative boundary within the S33 Tract is mined." FEIS 2-30. That finding should not limit the practicable alternatives analysis since the "applicant has also indicated" it will be able to mine the entire S33 Tract.

    - "The Corps finds that SCRA, SCRB, and SJAB are not practicable alternatives due to the required commitment to higher mining costs . . . without the expectation of fully recovering these development costs." FEIS 2-30.

    - "Alternatives that relocate into the S33 Tract within 15 years confront the applicant with a commitment to several years of mining at a cost not currently considered practicable. Therefore, alternatives that involve relocation to the S33 Tract within the initial 15 years are not practicable." FEIS 2-31.

- The Wilmington District arbitrarily contradicts itself in the practicability analysis, finding that mining in S33 is practicable for the purpose of including that tract in mine plans, but impracticable for purposes of the practicability determination. It is the same land, mined through the same process, during the same time period, thus its practicability must be the same throughout the analysis.

PCS'S PROPOSED MINE EXPANSION WOULD CAUSE UNACCEPTABLE ADVERSE HARM TO AQUATIC RESOURCES OF NATIONAL SIGNIFICANCE

The Albemarle-Pamlico Sound estuary and associated wetlands are aquatic resources of national importance.

- In the Water Quality Act of 1987, Congress directed that the Administrator of EPA give priority consideration to designation of Albemarle Sound as an estuary of national significance and to convene a management conference to develop a comprehensive management plan to recommend priority actions to restore and maintain water quality, fish and shellfish resources, wildlife, and recreational uses of the estuary. *33 U.S.C. 1330(a).*

- In October 1987, the State of North Carolina and Environmental Protection Agency designated Albemarle and Pamlico Sounds as an estuary of national significance and convened a management conference to assess trends in water quality and natural resources, determine the causes of changes, and develop a comprehensive management plan with recommendations for priority actions. *State/EPA Conference Agreement for National Estuary Program Designation Under the Water Quality Act of 1987 (NEP Designation).*

- Justifications for designation of Albemarle-Pamlico Sounds as an estuary of national significance include the following:

    - Declines in fisheries productivity including major declines in commercial fisheries. *NEP Designation at 5.*

    - Eutrophication from excessive nutrient inputs. *NEP Designation at 5-6..*

    - Habitat losses which "have greatly affected ecosystem functions of estuarine habitats and tightly-linked wetlands habitats. *NEP Designation at 6.*

- The Albemarle-Pamlico Sound management conference issued its comprehensive conservation and management plan in 1994. *Environmental and Economic Stewardship in the Albemarle-Pamlico Region – A Comprehensive Conservation and Management Plan 1994 (NEP Plan).* The Plan identifies goals and priority actions including the following:

    - Conserve and protect vital fish and wildlife habitats and maintain the natural heritage of the Albemarle-Pamlico Region. *NEP Plan at 23.* Identified vital habitats include rare natural communities, wetlands and primary nursery areas for fisheries. *NEP Plan at 24-25.* Protection rare natural communities "is vital to the survival of species and to the maintenance of the region's natural heritage. *NEP Plan at 24.* "North Carolina has lost more than 50 percent of its original 10 to 11 million wetland acres." *NEP Plan at 24.*

    - Promote the protection and conservation of valuable natural areas in the APES region. *NEP Plan at 28.*

    - Maintain, restore and enhance vital habitat functions to ensure the survival of wildlife and fisheries. *NEP Plan at 29.*

    - Enhance the ability of state and federal agencies to enforce existing wetlands regulations. *NEP Plan at 29.*

- Strengthen regulatory programs to protect vital fisheries habitats. *NEP Plan at 29.*

PCS proposes to mine substantial parts of the watersheds of five fishery nursery areas and impair the functions of these vital, priority habitats and aquatic resources of national significance.

- Primary fishery nursery areas "are of critical important to the propagation of over 75 species of fish and shellfish [in Albemarle-Pamlico Sound]. The functions of these nurseries can be impaired by freshwater drainage, land use changes, and excessive algal growth. Nursery areas are most threatened by nonpoint sources of pollution and by development on nearby lands." *NEP Plan at 25.*

- PCS proposes to mine substantial parts of the watersheds of four tidal creeks designated by the State of North Carolina as primary fishery nursery areas:

  - Porter Creek: 71% drainage basin reduction

  - Jacks Creek: 84% drainage basin reduction

  - Jacobs Creek: 75% drainage basin reduction

  - Tooleys Creek: 55% drainage basin reduction

- Primary nursery areas are "areas inhabited by embryonic, larval, or juvenile life stages of marine or estuarine fish or crustacean species due to favorable physical, chemical or biological factors." 15A NCAC 10C.0502.

- The EPA is not alone in determining that the proposed mine expansion will have unacceptable adverse effects on aquatic resources of national importance. State and federal agencies alike have opposed impacts like those proposed under Alternative L throughout the permitting process.

  - "Such large-scale wetland impacts located directly adjacent to the Pamlico River . . . will act to exacerbate the impacts of eutrophication while altering local food web stability; both of which have important implications for estuarine productivity." U.S. Fish and Wildlife Service comments on DEIS and SDEIS, FEIS J-III.A.4.

  - "Both Alternative L and Alternative M . . . would indirectly impact estuarine habitats associated with South Creek, Pamlico River, Durham Creek, and Porter Creek." Therefore, "[m]ining activities within the NCPC and Bonnerton tracts shall not be authorized." National Marine Fisheries Service comments on SDEIS, FEIS J-III.B.3.

  - "Overall, the Division of Coastal Management has serious concerns regarding the two new alternatives described in the SDEIS as well as the prior alternatives in the DEIS because of their significant adverse impacts to the environment." North Carolina Division of Coastal Management comments on SDEIS, FEIS J-IV.B.3.

- "All the examined alternatives [in the SDEIS] would have significant adverse impacts on water quality, estuarine resources, wetlands, and public trust waters." North Carolina Division of Marine Fisheries comments on SDEIS, FEIS J-IV.B.7.

- "[W]e recommend that neither the AP, EPA, SCR, or SJA alternatives be considered as appropriate mining options on the NCPC tract because of significant degradation of fish and wildlife resources and the inability to provide adequate compensatory mitigation." North Carolina Wildlife Resources Commission comments on DEIS, FEIS J-IV.A.10.

- "Losses of these non-coastal wetlands and waters will affect downstream coastal waters and public trust resources under the jurisdiction of the [Marine Fisheries Commission]. . . . The additional proposed loss of headwaters wetlands would add to the significance of habitat losses that affect coastal fisheries production." North Carolina Marine Fisheries Commission comments on DEIS, FEIS J-IV.A.11.

- PCS contends that a report by its consultant ENTRIX establishes that mining the headwaters and dramatically reducing the drainage basins of tidal creeks and primary nursery areas will have "no significant indirect effects" on the downstream waters and aquatic ecosystem. While generally attempting to diminish the importance of headwaters to downstream waters in advocating for mining these areas, PCS proposes to do all its proposed compensatory mitigation in headwaters areas of watersheds significantly inland from the estuary.

- The Pamlico-Tar River Foundation and other agencies have submitted comments to the Wilmington District explaining why the conclusions in the ENTRIX report are misplaced. Key shortcomings of the report include:

    - A fundamental shortcoming of the ENTRIX report is that is selects data from studies not designed to assess the effects of drainage basin reduction to draw conclusions about the effects of drainage basin reductions and support unsubstantiated claims that mining through headwaters of estuarine creeks will have no discernable effects on the function of those creeks as primary nursery areas. *See, e.g., Rulifson 1991 (study of finfish utilization of man-initiated and natural wetlands); West (2000) (study comparing created marshes to natural marshes).*

    - In assessing the potential impacts of drainage basin reductions, the ENTRIX report fails to examine or evaluate the full range of potential effects of substantial drainage basin reductions on downstream estuarine systems, including organic carbon export, fishery productivity, biogeochemical processes, and overall ecological integrity, which are important factors which must be assessed to determine significant degradation under the 404(b)(1) guidelines.

- The ENTRIX report's reliance on a created marsh system with a limited drainage basin to draw conclusions about the effects of substantial drainage basin reductions on a natural creek and marsh system is inappropriate. Moreover, this study postulated that a primary factor in the faunal characteristics of the created system was that it was surrounded by aquatic systems it was intended to mimic, thereby providing sources of infaunal recruits. There is no assessment of the cumulative effects of substantial drainage basin reductions of all the creeks and primary nursery areas on the western shore of South Creek, as proposed by PCS.

PCS proposes to mine 3,953 acres of wetlands adjacent and linked to primary fishery nursery areas and other waters of the Pamlico estuary, including nonriverine hardwood forests designated by the State of North Carolina to be of national ecological significance.

- The Albemarle-Pamlico Sound designation identifies loss of wetlands as a priority environmental concern and enhancing protection of remaining wetlands as a priority action. *NEP Designtion at 6 and NEP Plan at 29.*

- The PCS proposal to mine and destroy 3,953 acres of wetlands, if authorized, would constitute the largest permitted destruction of wetlands in the Albemarle-Pamlico watershed and in the State of North Carolina.

- PCS proposes to mine parts of the Bonnerton nonriverine wet hardwood forest.

- NatureServe ranks nonriverine wet hardwood forests as a G2 or globally imperiled natural community, meaning there are between only 5 and 20 viable sites remaining. *See www.NatureServe.org/Explorer* (Ecological System ID: CES203.304, *Quercus michauxii - Quercus pagoda / Clethra alnifolia - Leucothoe axillaris* Forest). The remaining nonriverine wet hardwood forests are among the most scarce and endangered wetland systems in the United States and an aquatic resource of national importance.

- The North Carolina Natural Heritage Program was established by the North Carolina General Assembly to "include classification of natural heritage resources, an inventory of their locations, and a data bank for that information." "Information from the natural heritage data bank may be made available to public agencies and private persons for environmental assessment and land management purposes." NCGS 113A-164.4.

- The North Carolina Natural Heritage Program has designated the Bonnerton nonriverine wet hardwood forests as a natural community of national significance as one of the five best remaining examples of this type of wetland in the world. *Schafale, Nonriverine Wet Hardwood Forests in North Carolina – Status and Trends, January 2008.*

- The North Carolina Division of Water Quality has designated the Bonnerton nonriverine wet hardwood forests as a wetland of state or national ecological significance under wetland water quality standards. *401 Certification; 15A NCAC 2H.0506(e).* Activities that would alter wetlands of state or national ecological significance may only be authorized if the activities are for a public purpose. *15A NCAC 2H.0506(e).*

- The primary conclusion of PCS's consultant Dr. James Gregory, in his "rapid forest assessment," is that Dr. Schafale's determination that the Bonnerton tract is a nonriverine wet hardwood forest is incorrect. Dr. Schafale conducted a detailed examination of the site. Dr. Schafale also co-authored the accepted scientific report defining the nonriverine wet hardwood forest natural community (cited by Dr. Gregory). *See Schafale and Weakley, Classification of the Natural Communities of North Carolina 1990.* In sum, Dr. Gregory, a watershed hydrology consultant, contends Dr. Schafale, the Plant Community Ecologist with the North Carolina Natural Heritage Program who wrote the accepted definition and description of a nonriverine wet hardwood forest, did not, after carefully examining the Bonnerton tract, correctly determine it is a nonriverine wet hardwood forest. Not only did Dr. Schafale correctly determine the tract is a nonriverine wet hardwood forest, he concluded it is one of the best five remaining examples of the imperiled natural community remaining.

- To support his contentions, Dr. Gregory cites the definition of nonriverine wet hardwood forest in the EPA/Corps guidance on silvicultural activities but overlooks, or fails to note, footnote 7 which clearly states that the definition used for this forest type in the guidance is "a subset of those described in Schafale and Weakley, 1990." There is no requirement in Schafale and Weakley that a nonriverine wet hardwood forest have a greater than 50% basal area per acre of oak species. *EPA and Corps, Application of Best Management Practices to Mechanical Silvicultural Site Preparation Activities for the Establishment of Pine Plantations in the Southeast 1995.*

PCS's proposed mitigation will not offset the unacceptable adverse impacts to aquatic resources of national importance.

- Unacceptable adverse effects means impact on an aquatic or wetland ecosystem which is likely to result in significant degradation of ... or significant loss of or damage to fisheries, shellfishing, or wildlife habitat or recreational areas. In evaluating the unacceptability of such impacts, consideration should be given to the relevant portions of the section 404(b)(1) guidelines. 40 C.F.R. § 231.2(e).

- Under the 404(b)(1) guidelines, compensatory mitigation is only appropriate for unavoidable wetland impacts. 40 C.F.R. § 230.10(a). Practicable alternatives exist that would avoid wetlands and impacts to primary nursery areas and Bonnerton nonriverine wet hardwood forests.

- Under the 404(b)(1) guidelines, even if no practicable alternative exists, no discharge of dredged or fill material shall be permitted which will cause or contribute to significant degradation of waters of the United States. 40 C.F.R. § 230.10(c). In addition, no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem. 40 C.F.R. § 230.10(d).

- Significant adverse impacts to the tidal creeks and primary nursery areas include significantly adverse effects on fish, wildlife and special aquatic sites; significantly adverse effects on life stages of aquatic life and wildlife dependent on aquatic ecosystems; significantly adverse effects on aquatic ecosystem diversity, productivity and stability; and significantly adverse effects on recreational and economic values. 40 C.F.R. § 230.10(c).

- None of the proposed compensatory mitigation for any of the adverse effects to the tidal creeks and primary nursery areas will be conducted within the immediate watersheds of these tidal creeks and primary nursery areas, resulting in unmitigated significant degradation of these aquatic resources of national importance.

- PCS inappropriately relies on proposed compensatory mitigation in the headwaters far removed from the estuary to mitigate the significant adverse effects of its mining operations on the tidal creeks and primary nursery areas and connected wetlands in the immediate watersheds that will be destroyed and severely degraded by its proposed mine plan.

- Destruction of the Bonnerton nonriverine wet hardwood forest will result in significantly adverse effects on a special aquatic site; adverse effects on aquatic ecosystem diversity, productivity and stability; and unmitigated significant degradation of an aquatic resource of national importance.

- Federal and state agencies agree that PCS has not provided adequately detailed mitigation plans and the mitigation it has proposed will not offset the proposed impacts:

    - "[T]he proposed compensatory mitigation is insufficient to offset adverse impacts to the aquatic environment except in the area south of Hwy 33." U.S. Fish and Wildlife Service comments on DEIS, FEIS J-III.A.4.

    - "The applicant's historical performance to ensure that adequate mitigation occurs for past mining efforts precludes NMFS from having reasonable assurance at this time that impacts from mining the NCPC tract will be satisfactorily mitigated." National Marine Fisheries Service comments on DEIS, FEIS J-III.A.6

    - "[T]he applicant has not developed a compensatory mitigation plan and, instead, continues to offer only a general strategy . . . we do not believe that the applicant has demonstrated that sufficient mitigation will be provided in a timely manner for the proposed project." National Marine Fisheries Service Comments on SDEIS, FEIS J-III.B.3.

- "Detailed mitigation plans must be provided in the final EIS, with adequate opportunity for thorough review." North Carolina Division of Marine Fisheries comments on DEIS, FEIS J-IV.A.8

- "Detailed mitigation plans need[] to be provide[d] in the final EIS." North Carolina Division of Marine Fisheries comments on SDEIS, FEIS J-IV.B.7.

- "[W]e conclude adequate mitigation in NCPC and Bonnerton has not been proposed." North Carolina Wildlife Resources Commission comments on DEIS, FEIS J-IV.A.10.

- "A detailed mitigation plan for permittable impacts has not been addressed." North Carolina Wildlife Resources Commission comments on DEIS, FEIS J-IV.B.11.

Palmer Hough/DC/USEPA/US
04/24/2009 02:03 PM

To Mike_Wicker <Mike_Wicker@fws.gov>, ron.sechler@noaa..gov, Wilber Pace <Pace.Wilber@noaa.gov>, Pete_Benjamin
cc Rebecca Fox/R4/USEPA/US@EPA
bcc
Subject 4-17-09 PCS briefing

Folks:

Here are the materials PCS provided on 4-17-09 during the site visit.

-Palmer

PCS White Paper_Purpose and Need.pdf
4-16-09 Brod memo_review of EPA NPV.pdf
4-16-09 draft forestry report-SNHA_Jim Gregory.pdf
4-17-09 briefing from PCS.pdf
4-17-09 Site Visit participant list.pdf
PCS White Paper_EPA Actions are Untimely.pdf
PCS White Paper_EPA use of Profit.pdf

Palmer F. Hough
US Environmental Protection Agency
Wetlands Division
Room 7231, Mail Code 4502T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Office: 202-566-1374
Cell: 202-657-3114
FAX: 202-566-1375
E-mail: hough.palmer@epa.gov

Street/Courier Address
USEPA
Palmer Hough
EPA West -- Room 7231-L
Mail Code 4502T
1301 Constitution Avenue, NW
Washington, DC 20460

Purpose and Need

Public Need

1. PCS is a major employer in the region and the largest employer in the county.

"With over 1,000 permanent employees and an annual payroll of over $60 million, PCS is the area's largest private employer. Approximately $5 million in state and local taxes is paid by PCS annually. Total annual purchases of goods and services by PCS in the state averages over $100 million. In addition, PCS is the largest user of the state port at Morehead City, shipping approximately one million tons of product through that single port at an average annual cost of approximately $11 million. The demand for goods and services created by PCS and its employees generates additional employment throughout the area, especially in service oriented fields. Population, labor force, and employment trends within the four-county area are not expected to be adversely affected by mining continuation activities associated with any mine continuation alternative boundary." FEIS 4.2.1.17, p. 4-38. *See also* FEIS 1.2.1, p. 1-4, and 3.17.5, 3.17.6, and 3.17.7, p. 3-77.

2. Phosphate rock is the only commercial source of the element phosphorous.

"Phosphate rock minerals are the only significant global commercial sources of elemental phosphorous." FEIS 121., p. 1-3.

3. Phosphorous is a basic component of fertilizer, animal feed, and consumer products.

"The largest user of phosphorous is the agricultural sector, which relies on phosphate products for fertilizer and animal feed supplements. Historically, over 90 percent of the phosphate rock produced has been used for agriculture." *Id.* It is also used in a variety of consumer products and in various industrial processes; most recently, it has been demonstrated to be an effective agent for controlling AMD (acid mine drainage), "the most significant environmental impact from coal mining in the Northern Appalachian Coal Basin." *Id.*

4. National impact of not mining the Aurora deposits.

"As one of the world's largest phosphate producers, the United States is important in meeting worldwide phosphate demand. Approximately 85 percent of the total domestic output is produced in Florida and North Carolina. Rising mining and production costs and ore depletion are expected to reduce Florida contribution to the market." FEIS 1.2.1, p. 1-3. The FEIS (1.2.1) identifies a number of US mines that have closed in recent years and the declining US production of phosphate. "In 2001, phosphate rock production decreased for the fifth consecutive year to reach its lowest point since 1965. . . . Current mining technology does not allow mining the deeper Florida deposits or offshore phosphorites and the most economical, high grade ore deposits in Florida are gradually being depleted." *Id.*

"As discussed above the Aurora Phosphate deposit is one of the few remaining minable deposits in the United States. An estimated one billion tons of phosphate rock concentrate may be found within the study area. Closure of this mine would mean the North Carolina phosphate resource would cease to be recovered and would no longer contribute to the phosphate resources available to US agriculture or the US share of the world market for phosphate products. The potential for substantial phosphate imports and loss of phosphate fertilizer exports may have effects beyond its regional implications. According to US Geological Survey, the United States is a leading consumer and producer of phosphate fertilizers. Halting the recovery of the Aurora phosphate deposit combined with the projected decline in Florida phosphate production would leave the US farm economy largely dependent upon foreign sources of phosphate supply." FEIS 1.2.1.

Applicant's Purpose and Need

" . . . the applicant's purpose and need is to implement a long-term systematic and cost-effective mine advance within the project area for ongoing PCS mine operation at Aurora, North Carolina."

FEIS 1.2.2, p. 1-4.

The PTRF challenged[1] the nearly identical purpose and need statement set forth in the prior EIS[2] developed for a 404 Permit originally applied for in 1988 (the "1988 Permit"). In that challenge, the PTRF argued that PCS should have been required to study importing all or some of its phosphate rock from Morocco. The Corps disagreed:

> First, the Corps considered and rejected the alternative of shutting down the mine, which would force PCS to import phosphate rock from foreign sources (principally Morocco). This alternative was rejected for several reasons: the severe socioeconomic impact it would have on the area FN4, the dependence of both PCS and the U.S. farm economy on foreign sources of phosphate rock and the inability of PCS to continue mining its phosphate reserves.
>
> > FN4. PCS is a major employer in the region. In 1991, the mine employed 598 people, paid $28 million in payroll and benefits, $2.1 million in state and local taxes, $2.7 million to the North Carolina State Ports Authority, and $73 million in the purchase of goods and services from North Carolina vendors. AR 015171.

Id. at 606-07. The PTRF also argued that the purpose and need statement was too narrow in requiring a long-term (approximately 20 years) mining advance, thereby eliminating another mining alternative (mining only uplands). The Corps rejected this alternative "primarily because it only allowed ten years of mining at current production rates; therefore, it was inconsistent with the purpose and need." 329 F.Supp.2d at 607.

---

[1] *Pamlico-Tar River Foundation v. U.S. Army Corps of Engrs., et al.*, 329 F.Supp.2d 600 (EDNC 2004).

[2] "a long-term (approximately 20 years) systematic and cost-effective mine advance within the 14,200 acre project area ... for the ongoing [PCS] mine operation at Aurora, North Carolina." *Id.* at 606.

The U.S. District Court for the Eastern District of North Carolina agreed with the Corps on both challenges to the purpose and need statement:

> The Corps' statement of the purpose and need for the project is set forth in detail in Section 2.0 of the FEIS and covers six single-spaced types pages. AR 15167-72. It begins with an explanation of the history of PCS's activities, noting that PCS began acquiring phosphate resources in 1961 and began mining and processing phosphate in 1965. The statement also analyzes the public's need for phosphate rock, noting it is the only significant commercial source of the element phosphorous, which is a basic component of fertilizer, animal feed products, and consumer products such as soft drinks, toothpaste, foods, and flavors. The Corps also notes the economic needs for PCSs's continued mining in the area. As noted above, PCS employs almost 600 people at the Beaufort County mine. In Section 2.2, the Corps turns to the applicant's purpose and need, providing information underlying the reasons for a 20-year mine plan and factors to be considered in determining an economic mine plan. . . .
>
> As is demonstrated by the thorough discussion of the purpose and need of the project, PCS's purpose was to continue to mine the resources it had been acquiring, not merely to supply the chemical processing plants. While the Corps is not required to blindly accept PCS's statement of purpose, neither can it completely ignore it. . . .
>
> An agency need only consider alternatives that are reasonable in light of the project's stated purpose. . . . Defendants did a thorough job of defining the project purpose and need in a reasonable manner.

Id. at 614-15.

The FEIS for the current permit application notes the same public and local economic needs, FEIS 1.2.1, pp. 1-3 and 1-4, and the same need for long planning horizons.[3] "Long-term investments of tens or hundreds of millions of dollars in equipment require substantial secured reserves to ensure continuation of mining for the recovery of the investment." *Id.*

When the Corps put forward Alternative L, it expressly recognized that the applicant's legitimate purpose and need requires 15 years of mining north of Route 33, the crossing of which will require a massive (>$90 million) expenditure, and not just 15 years of mining anywhere. The area north of Route 33 is where PCS can reasonably expect to mine in a cost effective manner. Under current market, technological, logistical and cost constraints,

---

[3] "The magnitude of the necessary investment in property and personnel requires the phosphate mining industry to develop long-term mining plans based on approximately 20-year horizons. . . . Long-term plans [are required for] pre-operation activities, . . . procurement of mining equipment, . . . develop[ing] the engineering data." FEIS 1.2.2, p. 1-4 -- 1-6.

it is not reasonable to commit now to mining south of Route 33, and a plan that gives less than 15 years of mining (of necessity, north of Route 33) is thus not consistent with the well-established need for a plan that is both long-term and cost effective, as recognized in the Corps' statement of purpose and need. The new NGO alternative provides only 8 years of mining north of Route 33, and hence is inconsistent with the applicant's legitimate purpose and need.

Memorandum

To: George House
From: Dr. Andrew Brod, consulting economist
Subject: EPA's price forecasts
Date: April 16, 2009

Introduction

In its document, "Detailed Comments on Proposed PCS Phosphate Mine Expansion Section 404 Permit," the U.S. Environmental Protection Agency (EPA) asserts that operating profit is the most appropriate criterion to assess the practicability of mining alternatives. In order to apply that criterion to the matter of the PCS Phosphate mine continuation, EPA forecasted the price of phosphate rock from 2008 into the future. In this memorandum, I will review that price forecast and discuss the implication for using operating profit as the determinant of practicability.

EPA's Forecast

Every statistical forecast starts by fitting a model to a time series of observed data. Then the estimated model is used to project future values of the variable of interest. EPA used U.S. Geological Survey data on phosphate-rock prices found in Table 2-7 of the Final Environmental Impact Statement (FEIS). These prices, for the 17 years 1991-2007, are expressed in constant 2005 dollars per short ton at 60 BPL.

The model used by EPA is a linear trend model:

$$p_t = \beta_0 + \beta_1 t + \varepsilon_t$$

where β_0 and β_1 are the intercept and slope coefficients to be estimated, t is the trend variable (= 1, 2, …, 17), and ε is a random error term. The standard terminology is that price p_t is regressed upon the time trend t. Estimating this regression model fits a straight line to the data when plotted against time. However, as illustrated by the diagram on p. 3 of the Appendix to "Detailed Comments," there is no discernible trend in the price data. This is borne out by EPA's estimate of β_1, which at –0.006 is quite small and implies that rock prices fell by an average of six-tenths of a cent per year during 1991-2007. But more to the point, the estimate is statistically indistinguishable from zero. There is no statistical evidence to refute a claim that the trend line is perfectly flat.[1]

---

[1] In fact, it's not even close. Statisticians frequently refer to the "p-value" of an estimate to assess its significance. The p-value is the probability (hence a number between 0 and 1) of having obtained the estimated value by chance if its true value is in fact zero. The smaller the p-value, the less likely the estimate was a fluke and the more likely the statistician will have confidence in it. A typical criterion for the p-value is 0.05, or a 5% significance level. If the p-value is, say, 0.07, then strictly speaking, the coefficient estimate is statistically insignificant, though the statistician may deem that to be sufficiently close to retain the variable in the model. But the p-value for the trend coefficient in EPA's trend regression was not close to 0.05; it was 0.96.

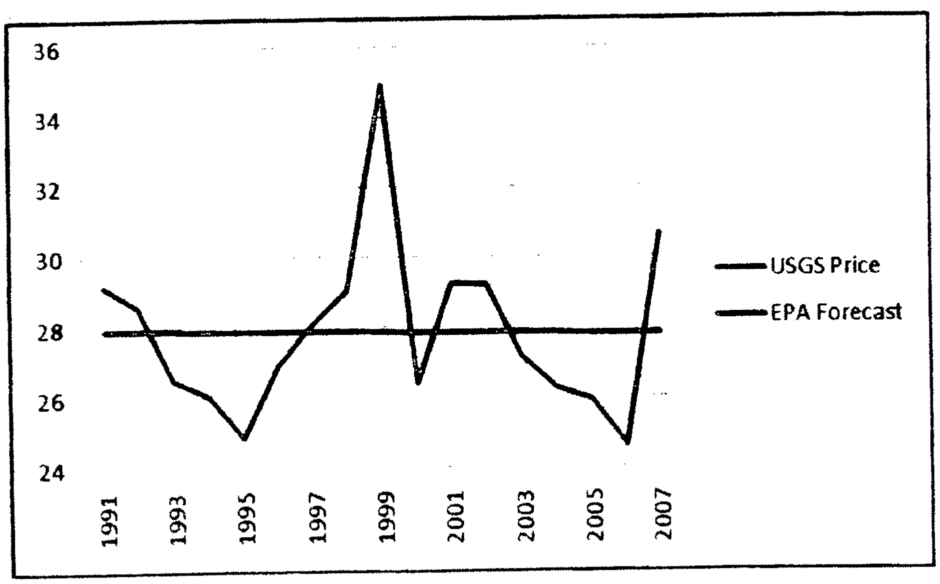
In a situation like this, it is standard practice to do one of two things: either discard the statistically insignificant variable and forecast price p_t without it, in this case as a simple average of the observed prices; or search for a better forecasting model. EPA did neither. For its projected profit calculations, EPA used the statistically insignificant estimate to reduce each successive year's price forecast by six-tenths of a cent.

Goodness of Fit

The "goodness of fit" of a statistical model is the degree to which it captures observed variations in the sample data. If two variables are highly correlated, then when one is regressed upon the other, the fit is likely to be quite good. A poor fit indicates a pronounced lack of correlation.

There are various ways to measures the fit of a model. The most frequently used measure is the R^2 statistic. For EPA's linear trend regression, $R^2 = 0.0002$. This implies that 0.02% of the total variation in price during the time period 1991-2007 is accounted for by the trend regression. One almost never sees an R^2 value that small. That it's effectively zero is consistent with the statistical insignificance of the slope coefficient.

The data graph on p. 3 of the Appendix to "Detailed Comments" actually disguises how badly the EPA model fits the data. The scale of the vertical axis is compressed. A very different picture emerges when a more reasonable scale is used:



As a rule, a decent fit is needed before one can be confident of the forecasts generated by a model. To be sure, in some models there is a trade-off between in-sample fit and out-of-sample forecast performance. One can sometimes improve the latter by sacrificing the former. But there is no such trade-off when $R^2 = 0.0002$. Hence there is no reason to place any confidence on the model's forecasts.

Other Models

Because the fit of the EPA model is so bad, I estimated a series of other pure time-series models of the rock price p_t in order to see if the fit could be improved. (I use the term "pure" here to indicate the absence of any actual data in the model besides price; the time trend t is a dummy, i.e. constructed, variable.) For example, I estimated a model that accounted for the possible autocorrelation of the error term, and one that estimated price as a first-order autoregressive process. When looking at alternative models, comparing values of R^2 is not the ideal approach, but it does provide a rough sense of fit. The largest R^2 I could find was approximately 0.12, or 12%. That is still a remarkably low value.

My provisional conclusion is that no pure time-series model does a good job of fitting this particular sample of price data. As the diagram on the previous page shows, rock prices had two big peaks during the 1991-2007 time period, both of which were brought on by external factors. Moreover, of the pure time-series models I considered, the EPA regression model has the worst fit and is effectively equivalent to doing nothing.

The only serious way to forecast price is to model it in such a way that takes supply, demand, and institutional factors into account, and that might require a multiple-equation model incorporating such data as rock production and fertilizer consumption. To be sure, such a model would require more data (both more variables and more observations per variable) than may be available here. But that's the point. Given the dearth of data, there appears to be no reliable way to forecast phosphate-rock prices. One might as well just take the average price and assume no growth, which is essentially what EPA did, even though it disguised it behind a façade of statistics.

Implications for Assessing Practicability

EPA generated its price forecasts so it could project operating profit for the various mining alternatives years into the future. A fair assessment of those forecasts finds them to be unreliable and highly speculative.

Beyond the specific problems with EPA's price forecasts, there are substantial difficulties in forecasting prices so far into the future. The outlook for global markets for phosphate rock, as well as related markets for such products as fertilizers and acids, is characterized by great uncertainty. Demand has roiled markets unpredictably for all commodities, including phosphate-derived products, most recently in the price run-up that ended in mid-2008. New sources of supply are expected, including a large mine in Saudi Arabia that is projected to come online in 2012. Given these and other factors, forecasting the price of phosphate rock is a highly speculative endeavor. To do it in a reliable manner, one would need a more sophisticated model and better data than were employed by EPA in its "Detailed Comments" document.

In contrast, it appears that we have a pretty good bead on costs. The unpredictable cost elements such as fuel account for a relatively small proportion of overall costs. And all parties in the PCS Phosphate matter have accepted as valid and reasonable the cost models generated by the Marston firm. An alternatives analysis is less likely to be speculative if based on comparisons of cost for a given purpose and need.

WATERSHED HYDROLOGY
CONSULTANTS
WatHydro

Assessing and Advancing Watershed Management

6301 Deerview Drive, Raleigh, NC 27606-8800 919-414-0993 jim.gregory@wathydro.com

April 16, 2009

William Cary, Esquire
Brooks, Pierce, McClendon, Humphrey & Leonard, L.L.P.
PO Box 26000
Greensboro, NC 27420

Reference: Rapid Forest Assessment: Nonriverine Wet Hardwood Stands on the Bonnerton Tract, PCS Phosphate Co., Inc.

Dear Mr. Cary:

My detailed report on the referenced assessment is in progress. However, to facilitate discussions with the U. S. Army Corps of Engineers at the scheduled site visit tomorrow, I have prepared a brief summary of my findings and conclusions.

The purpose of the rapid forest assessment reported here is to provide qualitative and limited quantitative description of three wetland mixed hardwood stands located on the Bonnerton Tract owned by PCS Phosphate Co., Inc., Aurora, NC (PCS). The three stands are the focus of ongoing discussions between staff of PCS and staff of the U. S. Environmental Protection Agency (EPA), U. S. Army Corps of Engineers (Corps), and N.C. Division of Water Quality (DWQ) regarding the forest type and the quality of those stands and their fate in the permitting process for expansion of phosphate mining into the Bonnerton Tract.

The three forest stands that are the subject of this report are denoted as vegetation type 7 on the drawing labeled: Modified Alt L – Bonnerton Proposed Impact Boundary 12/31/08 – Biotic Communities Impact. The three stands are also denoted as Significant Natural Heritage Areas on the aerial photo with property boundaries labeled as : Exhibit A, Non-Riverine Wet Hardwood Forest. For reference purposes, the three stands shall be referred to as: (1) eastern stand – easternmost of the three stands that contains the origin of Porter's Creek and consists mostly of the W. M. Gray and W. B. Gray tracts, (2) western stand – westernmost of the three stands at the intersection of NC 306 and SR 1958 and that consists mostly of the B. B. Ross and T. W. Bonner tracts, and (3) northern stand – northernmost of the three stands that lies west of the open field with air strip.

1. General Observations about the forest type "nonriverine wet hardwood forest"
   A. The forested vegetation type, nonriverine wet hardwood forest, was first named and described by Schafale and Weakley (1990) as an element of a classification system for the natural vegetation communities of North Carolina.

B. Many wetland forest stands that have been inventoried by the N.C. Natural Heritage Program (NHP) and labeled as nonriverine wet hardwood forest are not a "natural" area, as defined in NHP or EPA/Corps Guidance but instead are areas previously farmed/harvested/otherwise affected by human activity. In such forest stands, the current stand structure and tree species makeup is strongly influenced by the impacts of the past anthropogenic disturbances.

2. The nonriverine wet hardwood forest type is defined in Schafale and Weakley (1990) as "dominated" by 3 species, swamp white oak, laurel oak, and cherrybark oak in addition to several other tree species.
   A. In other NHP writings, the nonriverine wet hardwood forest type is clearly defined as applying only to stands dominated by the three key indicator species swamp white oak, laurel oak, and cherrybark oak, e.g. Schafale 2008.
   B. NHP does not define "dominated"
   C. In common forestry practice and other guidance documents, "dominated" by a tree species or combination of species typically means the single tree species or the combination of two or more species makes up greater than 50% of basal area of the stand.

3. Nonriverine wet hardwood forest in EPA/Corps guidance is defined as "with vegetation dominated (greater than 50% of basal area per acre) by swamp chestnut oak, cherrybark oak, or laurel oak alone or in combination". That same guidance also states that nonriverine wet hardwood forests are "rare, high quality wet forests, with mature vegetation". "Mature vegetation" is not specifically defined but for hardwood forests, foresters consider mature trees to be those that are at least 75 years old and ≥ 20 in dbh. For nonriverine wet hardwood forests, "high quality" also refers to extent of dominance of the three indicator species, swamp white oak, laurel oak, and cherrybark oak.

4. Nonriverine wet hardwood forests typically occur on poorly drained soils that are on the dry end of the range of wetland hydrology and are adapted to but not dependent on, wet conditions; can generally withstand long dry periods.

5. Initial Assessment
   A. There are three relatively distinct forested tracts on the Bonnerton Tract that have been labeled by NHP as nonriverine wet hardwood forest: Eastern, Western and Northern
   B. Cherrybark oak is conspicuously absent in all three tracts; this absence alone prevents characterizing the tracts as among the best nonriverine wet hardwood forests.

6. Eastern Tract
   A. best quality of the three
   B. approx. 22% of basal area in two of the indicator species, swamp white oak and laurel oak
   C. Many of the swamp white oak and laurel oak trees are relatively large, approx. 12"; some 18-20"; a few >20"
   D. no distinct 2 or 3 layer canopy

7. Western Tract
   A. poor quality
   B. approx. 5% of basal area in two of the indicator species, swamp white oak and laurel oak., very patchy distribution of the older trees with a second canopy layer of younger trees, the result of selective harvesting, likely about 30 years ago
   C. This stand also contains a number of relatively large southern red oaks, a tree adapted to well drained soils that typically does not occur in wetlands

8. Northern Tract
   A. very poor quality
   B. approximately 20% of basal area in two of the indicator species, swamp white oak and laurel oak
   C. high density harvest in very recent past
   D. large openings among the few older (often low quality) trees filling in with young, mostly "undesirable" species

9. Soils
   A. generally Tomotley fine sandy loam
   B. one area of higher and drier soils in Western Tract
   C. one depressional area in Western Tract that has evidence of long duration ponding; soils have higher organic carbon content in the surface zone that elsewhere on the tract
   D. all boreholes had positive hydric soil indicator, though on drier end of wetland hydrology and relatively low organic carbon content in the A horizon

10. Hydrology
    A. lower than expected water table (not yet recovered from drought)
    B. no saturated zone in upper 30" until proximate to Suffolk Scarp (lateral or upward hydraulic head of groundwater discharge from uplands to the west)
    C. depressional area in Western Tract had extensive areas of ponded water
    D. except for depressional area, no evidence of surface inundation in any of the three Tracts

11. Conclusions and Opinions
    A. Conclusion: the forest stands in none of the three Tracts meet the definitions of nonriverine wet hardwood forest in Schafale and Weakley (1990) and in EPA/Corps guidance.
    B. Opinion: regardless of the label, the three Tracts (singly) and the three Tracts collectively are not "significant" examples of the nonriverine wet hardwood forest type as contemplated by NHP. While portions of the Eastern Tract are good to very good quality, none of the Tracts are "exemplary," "unique," or "outstanding."
    C. Opinion: The bifurcation of the Western and Eastern Tracts by the proposed mining corridor should not negatively affect either Tract.

Literature Cited

Schafale, M. P. and A. S. Weakley. 1990. Classification of the natural communities of North Carolina. Third approximation. North Carolina Natural Heritage Program, N.C. Department of Environment, Health, and Natural Resources, Raleigh, NC.

Schafale, M. P. 2008. Nonriverine wet hardwood forests in North Carolina: Status and Trends. Unpublished report. North Carolina Natural Heritage Program, N.C. Department of Environment and Natural Resources, Raleigh, NC.

Cordially,

James D. Gregory

Digitally signed by James D. Gregory
DN: cn=James D. Gregory, o=Watershed Hydrology Consultants LLC, ou, [illegible]

James D. Gregory

PCS Presentation to ASA and COE Re: EPA Detailed Comments

April 17, 2009

PotashCorp

PotashCorp.com

PCS Presentation to ASA and COE
Re: EPA Detailed Comments

- Review of EPA Analysis of Unacceptable Adverse Effects on Aquatic Resources of National Importance
- Review of Project Purpose and Need
- Review of EPA Financial Analysis
  - Brod Critique of EPA Financial Analysis
  - Improper Consideration of "Profit' rather than "Cost"
  - Comparison of Alternative Ore Recovery and Impacts
  - Comparison of Alternative costs at 15 years and 20 years
  - Calculation of Ore Value Lost
- Review of EPA Failure to Comply with Required Review Procedures
  - Late Alternative
  - Failure to refer to Council on Environmental Quality

PotashCorp
Helping Nature Provide

CWA 404(q) MOA

…the elevation of individual permit cases should be limited to those cases where the net loss (i.e., after considering mitigation) from the project (i.e., within the scope of impacts being evaluated by the Corps), will result in unacceptable adverse effects to aquatic resources of national importance. Part IV.1

CWA 404(q) MOA

The Regional Administrator's opinion that elevation is warranted "should explain how the agency determination was made, should be based on **site specific information** and relate directly to matters within EPA's authority and expertise."

Part IV.3(b)(emphasis added)

PotashCorp
Helping Nature Provide

Modified Alternative L

Should not have been elevated because site specific information shows that net loss (after considering mitigation) will **not** result in:

– unacceptable adverse effects ("UAEs") to

– aquatic resources of national importance ("ARNIs")

PotashCorp
Helping Nature Provide

EPA - Identified ARNI

- Albemarle Pamlico Estuary ("APE")
- Tidal creeks (wind tides)
- PNAs
- Bonnerton hardwoods (271-acre tract)

PotashCorp
Helping Nature Provide

PotashCorp
Helping Nature Provide

No UAEs to APE, Tidal Creeks, or PNAs

- Direct effects - total avoidance
  - No direct effects after (or even before) mitigation
- Indirect effects -
  - Site-specific studies do not indicate significant indirect effects

PotashCorp
Helping Nature Provide

APE, Tidal Creeks, PNAs:

- EPA Comment:
  - Wetlands that surround or serve as headwaters for estuarine creeks are essential for the creeks to serve as Primary Nursery Areas.
  - Significantly reducing the drainage areas will significantly impact the tidal creeks and impair their function as PNAs.
  - We believe the potential effect of DBR on the production of marine fisheries resources is significant.

- Response
  - EPA comments not supported by site specific information

APE, Tidal Creeks, PNAs: Site Specific Information

- ENTRIX report
  - ***Site-specific*** analysis
  - Assesses indirect effects
  - Compiles and analyzes site-specific data from multiple sources spanning a period of more than 20 years
  - No significant indirect effects

APE, Tidal Creeks, PNAs: Site Specific Information

The available data:

- provided few indications of discernable changes that demonstrated an effect indicative of drainage basin reduction. . . . Indeed, overall there was no discernable effect based on the water quality parameters, fish assemblages or general benthic assemblage and condition, as indicated by species richness, expected dominance of certain taxonomic groupings, presence of sensitive or tolerant species, and other biotic indices used for assessing the health and integrity of estuarine tidal creeks. Entrix Report ¶ 5.1.1.

APE, Tidal Creeks, PNAs:

- EPA Comment: EPA does not believe it is valid to use the West study (on Project Area II) to make these inferences "of broad scale functional equivalency of PA II to local tidal creeks".

- Response:
  - West (2000) **(and Rulifson (1991))** both support functional equivalency based on *site-specific information*
  - In contrast, EPA relies on non-site-specific information and, in some cases applies information from dissimilar, non-estuarine, freshwater systems.

PA II – man-made, no drainage basin, year 1

PA II – man-made, no drainage basin, year 25

PotashCorp
Helping Nature Provide

APE, Tidal Creeks, PNAs:

- EPA Comment: SAV populations have recently declined by as much as 50%, possibly because of anthropogenic impacts.
- Response
  - No such decline in project area. Area creeks are densely populated by SAVs. FEIS 3.6.1.

PotashCorp
Helping Nature Provide

APE, Tidal Creeks, PNAs:

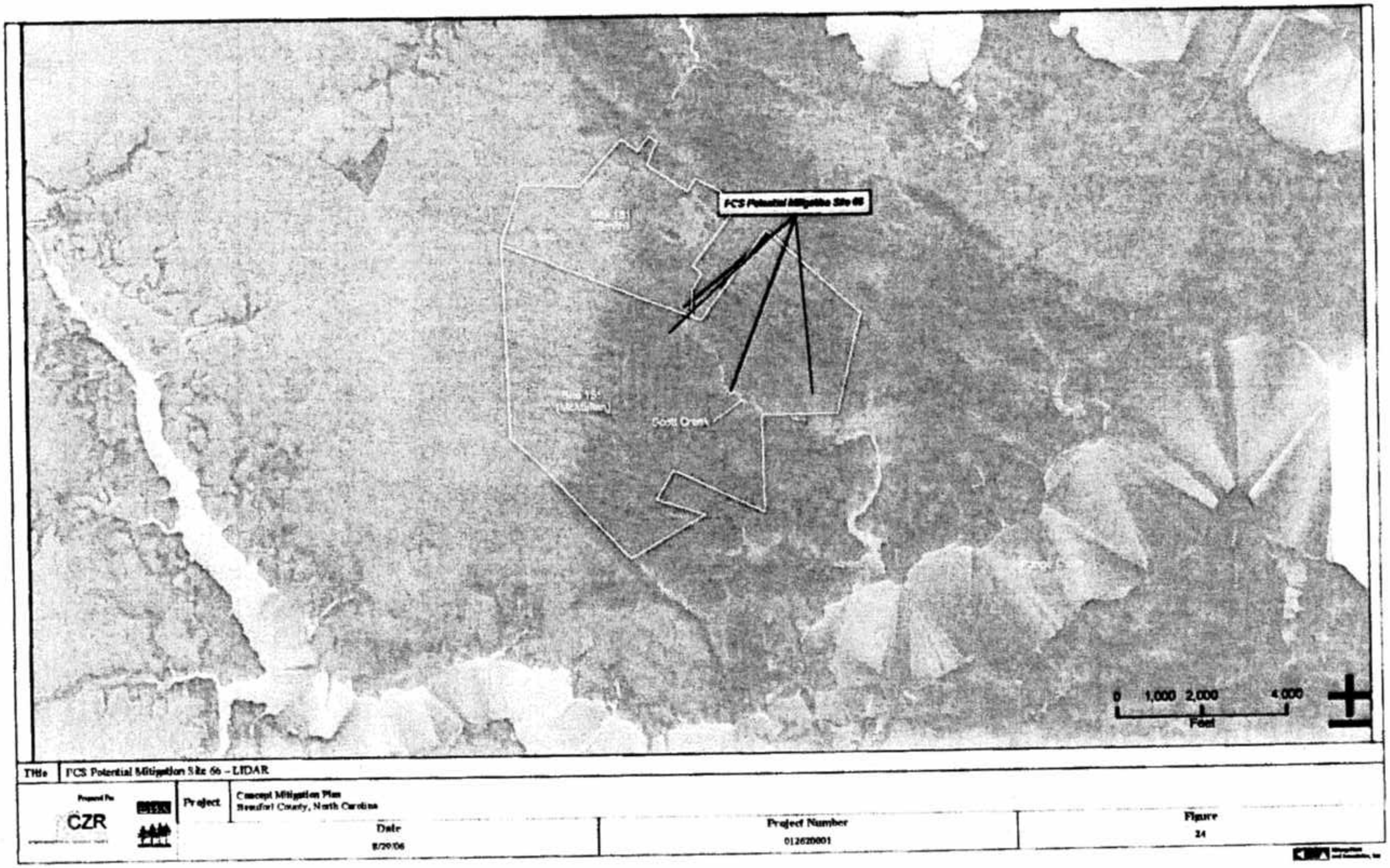
- EPA Comment: Most of the drainage basin wetlands that would be subject to impacts are wet forests… subject to repeated periods of inundation and desiccation … resulting in episodic exports of dissolved organic materials to the estuary.

- Response
  - The only "wet forests" that are subjected to repeated periods of inundation and desiccation would be 15 acres of bottomland hardwood, thus the existing episodic exports are minimal and their loss would be insignificant.

Mitigation

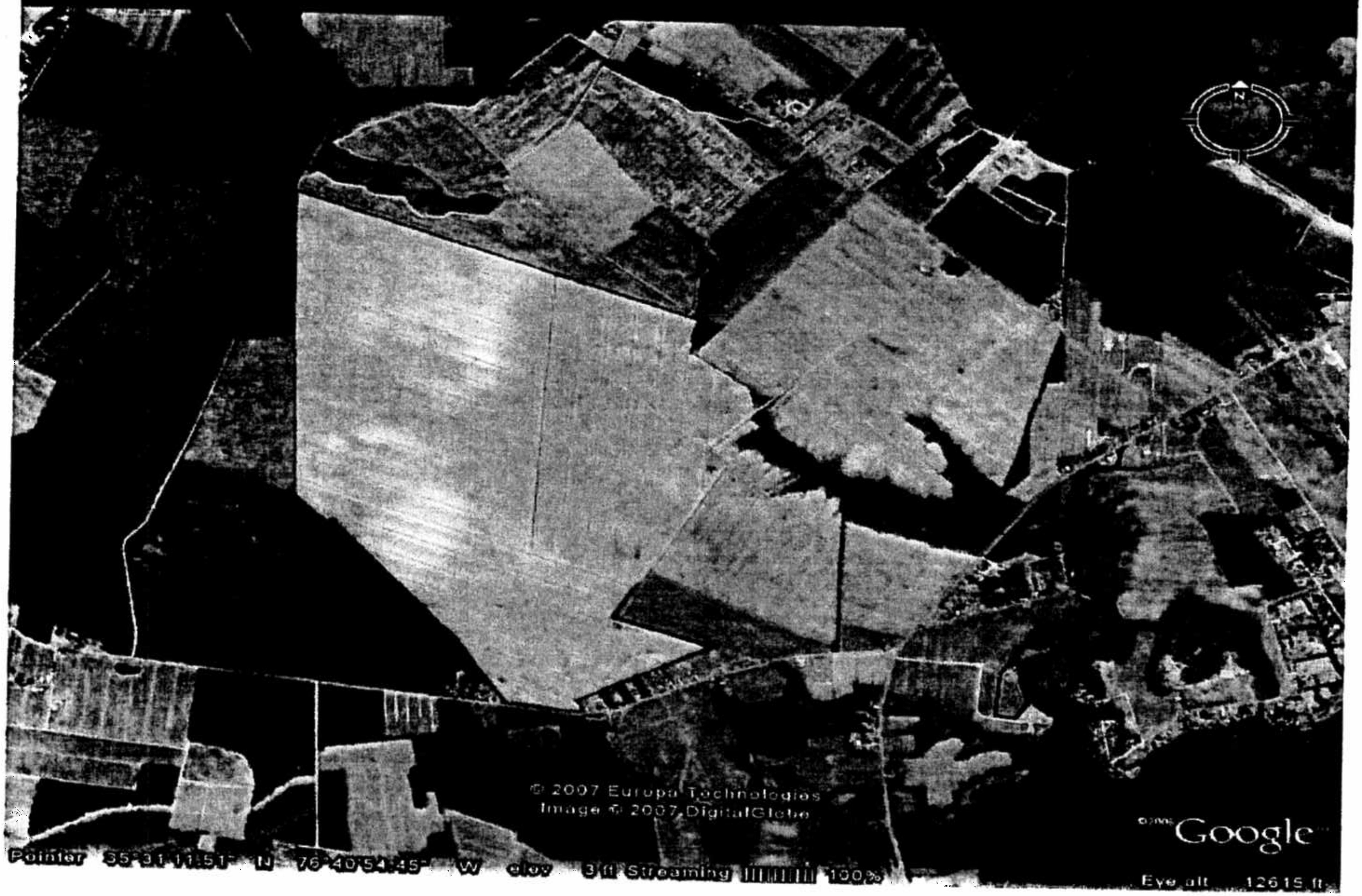
- Mitigation will not only offset direct impacts, but will provide and enhance functions that support APE, tidal creeks, and PNAs
- Wetlands mitigation plan involves over 11,500 acres of wetlands restoration, enhancement, and preservation
  - Wetlands restoration ratio alone is 2:1
  - The 2:1 ratio does not include preservation and enhancement
- Stream mitigation plan involves more than 70,000 feet of restoration and preservation
  - Stream restoration ratio alone is 1.8:1
  - The 1.8:1 ratio does not include preservation
- No net loss
- Net resource gain
- Higher ratios are unnecessary and inappropriate

Hell Swamp/Scott Creek Mitigation Site

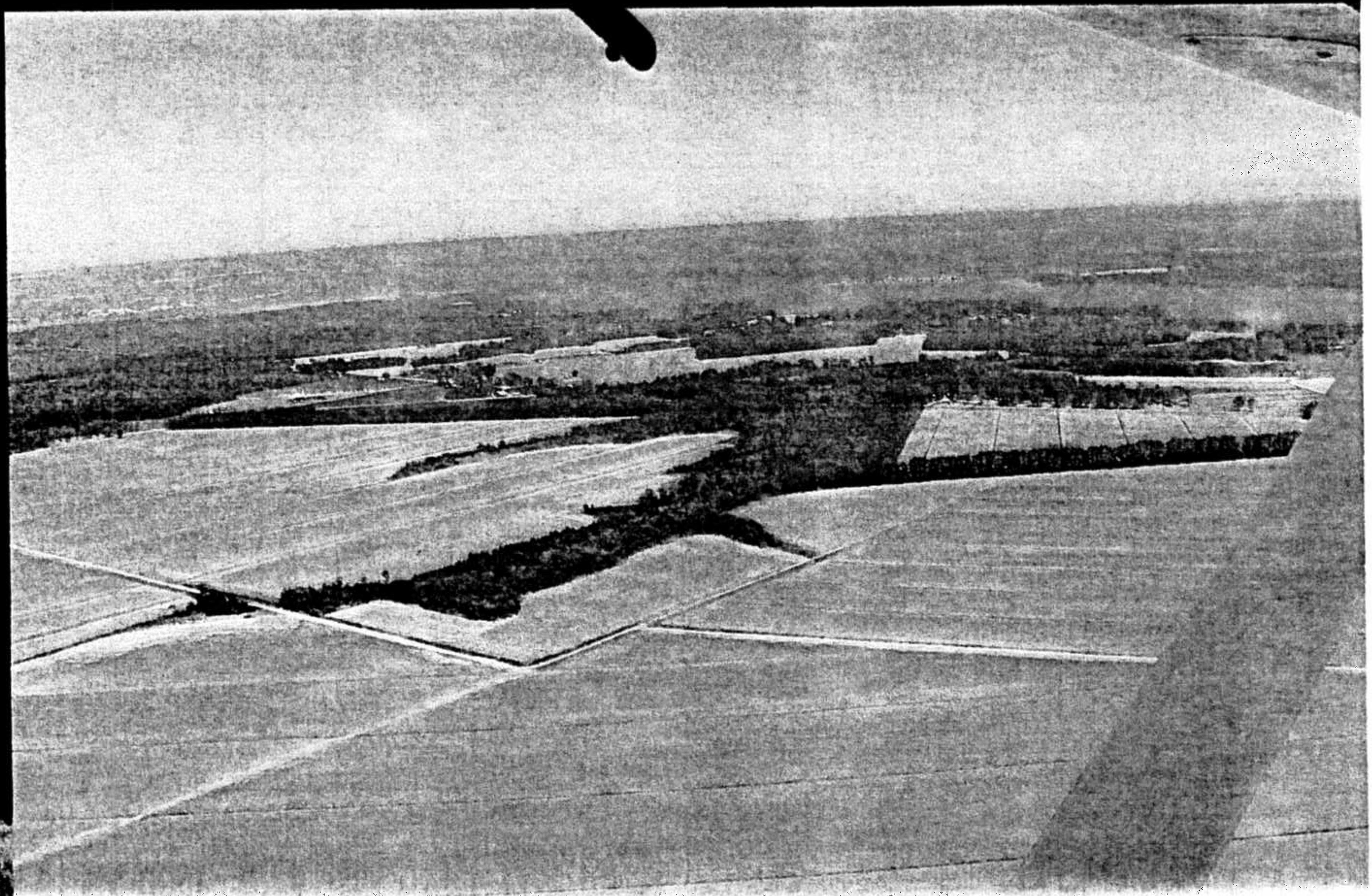


Helping Nature Provide

Hell Swamp/Scott Creek Mitigation Site



Hell Swamp/Scott Creek Mitigation Site



APE, Tidal Creeks, PNAs

Conclusion

- Total avoidance; zero direct effects
- No net loss
  - Findings of the best available site specific studies show no significant indirect effects
- Net resource gain
  - Mitigation will provide/enhance functions that support APE, tidal creeks, and PNAs
- No reasonable basis for finding UAEs on APE, tidal creeks or PNAs

PotashCorp
Helping Nature Provide

271-acre tract

"NATIONALLY SIGNIFICANT NATURAL HERITAGE AREA"

- **NOT** an official State classification or designation.

- An informal **listing** first published less than six months ago
  - Unilaterally, without notice, hearing or opportunity for meaningful outside expert input
  - not pursuant to any regulatory system
  - not reviewed by the statutorily created Advisory Committee
  - without ANY due process protections for the landowner

PotashCorp
Helping Nature Provide

271-acre tract

- EPA Comment
  - The proposed project would directly impact 97 acres of this ecologically valuable and rare wetland system.
- Response
  - Site specific information shows that:
    - The acreage to be impacted:
      - Is not rare or especially valuable. *See* Gregory report.
      - Includes two "connection areas" that are pine plantation and shrub-scrub.
    - Modified Alternative L will even avoid substantial areas of the tract that are not rare or especially valuable

271-acre tract

- Initial Site Assessment
  - James D. Gregory
    - Ph.D. – Forest Hydrology & Soils
    - Professor Emeritus (NCSU) – Forestry, Watershed & Wetlands Hydrology
  - Site Inspection – April 9, 2009
  - Average basal area/acre estimate - April 13, 2009 (Seth Ward, Sr. Forester, Environmental Services, Inc.)

- Final Gregory Report – in preparation. Available during week of April 20, 2009

271-acre tract
Dr. Gregory's findings:

- Tract is not NRWHF as defined by NHP
  - Not "dominated" by indicator species [swamp white oak, laurel oak, cherrybark oak]
  - Absence of cherrybark oak precludes characterization as among the best examples
  - All 3 parcels < 25% indicator species
  - Not "high quality" (age, size)
- Eastern portion (best of the three) is "good" or "very good," but not outstanding, exemplary or unique
- Western portion is poor
- Northern portion is very poor
- Hydrology
  - Eastern and Western portions not interdependent
    - Eastern is related to Porter's Creek headwaters
    - Western is related to Suffolk Scarp
  - NRWHFs are adapted to, but not dependent on, wet conditions
  - Except for a few wet depressions in the Western portion, no evidence of inundation

PotashCorp
Helping Nature Provide

271-acre tract
Dr. Gregory's Opinions

- Tract does not merit NHP Designation of National Significance

- Tract will not be adversely affected by mining corridor
  - eastern and western portions are not interdependent

PotashCorp
Helping Nature Provide

271-acre tract
EPA/Corps Guidance*

- EPA/Corps Guidance provides insight about NRWHFs
- EPA/Corps Guidance requires permitting for mechanical silvicultural site preparation if an area is of "rare, high quality wet forests, with mature vegetation."
- 271-acre tract not rare; not high quality. *See* Gregory
- EPA/Corps Guidance says high quality if:
  - "undisturbed forest stands, whose character is not significantly affected by human activities (e.g., forest management)."
- "Its current condition can be **attributed to** past logging. . ." Michael Schafale (NC NHP), July 15, 2008 (emphasis added).

* EPA/Corps Memorandum, November 28, 1995, "Application of Best Management Practices to Mechanical Silvicultural Site Preparation Activities for the Establishment of Pine Plantations in the Southeast."

PotashCorp
Helping Nature Provide

271-acre tract

- EPA Comment: In light of the very unique and rare qualities of this area, it is not clear that its attributes could be replaced by compensatory mitigation, raising concerns regarding significant degradation.

- Response:
  - Site specific information shows that the area is not unique or rare. Impacts would be to lowest quality areas.
  - PCS mitigation sites provide over 1,000 acres of restored NRWHF that are planted in a variety of wetland oaks and other wetland species on soil types identified by NCNHP as NRWHF soil types, and in similar geographic position as Bonnerton.
  - A 34-acre tract of NRWHF is also being preserved contiguous with a mitigation site.

Gum Run: NRWHF Mitigation Site (Planted in 1992)

271-acre tract
Conclusion

- No ARNI
  - Not nationally important
  - Not rare or especially valuable

- No UAEs
  - Only 97 acres of replaceable shrub-scrub, pine plantation and other forest would be impacted
  - Impacts are mitigatable
  - No net loss
  - Net resource gain

PotashCorp
Helping Nature Provide

Upfront mitigation

- All mitigation projects will be constructed and sufficient prior to impacts

Reclamation

- All mined areas will be reclaimed consistent with regulatory requirements
- Approximate drainage basins will be restored

Overall Conclusions

- APE, tidal creeks and PNAs
  - Total avoidance
    - No direct impact
  - Indirect impact is insignificant
    - EPA comments are not supported by best available site-specific science

- 271-acre tract
  - Not an ARNI
  - Impacts mitigatable

- Substantial upfront mitigation; reclamation; no net loss; net resource gain

- No UAEs to ARNIs

PotashCorp
Helping Nature Provide

Purpose and Need
Public Need

- PCS is a major employer in the region and the largest employer in the county
- Phosphate rock is the only commercial source of the element phosphorous
- Phosphorous is a basic component of fertilizer, animal feed, and consumer products
- ". . . [T]he Aurora Phosphate deposit is one of the few remaining minable deposits in the United States." FEIS 1.2.1
- "Halting the recovery of the Aurora phosphate deposit combined with the projected decline in Florida phosphate production would leave the US farm economy largely dependent upon foreign sources of phosphate supply." *Id.*

PotashCorp
Helping Nature Provide

Purpose and Need
Applicant's Need

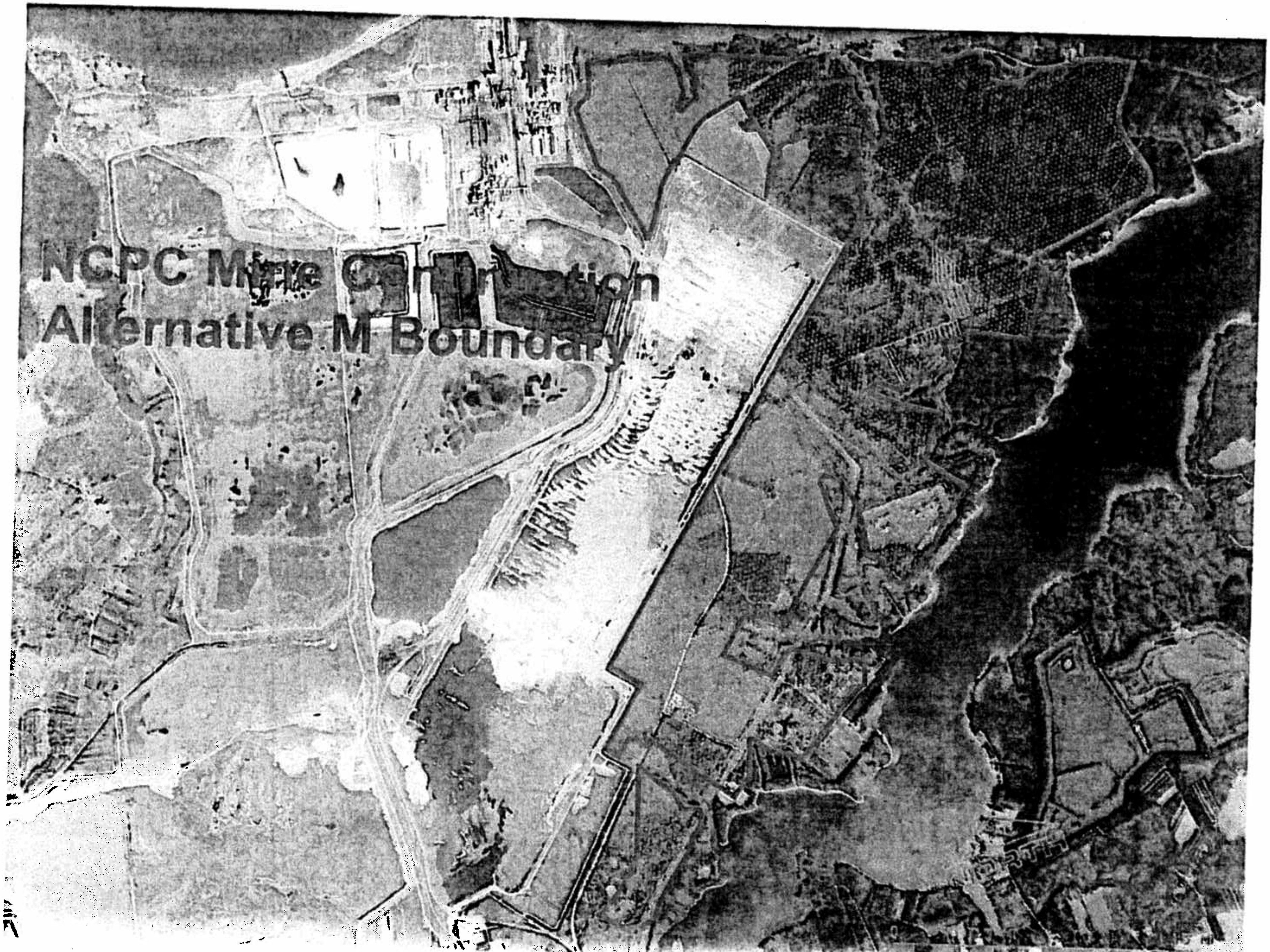
- ". . . the applicant's purpose and need is to implement a **long-term** systematic and **cost-effective** mine advance within the project area for ongoing PCS mine operation at Aurora, North Carolina." FEIS 1.2.2, p. 1-4.
- This is the same statement of Purpose and Need as was used in the prior 404 permitting process:
- "a long-term (approximately 20 years) systematic and cost-effective mine advance within the 14,200 acre project area ... for the ongoing [PCS] mine operation at Aurora, North Carolina." *Pamlico-Tar River Foundation v. U.S. Army Corps of Engrs.. et al.*, 329 F.Supp.2d 600, 606 (EDNC 2004).
- That statement of Purpose and Need has been approved by the Court:
- "Defendants did a thorough job of defining the project purpose and need in a reasonable manner." *Id.* at 614-15.

PotashCorp
Helping Nature Provide

NGO Alternative Does not Meet Purpose and Need

- The Purpose and Need statement recognizes that the mining plan must be BOTH <u>long-term</u> and <u>cost effective</u>.
- Mining south of Route 33 is not <u>cost-effective</u> in the foreseeable future.
- The Corps has recognized that this Purpose and Need statement means that PCS needs <u>15 years</u> mining north of Route 33.
- The new NGO alternative provides only 8 years of mining north of Route 33, and hence is inconsistent with the applicant's legitimate purpose and need.


NCPC Mine Continuation
AP Boundary


NCPC Mine
Alternative M Boundary


NCPC Mine Continuation
Modified Alternative L Boundary


NCPC Mine Continuation
EPA Boundary

Alternatives Comparison Summary
(Tons x 1,000,000)

	TONS	YEARS	WETLANDS	STREAMS
Alt EAPA	244	49	5,668	89,150
Alt M	204	41	4,592	36,999
Alt L	185	37	4,135	29,288
Modified Alt L (401 WQC)	176	35	3,977	25,727
Alt EPA/NGO (03/24/09)	147	29		

Reductions vs EAPA

	TONS	YEARS	WETLANDS	STREAMS
Alt EAPA	-	-	-	-
Alt M	(40)	(8)	(1,076)	(52,151)
Alt L	(59)	(12)	(1,533)	(59,862)
Modified Alt L (401 WQC)	(68)	(14)	(1,691)	(63,423)
Alt EPA/NGO (03/24/09)	(97)	(20)		

Reductions vs EAPA

	TONS	YEARS	WETLANDS	STREAMS
Alt EAPA	-	-	-	-
Alt M	-16%	-16%	-19%	-58%
Alt L	-24%	-24%	-27%	-67%
Modified Alt L (401 WQC)	-28%	-28%	-30%	-71%
Alt EPA/NGO (03/24/09)	-40%	-41%		

PotashCorp
Helping Nature Provide

[4 Robert A 833]

Financial Analysis

- Economist Dr. Andrew Brod reviewed models EPA used to forecast profitability and determined: "there is no reason to place any confidence on the model's forecasts."
- "Profitability" is the wrong factor to be considered in determining "Practicability". The words in Guidelines are "taking into consideration cost, existing technology, and logistics in light of the overall project purpose". 40 C.F.R. § 230.10(a)(2).
- "It is important to emphasize . . . that it is not a particular applicant's financial standing that is the primary consideration for determining practicability, but rather the characteristics of the project and what constitutes a reasonable expense for these projects that are most relevant to practicability determinations." EPA Memorandum To The Field, at 5 (August 1993)

PotashCorp
Helping Nature Provide

Alternatives Comparison Summary
Total Cash Cost Commitment for EAPA
Additional Cash Cost Commitment vs EAPA
($ x 1,000,000)

	15 YEARS	29 YEARS
Alt EAPA	1,678	3,354
Alt M	(21)	72
Alt L	7	183
Modified Alt L (401 WQC)	8	214
Alt EPA/NGO (03/24/09)	118	327

PotashCorp
Helping Nature Provide

Value of Ore Lost Due to Permanent Easement

Lost Tons (in millions of short tons)

	NCPC	Bonnerton	Total
EAP	76	43	119
EPA/NGO	15	27	42
Lost Tons	61	16	77

Approach #1: "All at once"

Value of Lost Ore	NCPC	Bonnerton	Total
Avg. USGS price, 1991-2007	27.84	27.84	
Cost per ton	21.72	23.53	
Margin ($/ton)	6.12	4.32	
Profit ($ million)	373.57	69.11	442.68

Sources:

- *Aggregate tons: PCS Phosphate*
- *USGS adjusted prices: FEIS Table 2-7*
- *Cost per ton: FEIS p. 2-25*
- *EPA price forecast: Appendix to Detailed Comments p. 8*

All dollar values expressed in constant 2005 dollars

Approach #2: Mined over 16 years

Year (ordinal)	1	2	3	4	5	6	7	8
Year (actual)	2009	2010	2011	2012	2013	2014	2015	2016
EPA price forecast	27.78	27.77	27.77	27.76	27.76	27.75	27.74	27.74
Cost per ton	21.72	21.72	21.72	21.72	21.72	21.72	21.72	21.72
Margin ($/ton)	6.06	6.05	6.05	6.04	6.04	6.03	6.02	6.02
Tons (millions)	5	5	5	5	5	5	5	5
Profit/year ($ million)	30.31	30.27	30.24	30.21	30.18	30.15	30.12	30.09
Present Value @ 3%	30.31	29.39	28.51	27.65	26.81	26.01	25.22	24.46
Present Value @ 7%	30.31	28.29	26.42	24.66	23.02	21.50	20.07	18.74

Year (ordinal)	9	10	11	12	13	14	15	16	Total
Year (actual)	2017	2018	2019	2020	2021	2022	2023	2024	
EPA price forecast	27.73	27.72	27.72	27.71	27.71	27.70	27.69	27.69	
Cost per ton	21.72	21.72	21.72	21.72	23.18	23.53	23.53	23.53	
Margin ($/ton)	6.01	6.00	6.00	5.99	4.54	4.17	4.17	4.16	
Tons (millions)	5	5	5	5	5	5	5	2	77
Profit/year ($ million)	30.05	30.02	29.99	29.96	22.71	20.87	20.84	8.32	434.33
Present Value @ 3%	23.72	23.01	22.32	21.64	15.93	14.21	13.78	5.34	358.31
Present Value @ 7%	17.49	16.33	15.25	14.23	10.08	8.66	8.08	3.02	286.14

Notes:

- *Cost per ton for Bonnerton calculated as the average of costs under EAPA and EAPB.*
- *Cost per ton in year 13 calculated as the weighted average of costs in NCPC and Bonnerton.*

PotashCorp
Helping Nature Provide

EPA Has Not Complied With Established Project Review Procedures

- 1. <u>The Corps cannot consider alternatives that were not reasonably studied in the FEIS</u>.
- EPA was an "active participant" in nearly 20 Review Team meetings addressing alternative selection for 9 years.
- EPA specifically requested discussions that led to Alternative L being studied in the SDEIS
- EPA did not present its NGO Alternative until one year after comments closed on the FEIS
- Under the law of the US Supreme Court, the Corps has no obligation under NEPA or the 404(q) MOA to consider alternatives not raised in the EIS process. *Department of Transp. V. Public Citizen, 541 U.S. 752, 764-5 (2004)*
- As the Supreme Court stated: "Indeed, administrative proceedings should not be a game or a forum to engage in unjustified obstructionism by making *554 cryptic and obscure reference to matters that 'ought to be' considered and then, after failing to do more to bring the matter to the agency's attention, seeking to have that agency determination vacated on the ground that the agency failed to consider matters 'forcefully presented.'" *Vermont Yankee v. NRDC, 98 S. Ct. 1197, at 1217 (1978)*
- PCS is substantially prejudiced by EPA's untimely actions.

PotashCorp
Helping Nature Provide

EPA Has Not Complied With Established Project Review Procedures

- 2. EPA has not complied with requirements to refer any "unsatisfactory" environmental effects to CEQ (309 referral).
  - "In the event the Administrator determines that any such . . . action . . . is unsatisfactory from the standpoint of public health or welfare or environmental quality, he shall publish his determination and the matter shall be referred to the Council on Environmental Quality." 42 U.S.C.A. § 7609 (emphasis added).
  - "The referring agency shall deliver its referral to the Council not later than twenty-five (25) days after the final environmental impact statement has been made available . . . . " 40 CFR 1504.3
  - EPA made no referral to CEQ – timely or otherwise
  - EPA either failed to comply with the statute and regulations or concluded the impacts were not "unsatisfactory"

EPA Has Not Complied With Established Project Review Procedures

- 3. In this case, the 404(q) request is based on the same facts and issues as should have been raised in the 309 referral analysis.
  - Both tests require EPA to evaluate for national importance
    - Section 404(q) MOA Part IV.1: "The elevation of specific individual permit cases will be limited to those cases that involve aquatic resources of national importance"
    - 40 C.F.R. § 1504.3(c)(2)(iv): requiring a referral to CEQ to include a finding by EPA "whether the issue raised is of national importance"
  - Section 309 regulations require EPA to consider:
    - Possible violations of national environmental standards, severity, scope, duration, importance as precedent and environmentally preferable alternatives
  - EPA's current elevation position relies solely on known issues that EPA was required to consider when making its referral decision.
  - EPA did not find these facts sufficient to justify a 309 referral.

PotashCorp
Helping Nature Provide

PotashCorp
Helping Nature Provide

PCS Presentation to ASA and COE Re: EPA Detailed Comments

April 17, 2009

PotashCorp

PotashCorp.com

PCS Presentation to ASA and COE
Re: EPA Detailed Comments

- Review of EPA Analysis of Unacceptable Adverse Effects on Aquatic Resources of National Importance
- Review of Project Purpose and Need
- Review of EPA Financial Analysis
  - Brod Critique of EPA Financial Analysis
  - Improper Consideration of "Profit' rather than "Cost"
  - Comparison of Alternative Ore Recovery and Impacts
  - Comparison of Alternative costs at 15 years and 29 years.
  - Calculation of Ore Value Lost
- Review of EPA Failure to Comply with Required Review Procedures
  - Late Alternative
  - Failure to refer to Council on Environmental Quality

PotashCorp
Helping Nature Provide

4/17/09 EPA, USACE 404Q - PCS Phosphate

Name	Group
Tom Walker	USACE - SAW
Arch Middleton	USACE - SAD
Robert Wood	USEPA - HQ - Wetlands, Oceans, Watersheds
Jennifer Derby	USEPA - Region 4 Wetlands
Palmer Hough	EPA - HQ - WD
Garrett Dorsey	USACE - HQ detail assignment
Brooke Lawson	USACE - SAW
Ken Jolly	USACE - SAW
Jennifer Moyer	HQ USACE
JEFF RYSCAVAGE	USACE - WILMINGTON
CHIP SMITH	ASA - CIVIL WORKS
STEVE BECKEL	PCS PHOSPHATE
Suzanne Chubb	ASA - Civil Works
JERRY WATERS	PCS. PHOSPHATE
Randy Tinsley	BPMHC for PCS
George House	BPMHL for PCS
Bill Cary	"
PAUL M. LEONARD	ENTRIX, INC.
Larry Liebesman	Holland + Knight for PCS
Ross Smith	PCS PHOSPHATE
JEFF FURNESS	PCS PHOSPHATE
Julia K. Berger	CZR Incorporated
David Lekson	USACE

EPA's Actions are Untimely and Prejudicial

A. EPA's new Alternative is Untimely.

The new "NGO" Alternative was suggested by the EPA for the first time at a meeting on March 24, 2009, ten months after publication of the FEIS and two months after NC DENR had completed its 401 review and issued its certification. It is, as demonstrated earlier, both inconsistent with the FEIS's statement of purpose and need and not practicable. In addition, it comes too late.

CEQ's NEPA regulations prohibit consideration of a new alternative at this stage: "A decisionmaker must not consider alternatives beyond the range of alternatives discussed in the relevant environmental documents."[1] The reason is plain: "NEPA procedures must insure that environmental information is available to public officials and citizens before decisions are made and before actions are taken." 40 C.F.R. § 1500.1 (emphasis added). Accordingly, Federal agencies are required to adopt procedures to ensure that decisions are made in accordance with the policies and purposes of NEPA, including "[r]equiring that the alternatives considered by the decisionmaker are encompassed by the range of alternatives discussed in the relevant environmental documents. . . ." 40 C.F.R. 1505.1(e). For nearly 25 years, EPA's own policies have required it to suggest alternatives at the draft comment stage. EPA "Policy & Procedures for the Review of Federal Actions Impacting the Environment," Oct. 3, 1984.

The United States Supreme Court has held that under NEPA, commenters who fail to raise practicable alternatives during the EIS process forfeit their rights to raise objections with the proposed action. *Department of Transp. v. Public Citizen*, 541 U.S. 752, 764-65 (2004). As one district court has concluded, "[t]he question thus becomes whether the challenging party has placed the agency on notice as to the specific alternative it favors." *High Sierra Hikers Ass'n v. U.S. Forest Service*, 436 F.Supp.2d 1117, 1148 (E.D. Cal. 2006) (emphasis added); *accord Biodiversity Conservation*

---

[1] "CEQ's Forty Most Frequently Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 F.R. 18036 (Mar. 23, 1981) as amended by 51 F.R. 15618 (Apr. 25, 1986) (emphasis added).

Alliance v. U.S. Bureau of Land Management, 404 F.Supp.2d 212, 219 (D.D.C. 2005) ("The plaintiffs failed to urge the BLM to consider this alternative in their comments to the proposed action and, therefore, they have forfeited their opportunity to challenge the EA on this basis at this time."). When NEPA regulations were being debated, it was suggested that Federal commenting agencies should not be held to the same standard as other commenters, but that suggestion was rejected:

> "*Comments on § 1503.2: Duty to comment.* Section 1503.2 set forth the requirements of federal agencies to comment on environmental impact statements. Several commenters suggested reinforcing the requirement that Federal agencies are subject to the same time limits as those outside the Federal government in order to avoid delays. The Council concurred in this suggestion and amended the provision accordingly."

43 F.R. 55978, 55985 (Nov. 29, 1978) (emphasis added).

Here, the record reflects no attempt by EPA to raise the NGO Alternative at any time before the Corps finalized the EIS and was prepared to issue a 404 Permit. It is not as though EPA did not have an opportunity to suggest a new alternative in a more timely fashion: EPA participated actively on the interdisciplinary Review Team that met more than twenty times throughout the EIS process to identify and refine alternatives. Indeed, EPA requested discussions (see Review Team Minutes of 1 September 2006 Meeting) that appear to have culminated in the Corps developing and considering Alternative L in a supplemental DEIS.

EPA has presented neither a legal basis nor a factual basis that would justify the Corps' reconsideration of its conclusion that Alternative L is the Least Environmentally Damaging Practicable Alternative.

EPA and all parties have been aware for four or more years of the fact that PCS will run out of land permitted for mining impacts by May of 2009. EPA actions place PCS under duress. It must either curtail operations by laying off workers and contractors involved in pre-stripping or accept a permit alternative which is clearly not practicable. After 9 years of participation, EPA should not be rewarded for its dalliance.

B. EPA's obligation to review the Project and refer disputes to CEQ.

EPA is required by law to review the Project[2] for "the environmental impact of any matter relating to [EPA's] duties and responsibilities." 42 USC §7609(a). "In the event the Administrator determines that any such . . . action . . . is unsatisfactory from the standpoint of . . . environmental quality, he shall publish his determination and the matter shall be referred to the Council on Environmental Quality." 42 USC §7609(b)(emphasis added). Notice of the referral should be given to the lead agency [here, the Corps] "at the earliest possible time," 40 CFR §1504.3(a)(1), and the referral to CEQ must be made within 25 days after the FEIS is made available to EPA. *Id.*, §1504.3(b). The purpose of the statute and regulatory scheme is to assure "early resolution of [interagency] disagreements." 40 CFR §1504.1(a).

The EPA recognizes the legal requirement of early resolution of interagency disputes. Consistent with the NEPA regulations, EPA guidance calls for resolving interagency disputes before the last minute.

> It is not the Agency's intention to hold back and then suddenly spring a veto action at the last minute. The fact that 404(c) may be regarded as a tool of last resort implies that EPA will first employ its tool for "first resort," e.g. comment and consultation with the permitting authority at all appropriate stages of the permit process.

44 F.R. 58076, 58080 (Oct. 9, 1979) (emphasis added).

C. EPA failed to act under CEQ requirements.

The FEIS was published and distributed on May 22, 2008. EPA did not, at *any* time thereafter:

- publish a determination that the Project was "unsatisfactory;"
- notify the Corps that a referral to CEQ would be made;

[2] As used herein, "Project" is shorthand for the proposed action, as described in the EIS and proposed permit.

- refer the matter to CEQ; or
- seek an extension of time for such a referral.

These facts are not in dispute.

D. <u>Reconciling EPA's failure to act with its 404(q) request</u>.

There are two possible explanations for the EPA's invocation of 404(q) [and its threatened use of 404(c)] after failing to act in a timely manner during the NEPA process:

1. EPA found the Project to be unsatisfactory, but decided not to publish that finding or refer the matter to CEQ. If EPA believes this project is environmentally unsatisfactory, its failure to make that finding and refer it to CEQ would be a clear violation of federal law. *See, e.g.*, *Sierra Club v. Morton*, 379 F. Supp. 1254, 1260 (D. Colo. 1974) (finding Section 309 "places a mandatory duty upon the Administrator" to refer in the event that he determines the action is "unsatisfactory"). We should not presume that EPA intentionally chose this course.
2. EPA did not find the Project unsatisfactory in May of 2008, but believes the facts have now changed such that the Project has become environmentally unsatisfactory in April of 2009. However, the facts have not changed: the only difference between the FEIS and the 404 permit the EPA now calls "unacceptable" is the protection of 196 additional acres of the Bonnerton Tract, which the Project as described in the FEIS would have allowed PCS to mine.

E. <u>There is no difference between the standards for EPA review</u>.

When the FEIS was published, EPA was required to evaluate the following aspects of potential impacts when deciding whether to refer the matter to CEQ:

(a) Possible violation of national environmental standards or policies.
(b) Severity.
(c) Geographical scope.

(d) Duration.
(e) Importance as precedents.
(f) Availability of environmentally preferable alternatives.

40 CFR §1504.2. CEQ's regulations require a referral to include a finding by EPA "whether the issue raised is of national importance because of the threat to national environmental resources or policies or for some other reason." *Id.* § 1504.3(c)(2)(iv).

By comparison, the Section 404(q) MOA requires EPA to conclude that the Project "will result in unacceptable adverse effects to aquatic resources of national importance." EPA's April 3, 2009 letter requesting elevation summarizes the impacts of this project, which EPA finds "unacceptable," as follows: "In summary, EPA believes the impacts to ecological functions at the scale associated with this project, as described above, would cause or contribute to significant degradation [40 CFR 230.10(c)] of the Nation's waters."

There is no substantive difference in this case between the standards for CEQ referral determinations and those for 404(q) elevation requests. If the EPA believes the Project will result in unacceptable adverse effects to resources of national importance," how could EPA *not* conclude that the Project is *un*satisfactory? Stated differently, under what scenario is it satisfactory to do that which is unacceptable?

EPA had more than enough time and information to decide whether the Project was unsatisfactory from the standpoint of environmental quality. EPA was actively involved in the permit review from 2000 until the deadline for its determination and CEQ referral in June of 2008. If EPA had identified any unsatisfactory impacts to the environment by that time, it was required by federal law to forward the matter to CEQ. It did not make such a referral, so it can only be concluded that, at that time, EPA did <u>not</u> determine that the Project, albeit flawed (in EPA's eyes), raised issues "of national importance because of the threat to national environmental resources."

In neither its 404(q) elevation request letter nor its subsequent "Detailed Comments on Proposed PCS Phosphate Mine Expansion Section 404 Permit" does EPA attempt to reconcile how the current permit is unacceptable in early 2009, but the Project as described in the FEIS in May 2008 was not unsatisfactory.

EPA's failure to seek timely resolution in this case through referral to CEQ has not only violated PCS's rights under federal law, but has consequently threatened PCS's ability to continue mining without costly interruption.

EPA USE OF PROFIT AS DETERMINATIVE OF PRACTICABILITY

EPA's Detailed Comments improperly focuses on potential profitability as a determinant of practicability. This is inconsistent with EPA's own guidelines and established case law.

EPA Guidelines:

The EPA has established guidelines for evaluating compliance with § 404, at 40 C.F.R. Part 230 (the "Guidelines"). With respect to a practicable alternatives analysis, the Guidelines state that "[a]n alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." 40 C.F.R. § 230.10(a)(2).

As an initial matter, the stated project purpose is a significant component of the alternatives analysis, *infra*, and it is therefore difficult (and illogical) to segregate considerations of cost in a practicable alternatives analysis from the project purpose itself. The Purpose and Need statement for the PCS Aurora mine expansion states that "the applicant's purpose and need is to implement a long term systematic and cost-effective mine advance within the project area for ongoing PCS mine operation at Aurora, North Carolina." FEIS ¶ 1.2.2.

Cost is a critical factor, profit is not a factor. As the preamble to the final rule adopting the Guidelines explains:

> [T]he Guidelines explicitly include the concept of "practicability" in connection with both alternatives and steps to minimize impacts. *If an alleged alternative is unreasonably expensive to the applicant, the alternative is not "practicable."*

45 Fed. Reg. 85336, 85343 (December 24, 1980) (emphasis added). The preamble clarifies that the Guidelines adhere to the term "cost" as a factor. The proposed term "economic" was rejected because "the term 'economic' might be construed to include consideration of the applicant's financial standing, or investment, or market share." 45 Fed. Reg. at 85339. The stated intent "is to consider those alternatives which are reasonable in terms of the overall scope/cost of the proposed project." *Id.*

An EPA Memorandum to the Field, relying heavily on the preamble, confirms that, rather than a more nebulous "economic" or "profitability" analysis, cost in light of the project type is the driving factor:

> It is important to emphasize . . . that it is not a particular applicant's financial standing that is the primary consideration for determining practicability, *but rather characteristics of the project and what constitutes a reasonable expense for these projects that are most relevant to practicability determinations.*

EPA MEMORANDUM TO THE FIELD, Appropriate Level of Analysis Required for Evaluating Compliance with the Section 404(b)(1) Guidelines Alternatives Requirements, at 5 (August 1993) (emphasis added). The Memorandum assents to the preamble's statement that an unreasonably expensive alternative is not practicable. *Id.* at 4. In determining what constitutes an unreasonable expense, the Corps "should generally consider whether the projected cost is substantially greater than the costs normally associated with the particular type of project." Here, the normal costs are demonstrated by Alternative EAPA and the variants result from different levels of impacts.

In their application of the Guidelines, courts have consistently approved considerations of cost and logistics, in light of project purpose. For instance, the Court in *Friends of the Earth v. Hintz*, 800 F.2d 822 (9th Cir. 1986), examined the Corps' evaluation of four alternatives, finding that the "Corps rationally concluded that . . . two were too costly for the applicant, and two were logistically unfeasible in light of [the applicant's] legitimate purposes." *Id.* at 833–34. The Ninth Circuit has reaffirmed that "the Corps may legitimately consider such facts as cost to the applicant and logistics." *Sylvester v. U.S. Army Corps of Eng'rs*, 882 F.2d 407, 409 (9th Cir. 1989) (citation omitted).

Similarly, in *Sierra Club v. U.S. Army Corps of Eng'rs*, 935 F.Supp. 1556 (S.D. Ala. 1996), challenged the Corps' failure to consider a parking deck as an alternative to a standard lot in the construction of a baseball stadium. The applicant presented evidence that the cost of the deck alone would exceed the total project budget, and that building the deck would lead to substantial delay in construction. *Id.* at 1575. The Court therefore determined "that construction of a parking deck on the stadium site was not practicable on the basis of both cost and logistics." *Id.* at 1576; *see also D'Olive Bay Restoration & Preservation Comm. v. U.S. Army Corps of Eng'rs*, 513 F.Supp.2d 1261, 1281, 1298 (S.D. Ala. 2007) (Corps determined that proposed alternative was impracticable based on increased cost and impediment to project purpose; the Corps' analysis and findings were "rational and well-reasoned.").

Project Purpose is relevant to the inquiry, as "the Corps has a duty to take into account the objectives of the applicant's project. Indeed, it would be bizarre if the Corps were to ignore the purpose for which the applicant seeks a permit and to substitute a purpose it deems more suitable." *Louisiana Wildlife Fed'n v. York*, 761 F.2d 1044, 1048 (5th Cir. 1985) (per curiam) (footnote omitted). The applicant's purpose must be "legitimate," but in determining whether an alternative is practicable "the Corps is not entitled to reject [the applicant's] genuine and legitimate conclusion" that its desired project is economically advantageous. *Sylvester*, 882 F.2d at 409. Further, "[t]he Corps is not a business consulting firm. It is in no position to conduct a feasibility study of alternative sites . . . that would have it [] evaluate [the applicant's] business needs . . . ." *River Rd. Alliance v. U.S. Army Corps of Eng'rs*, 764 F.2d 445, 453 (7th Cir. 1985).

Thus, assuming the legitimacy of the Purpose and Need statement, the appropriate alternatives analysis as to PCS should consider those alternatives that allow for a long-term cost effective mine advance within the project area. Economic feasibility is not an appropriate consideration in determining practicable alternatives. Rather, the inquiry should focus on costs and logistic and technological feasibility in light of project purpose. Unreasonable costs—those that substantially exceed the costs normally associated with this sort of project—result in impracticable alternatives.

As discussed previously, the Purpose and Need for this mine continuation has been previously approved by the U.S. District for Eastern District of North Carolina.

"Curry, Robert L." <robert.curry@ncwildlife.org>

04/24/2009 02:53 PM

To Jim Giattina/R4/USEPA/US@EPA
cc Tom Welborn/R4/USEPA/US@EPA, Jennifer Derby/R4/USEPA/US@EPA, Rebecca Fox/R4/USEPA/US@EPA, "Curry, Robert L."
bcc
Subject Request for Review and Comment

History: This message has been forwarded.

Dear Jim:

Attached is our position statement and response to your email message. In addition, the official agency position for this project is clearly articulated in our comments from 1 July 2008. No other information can supplant those comments.

I hope this letter clarifies our position on this project. If you have additional questions please don't hesitate to contact me at (919) 707-0221.

bob Curry

(See attached files: PCS FEIS 7-01-08.pdf and WRC PCS Position to EPA.pdf)

Robert L. Curry, Chief
Division of Inland Fisheries
1721 Mail Service Center
Raleigh, NC 27699-1721
Phone: (919) 707-0221
Fax: (919) 707-0028
Email: robert.curry@ncwildlife.org

-----Original Message-----
From: Giattina.Jim@epamail.epa.gov [mailto:Giattina.Jim@epamail.epa.gov]
Sent: Thursday, April 23, 2009 8:20 AM
To: Curry, Robert L.
Cc: welborn.tom@epa.gov; derby.jennifer@epa.gov; Fox.Rebecca@epamail.epa.gov
Subject: Request for Review and Comment

Bob,

As you know, EPA has elevated the PCS Phosphate permit decision to Assistant Secretary of the Army (Civil Works). As part of that elevation, it is EPA's position that the impacts to the drainage basins for the tidal creeks (including four PNAs) should be further avoided.
The reduction to the drainage basins for the PNAs, with the pending permit decision will be in excess of 70 to 80%. NCWRC has held a strong position throughout this long process that these PNAs will likely be significantly degraded with such a large reduction to the drainage basins, including headwater creeks and wetlands. During this elevation process, EPA has received two documents (Notice of Intent to issue permit and the draft Record of Decision) from the Wilmington District that use information contained in a September 2008 edition of the NCWRC publication of "Wildlife in North Carolina" to support their position that these PNAs will function very well with a significant loss of their drainage basins. We can not share the draft ROD with you because it is not yet a public document but we are attaching the NOI which has the

exact same language (paragraph 1, page 5) that is contained several places in the draft ROD.

We are sharing this information with you because it is our understanding that your agency has strongly opposed the view that these areas can function with significant losses of their drainage basins. We aks that you review this language, as it will likely be in the final ROD as support for the Corps' position on drainage basin reduction for the PNAs, and let us know if it is consistent with the scientific analysis of the NCWRC. A letter from NCWRC on this matter would also help EPA better understand the significance of the impacts to the tidal creek watersheds. Time is of an essence, as the Army is formulating their decision this week and plan to have an internal draft decision by Monday (4-27-09). If you do decide to respond, please do so as soon as possible by email correspondence and I will forward to my staff, EPA and Corps headquarters and the Army.

Thanks for your attention to this matter.

Jim Giattina, Director
Water Protection Division

(See attached file: 404 q COE letter.pdf)

North Carolina Wildlife Resources Commission

MEMORANDUM

TO: Melba McGee, Environmental Coordinator
Office of Legislative and Intergovernmental Affairs
North Carolina Department of Environment and Natural Resources
and
Tom Walker
U.S. Army Corps of Engineers
Wilmington District

FROM: Shannon L. Deaton, Manager
Habitat Conservation Program

DATE: July 1, 2008

SUBJECT: Comments on Final Environmental Impact Statement for the PCS Mine Continuation, Aurora, North Carolina.
OLIA No. 08-0356; Corps Action ID No. 200110096

Biologists with the North Carolina Wildlife Resources Commission (NCWRC) reviewed the final environmental impact statement (FEIS) with regard to impacts of the project on fish and wildlife resources. Our comments are provided in accordance with the North Carolina Environmental Policy Act (G.S. 113A-1 et seq., as amended; 1 NCAC-25), provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the Clean Water Act of 1977 (as amended) and the Coastal Area Management Act (G.S. 113A-100 through 113A-128), as amended.

The applicant, PCS Phosphate, Inc., Aurora (PCS) submitted a DEIS with the US Army Corps of Engineers (USACE) on October 20, 2006. This document was reviewed by the NCWRC and formal comments were issued on February 1, 2007. On December 31, 2007 the NCWRC submitted formal comments to a supplement of the DEIS that presented two new alternatives, Alternative L and Alternative M. Descriptions of these alternatives and differences in impact area have been thoroughly described in the DEIS and SDEIS. The USACE posted the FEIS for review on May 23, 2008. The applicant's overall purpose and need is to continue mining its phosphate reserve in an economically viable fashion. More specifically, the applicant's purpose and need is to implement a long-term systematic and cost-effective mine advance within the project area for the ongoing PCS mine operation at Aurora, North Carolina. Although the purpose and need of the applicant has remained the same, PCS is now pursuing Alternative L rather than the Applicant Preferred (AP) and Expanded Applicant Preferred (EAP) boundaries.

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

Alternative L includes areas within the NCPC, Bonnerton, and South of Highway 33 tracts. NCPC is a 3,608 acre area within the Hickory Point peninsula adjacent the Pamlico River and South Creek. Seventy-one percent of this tract is designated wetlands and contains six tidal creeks, including three inland primary nursery areas (PNAs). Bonnerton is a 2,806 acre area adjacent the Pamlico River that is 76% wetlands and contains the headwater drainage to one inland PNA as well as a nationally significant wetland heritage area. South of Highway 33 is an 8,686 acre tract, 20% of which are wetlands. The entire project area is classified nutrient sensitive and is therefore subject to the NC Division of Water Quality's Tar/Pamlico Basin Buffer Rules. Alternative L is briefly described below:

Alternative L
This boundary utilizes the SCR boundary in the NCPC Tract, avoids the Porter Creek headwaters north of Grey Road, utilizes the AP boundary south of the Grey Road in the Bonnerton Tract, and avoids the South Creek Canal, all wetlands south of the South Creek Canal, and all areas regulated by the NC Division of Coastal Management (NCDCM) as Areas of Environmental Concern (AEC). Total wetland impacts per information from the "Biotic Communities Impacts" figures include 4,135 acres of wetlands and 59 acres of 47% wetlands. It is stated this alternative would provide 37 years of mining with at least 15 years of mining north of Highway 33.

NCWRC has reviewed the information presented within the FEIS, including responses to agency concerns. The additional information provided has not changed our position on proposed project and its impacts to aquatic and wildlife resources. Our February 1, 2007 and December 31, 2007 comments stated and reiterated, *"The NCWRC would like to conclude that we are concerned with the impacts the mine expansion will have on fish and wildlife resources throughout the project area. We are especially concerned with the impacts to the valuable habitat areas within the NCPC tract including wetlands, streams, creeks, and inland PNAs that support the Pamlico estuarine system and provide contiguous habitat areas for terrestrial species. Therefore, the Commission would look more favorably on mine expansion that does not include the NCPC tract."* The NCWRC believes further mining within the NCPC tract would cause significant degradation to fish and wildlife resources within the project site and adjacent Pamlico Sound estuary. Significant measures should be employed to avoid and minimize direct and indirect impacts to important and irreplaceable habitat areas as is directed by NEPA. Alternative L will significantly impact these resources.

Three inland PNAs exist within the NCPC tract and one within the Bonnerton tract. All would be further impacted by any mine advance, especially those within NCPC. Jack's, Jacob's, and Tooley's creeks within NCPC and Porter's Creek within Bonnerton are all designated inland PNAs by the NC Wildlife Resources Commission. PNAs are defined as those areas inhabited by the embryonic, larval or juvenile life stages of marine or estuarine fish or crustacean species due to favorable physical, chemical or biological factors. The purpose of inland PNAs are to establish and protect those fragile inland waters which support embryonic, larval or juvenile populations of marine or estuarine fish or crustacean species. The critical input to and function of PNAs are not contained just with public trust waters, but includes the headwater drainages. Biologists with NCWRC conducted a site visit on November 1, 2006 to determine the species present within Jack's, Jacob's, and South Creeks. Although collected fish included red drum and American eel, data collected showed a high contribution of inland species relative to estuarine species. In terms of numerical catch and biomass, the data we collected does not support that fish production originates from downstream estuarine environments. The ENTRIX report provided by PCS in January 2008 did not adequately address freshwater species nor did it establish a linkage between biota and previous mining impacts in the area, including watershed reduction and ground water draw-down from mining operations. Therefore, the ability to predict further watershed reduction impacts based on the report alone was negated. The report used data

collected after Jack's Creek watershed had already been diminished by almost 20% as "pre-data". Small reductions in watershed area, less than 10%, may have large biotic impacts and therefore is problematic when comparing watershed reduction and biota in the South Creek system if "pre-data" includes significantly impacted areas.

Removal of headwater streams and drainage areas would directly alter flow from ground water and stormwater runoff, therefore decreasing fresh water input, increasing salinity through estuarine tidal influences, impact filtration of nutrients and other contaminants from decreased wetlands, increase sedimentation, and reduce the input of organic materials. The disruption of these functions in the drainage basin will significantly impact the ability of these systems to function as an inland PNA. The value of a PNA cannot be measured in fisheries catch per unit effort alone.

Special conditions for the Department of the Army Permit No. 198899449 and DWQ issued Water Quality Certification #3092 included three conditions stating PCS must perform appropriate studies to assess whether there are water quality impacts or hydrologic impacts of the tributaries of South Creek and the Pamlico River due to the removal of drainage area from these tributaries. PCS requested CZR Incorporated (CZR) and Dr. Wayne Skaggs to prepare a stream monitoring plan. This plan, "NCPC Tract Stream Monitoring Program", has been implemented and reported to state and federal agencies for six years. Included in this plan were the monitoring and data comparison of Huddles Cut, Tooley, and Jacks creeks. As a result of the issued permit, the drainage basins for these streams were significantly altered. The drainage area for Huddles Cut was reduced from 872 acres to 651 acres (25.3%); Jacks Creek was reduced from 528 acres to 331 acres (37.3%), and Tooley Creek from 498 acres to 431 acres (13.5%). Review of these data has shown elevated levels of cadmium (Cd) within Huddles Cut and Jacks Creek as compared to background levels of Cd in the open areas of the Pamlico River estuary. Cd is a priority pollutant with no known biological function and a host of known adverse effects, including mutagenicity, teratogenicity and suspected carcinogenicity. The "NCPC Tract Stream Monitoring Program" reports state, "*We may predict, within the limits of established guidelines, that Cd concentrations in sediments from Jacks Creek may occasionally cause adverse biological effects*". These results were found in only six years of study, with 37.3% of the total drainage area reduced. Therefore, it can be concluded that the predicted long term effects would be greater when the drainage area is significantly reduced again. One explanation of the increased levels of Cd within the sediment of Huddles Cut was that the sediment is rich in fine grained, clay material. This result may be due to recent deposition or part of an overall patchy distribution of sediment in the area. A reduction of wetlands adjacent to surface waters would once again greatly reduce the opportunity for removal of these sediments prior to reaching the creeks and river.

The FEIS states drainage area impacts are considered temporary for those areas where mine configuration allows drainage areas to be restored throughout the approximate 15-year land reclamation process. However, due to the importance of these systems and lack of examples and references on reconstructing functional drainage basins especially on reclaimed mines containing high levels of nutrients and contaminants we feel the impacts will likely be much more far reaching and these systems may never recover. The FEIS states the area impacted will be reclaimed, not restored. Therefore essential components such as headwater drainages, riparian wetlands, and transitional areas that lead to coastal marshes that support the highly productive Pamlico estuarine system will be directly impacted and permanently removed, indirectly impacting the entire South Creek and Pamlico River systems.

Alternative L has less impact than AP / EAP, but still significantly impacts wetlands and watersheds with the meandering path between creeks and watersheds. We do not concur that appropriate avoidance and minimization has been conducted prior to consideration of mitigation. Reduction of impacts to these valuable systems would allow mitigation to be considered appropriate and adequate. We understand the

applicant does not have to demonstrate "no impact", but we feel impacts within the current proposal will be significant and could not be adequately offset even with compensatory mitigation.

The FEIS contains a section that provides information on several proposed mitigation sites located near the South Creek area and within the Tar / Pamlico River Basin. The NCWRC appreciates the effort PCS has put forth to show commitment in moving forward to mitigate impacts that cannot be avoided and minimized. However, we believe impacts could be reduced significantly and are concerned with the ability to mitigate for the loss of wetlands, streams, stream buffers, and the biological and chemical functions of the systems within Alternative L. The mitigation strategy proposed in the FEIS does not appropriately compensate for the proposed impacts to submerged aquatic vegetation (SAV), shallow water habitat, essential fish habitat (EFH), riparian wetlands, coastal marsh, inland PNAs, and the role of drainage basin areas to these important inland and estuarine systems immediately adjacent the Pamlico River system in the NCPC tract. Direct removal of some of these resources may not occur with the proposed actions, but the indirect, secondary, and cumulative impacts with the removal and degradation of the system leads to the impacts and the potential functional removal of these resources. The FEIS states impacts to jurisdictional areas under Alternative L within the NCPC and Bonnerton tracts would be mitigated at approximately a 1.8:1 ratio. This ratio is used to help calculate the cost models and therefore the expense of mitigation for each alternative and was obtained by giving 1:1 to poor-fair valued systems, 2:1 to good systems, and 3:1 to excellent systems. NCWRC has reviewed the provided information and does not agree that the proposed 1.8:1 ratio is adequate for the impacts the project will have on the ecosystem.

The potential mitigation sites at Bay City Farm, Hell Swamp, and Scott Creek may be good wetland enhancement or restoration sites for the wetlands and streams they once were, but may not replace the valuable wetland and aquatic habitats and functions lost within the NCPC and Bonnerton tracts. We still do not believe the FEIS adequately addresses the differences in complexity and function between ecosystems within the NCPC tract and the proposed mitigation areas. Replacement of lost functions is a critical consideration as well as general availability of lands in the area appropriate for wetland, stream, and buffer mitigation. Due to the inability of the applicant to find adequate area to mitigate and restore mined buffers, PCS is proposing to present "flexible buffer mitigation" before the Environmental Management Commission. We do not support this proposal especially for the proposed area of impact versus conventional buffer mitigation. This discrepancy could be resolved by avoiding and minimizing impacts to these areas.

The FEIS states continued mining of the NCPC tract would have temporary impacts that would be mitigatable. However, due to the importance of these systems, NCWRC disagrees. The FEIS states the area impacted will be reclaimed, not restored. Therefore, essential components such as headwater drainages, riparian wetlands, and transitional areas that lead to coastal marshes that support the highly productive Pamlico estuarine system will be directly impacted and permanently removed, indirectly impacting the entire South Creek and Pamlico River systems. We continue to question how the functional loss of three inland PNAs would be mitigated.

The NCWRC has reviewed the compensatory mitigation section contained within the FEIS. At this time, we are not providing detailed comments about these proposals. These options are being pursued with the understanding from the applicant that they may not be accepted as adequate mitigation for the proposed mining plan. We will provide more detailed comments on the individual mitigation sites during the 401(b)(1) review process of the NC Division of Water Quality. Concerns and comments for overall proposed mitigation as well as individual sites would include inability to mitigate the complexity and function of areas in the South Creek estuary with proposed mitigation areas, inability to mitigate the

functional loss of PNAs, restoration versus enhancement, insuring restored mitigation areas are not limited in their function by downstream constraints, grading, planting, and site specific construction conditions.

Due to the afore mentioned concerns, we cannot concur that Alternative L is an appropriate mining option on the NCPC tract because of significant degradation of fish and wildlife resources and the uncertainty in providing adequate, functional compensatory mitigation. We have made this statement for alternatives AP, EAP, SCR, SJA, and Alternative M on the NCPC tract as well. This concern also extends to the significant wetland areas on Bonnerton.

The concerns we have with the impacts of mining important ecosystems adjacent the South Creek, Durham Creek, and Pamlico River systems and the inability to adequately mitigate those impacts could be addressed with more intense avoidance and minimization. Once avoidance and minimization has been satisfied, a detailed mitigation plan for unavoidable impacts should be submitted detailing the ability to mitigate for the loss of important wetland habitat areas as well as water quality functions. The mitigation plan should include specific details for any areas impacted including potential SAV, shallow water habitat, EFH, inland PNAs, perennial streams, intermittent streams, coastal marsh, riparian wetlands, and riparian buffers. All impacts should be considered when developing such a plan, including direct, indirect, secondary, and cumulative impacts.

We appreciate the opportunity to participate in the commenting process and review of the FEIS. We also look forward to any additional information, response, and discussion of our comments during this process. If you have further questions or comments, please contact Maria Dunn at (252) 948-3916.

cc: Lekson, D. – US Army Corps of Engineers
Wicker, M. – US Fish and Wildlife Service
Fox, B. – US Environmental Protection Agency
Sechler, R. – National Marine Fisheries Service
Moye, D. – NC Division of Coastal Management
Rynas, S. – NC Division of Coastal Management
Peed, R. – NC Division of Land Resources
McKenna, S. – NC Division of Marine Fisheries
Dorney, J. – NC Division of Water Quality
Barnes, K. – NC Division of Water Quality
Emmerling, D. – Pamlico-Tar River Foundation
McNaught, D. – Environmental Defense
Cooper, S. – CZR, Inc - Wilmington
Furness, J. – PCS Phosphate Co.

Rebecca Fox/R4/USEPA/US
04/24/2009 03:11 PM

To Ron Sechler <ron.sechler@noaa.gov>
cc
bcc
Subject Re: Fw: Information requested by Stan for PCS Phosphate trip to NC on Monday, April 27th

I believe Palmer already sent it to you all. b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov
Ron Sechler <ron.sechler@noaa.gov>

Ron Sechler
<ron.sechler@noaa.gov>
04/24/2009 02:39 PM

To Rebecca Fox/R4/USEPA/US@EPA
cc
Subject Re: Fw: Information requested by Stan for PCS Phosphate trip to NC on Monday, April 27th

Becky,
Would like to have PCS presentation if you can send w/o to much trouble.
Ron.

Fox.Rebecca@epamail.epa.gov wrote:
> Hey FWS/NMFS,
>
> Look forward to seeing you on Monday! Just forwarding on some counter
> points I made to the ppt given by PCS at the 4-17-09 mtg. It is a piece
> of work... Don't remember if we sent it to you. If not and you would
> like to see it, let me know and we will send it your way. I presume
> they will give something like this again on Mon... We also just
> received a response from SELC that was sent to AA and ASA that I will
> forward to you. Talk to you later, b see attachment at end of email
> chain.
>
> Becky Fox
> Wetland Regulatory Section
> USEPA
> Phone: 828-497-3531
> Email: fox.rebecca@epa.gov
> ----- Forwarded by Rebecca Fox/R4/USEPA/US on 04/24/2009 01:24 PM -----
>
> Jennifer
> Derby/R4/USEPA/U
> S
> To
> 04/24/2009 12:35 Rebecca Fox/R4/USEPA/US@EPA,
> PM Rebecca Cover/R4/USEPA/US@EPA,
> Stan Meiburg/R4/USEPA/US@EPA
cc

Jim Giattina/R4/USEPA/US@EPA,
Palmer Hough/DC/USEPA/US@EPA, Tom
Welborn/R4/USEPA/US@EPA

Subject

Re: Information requested by Stan for PCS Phosphate trip to NC on Monday, April 27th(Document link: Rebecca Fox)

> Thanks for this timely information, Becky (Fox).
>
> Becky Cover - please provide this information to Stan asap as it is
> background for his Monday trip to PCS Phosphate mine in NC.
>
> Thank you,
> Jennifer
>
> Jennifer Derby
> EPA Region 4 Water Division
> 61 Forsyth Street
> Atlanta, GA 30303
> phone - 404-562-9401
> fax - 404-562-9343
> email - derby.jennifer@epa.gov

Rebecca
Fox/R4/USEPA/US

04/24/2009 11:39
AM

To

Tom Welborn/R4/USEPA/US@EPA,
Jennifer Derby/R4/USEPA/US@EPA,
Palmer Hough/DC/USEPA/US@EPA, Jim
Giattina/R4/USEPA/US@EPA

cc

Subject

Information requested by Stan

> Hi everyone,
>
> I put together a short paper (2.5 pages of mainly bullets) for Stan with
> information he requested on the arguments being used by PCS and COE
> against our indirect impacts to drainage basins position. I also
> countered some other points from the PCS ppt of 4-17-09, including the

> latest info I have from NHP on SNHA. That ppt is full of half truths
> and misrepresentations and I just tried to hit some of the most
> egregious... I didn't get into the economics -- thought I'd leave that
> to Palmer if he thinks we need to send anything to Stan on that since he
> has been discussing with Matt. Please forward on to Stan as soon as
> possible so he can have a chance to review and ask any questions he may
> have before the Monday mtg. Thanks! b
>
> (See attached file: RA paper -- PCS issues for 4-27 mtg.doc)
>
> Becky Fox
> Wetland Regulatory Section
> USEPA
> Phone: 828-497-3531
> Email: fox.rebecca@epa.gov

Rebecca Fox /R4/USEPA/US
04/24/2009 03:16 PM

To Palmer Hough/DC/USEPA/US@EPA
cc
bcc
Subject Fw: Request for Review and Comment from WRC

Palmer,

Here is WRC response. Do you want to forward it on to master list? If so, should just do attachments and not the email correspondence below which requests their response. b

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov

----- Forwarded by Rebecca Fox/R4/USEPA/US on 04/24/2009 03:14 PM -----

"Curry, Robert L."
<robert.curry@ncwildlife.org>

04/24/2009 02:53 PM

To Jim Giattina/R4/USEPA/US@EPA
cc Tom Welborn/R4/USEPA/US@EPA, Jennifer Derby/R4/USEPA/US@EPA, Rebecca Fox/R4/USEPA/US@EPA, "Curry, Robert L." <robert.curry@ncwildlife.org>
Subject Request for Review and Comment

Dear Jim:

Attached is our position statement and response to your email message. In addition, the official agency position for this project is clearly articulated in our comments from 1 July 2008. No other information can supplant those comments.

I hope this letter clarifies our position on this project. If you have additional questions please don't hesitate to contact me at (919) 707-0221.

bob Curry

(See attached files: PCS FEIS 7-01-08.pdf and WRC PCS Position to EPA.pdf)

Robert L. Curry, Chief
Division of Inland Fisheries
1721 Mail Service Center
Raleigh, NC 27699-1721
Phone: (919) 707-0221
Fax: (919) 707-0028
Email: robert.curry@ncwildlife.org

-----Original Message-----

From: Giattina.Jim@epamail.epa.gov [mailto:Giattina.Jim@epamail.epa.gov]
Sent: Thursday, April 23, 2009 8:20 AM
To: Curry, Robert L.
Cc: welborn.tom@epa.gov; derby.jennifer@epa.gov; Fox.Rebecca@epamail.epa.gov
Subject: Request for Review and Comment

Bob,

As you know, EPA has elevated the PCS Phosphate permit decision to Assistant Secretary of the Army (Civil Works). As part of that elevation, it is EPA's position that the impacts to the drainage basins for the tidal creeks (including four PNAs) should be further avoided.
The reduction to the drainage basins for the PNAs, with the pending permit decision will be in excess of 70 to 80%. NCWRC has held a strong position throughout this long process that these PNAs will likely be significantly degraded with such a large reduction to the drainage basins, including headwater creeks and wetlands. During this elevation process, EPA has received two documents (Notice of Intent to issue permit and the draft Record of Decision) from the Wilmington District that use information contained in a September 2008 edition of the NCWRC publication of "Wildlife in North Carolina" to support their position that these PNAs will function very well with a significant loss of their drainage basins. We can not share the draft ROD with you because it is not yet a public document but we are attaching the NOI which has the exact same language (paragraph 1, page 5) that is contained several places in the draft ROD.

We are sharing this information with you because it is our understanding that your agency has strongly opposed the view that these areas can function with significant losses of their drainage basins. We aks that you review this language, as it will likely be in the final ROD as support for the Corps' position on drainage basin reduction for the PNAs, and let us know if it is consistent with the scientific analysis of the NCWRC. A letter from NCWRC on this matter would also help EPA better understand the significance of the impacts to the tidal creek watersheds. Time is of an essence, as the Army is formulating their decision this week and plan to have an internal draft decision by Monday (4-27-09). If you do decide to respond, please do so as soon as possible by email correspondence and I will forward to my staff, EPA and Corps headquarters and the Army.

Thanks for your attention to this matter.

Jim Giattina, Director
Water Protection Division

(See attached file: 404 q COE letter.pdf)

PCS_FEIS 7-01-08.pdf WRC PCS Position to EPA.pdf

North Carolina Wildlife Resources Commission

MEMORANDUM

TO: Melba McGee, Environmental Coordinator
Office of Legislative and Intergovernmental Affairs
North Carolina Department of Environment and Natural Resources
and
Tom Walker
U.S. Army Corps of Engineers
Wilmington District

FROM: Shannon L. Deaton, Manager
Habitat Conservation Program

DATE: July 1, 2008

SUBJECT: Comments on Final Environmental Impact Statement for the PCS Mine Continuation, Aurora, North Carolina.
OLIA No. 08-0356; Corps Action ID No. 200110096

Biologists with the North Carolina Wildlife Resources Commission (NCWRC) reviewed the final environmental impact statement (FEIS) with regard to impacts of the project on fish and wildlife resources. Our comments are provided in accordance with the North Carolina Environmental Policy Act (G.S. 113A-1 et seq., as amended; 1 NCAC-25), provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the Clean Water Act of 1977 (as amended) and the Coastal Area Management Act (G.S. 113A-100 through 113A-128), as amended.

The applicant, PCS Phosphate, Inc., Aurora (PCS) submitted a DEIS with the US Army Corps of Engineers (USACE) on October 20, 2006. This document was reviewed by the NCWRC and formal comments were issued on February 1, 2007. On December 31, 2007 the NCWRC submitted formal comments to a supplement of the DEIS that presented two new alternatives, Alternative L and Alternative M. Descriptions of these alternatives and differences in impact area have been thoroughly described in the DEIS and SDEIS. The USACE posted the FEIS for review on May 23, 2008. The applicant's overall purpose and need is to continue mining its phosphate reserve in an economically viable fashion. More specifically, the applicant's purpose and need is to implement a long-term systematic and cost-effective mine advance within the project area for the ongoing PCS mine operation at Aurora, North Carolina. Although the purpose and need of the applicant has remained the same, PCS is now pursuing Alternative L rather than the Applicant Preferred (AP) and Expanded Applicant Preferred (EAP) boundaries.

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

Alternative L includes areas within the NCPC, Bonnerton, and South of Highway 33 tracts. NCPC is a 3,608 acre area within the Hickory Point peninsula adjacent the Pamlico River and South Creek. Seventy-one percent of this tract is designated wetlands and contains six tidal creeks, including three inland primary nursery areas (PNAs). Bonnerton is a 2,806 acre area adjacent the Pamlico River that is 76% wetlands and contains the headwater drainage to one inland PNA as well as a nationally significant wetland heritage area. South of Highway 33 is an 8,686 acre tract, 20% of which are wetlands. The entire project area is classified nutrient sensitive and is therefore subject to the NC Division of Water Quality's Tar/Pamlico Basin Buffer Rules. Alternative L is briefly described below:

Alternative L
This boundary utilizes the SCR boundary in the NCPC Tract, avoids the Porter Creek headwaters north of Grey Road, utilizes the AP boundary south of the Grey Road in the Bonnerton Tract, and avoids the South Creek Canal, all wetlands south of the South Creek Canal, and all areas regulated by the NC Division of Coastal Management (NCDCM) as Areas of Environmental Concern (AEC). Total wetland impacts per information from the "Biotic Communities Impacts" figures include 4,135 acres of wetlands and 59 acres of 47% wetlands. It is stated this alternative would provide 37 years of mining with at least 15 years of mining north of Highway 33.

NCWRC has reviewed the information presented within the FEIS, including responses to agency concerns. The additional information provided has not changed our position on proposed project and its impacts to aquatic and wildlife resources. Our February 1, 2007 and December 31, 2007 comments stated and reiterated, *"The NCWRC would like to conclude that we are concerned with the impacts the mine expansion will have on fish and wildlife resources throughout the project area. We are especially concerned with the impacts to the valuable habitat areas within the NCPC tract including wetlands, streams, creeks, and inland PNAs that support the Pamlico estuarine system and provide contiguous habitat areas for terrestrial species. Therefore, the Commission would look more favorably on mine expansion that does not include the NCPC tract."* The NCWRC believes further mining within the NCPC tract would cause significant degradation to fish and wildlife resources within the project site and adjacent Pamlico Sound estuary. Significant measures should be employed to avoid and minimize direct and indirect impacts to important and irreplaceable habitat areas as is directed by NEPA. Alternative L will significantly impact these resources.

Three inland PNAs exist within the NCPC tract and one within the Bonnerton tract. All would be further impacted by any mine advance, especially those within NCPC. Jack's, Jacob's, and Tooley's creeks within NCPC and Porter's Creek within Bonnerton are all designated inland PNAs by the NC Wildlife Resources Commission. PNAs are defined as those areas inhabited by the embryonic, larval or juvenile life stages of marine or estuarine fish or crustacean species due to favorable physical, chemical or biological factors. The purpose of inland PNAs are to establish and protect those fragile inland waters which support embryonic, larval or juvenile populations of marine or estuarine fish or crustacean species. The critical input to and function of PNAs are not contained just with public trust waters, but includes the headwater drainages. Biologists with NCWRC conducted a site visit on November 1, 2006 to determine the species present within Jack's, Jacob's, and South Creeks. Although collected fish included red drum and American eel, data collected showed a high contribution of inland species relative to estuarine species. In terms of numerical catch and biomass, the data we collected does not support that fish production originates from downstream estuarine environments. The ENTRIX report provided by PCS in January 2008 did not adequately address freshwater species nor did it establish a linkage between biota and previous mining impacts in the area, including watershed reduction and ground water draw-down from mining operations. Therefore, the ability to predict further watershed reduction impacts based on the report alone was negated. The report used data

collected after Jack's Creek watershed had already been diminished by almost 20% as "pre-data". Small reductions in watershed area, less than 10%, may have large biotic impacts and therefore is problematic when comparing watershed reduction and biota in the South Creek system if "pre-data" includes significantly impacted areas.

Removal of headwater streams and drainage areas would directly alter flow from ground water and stormwater runoff, therefore decreasing fresh water input, increasing salinity through estuarine tidal influences, impact filtration of nutrients and other contaminants from decreased wetlands, increase sedimentation, and reduce the input of organic materials. The disruption of these functions in the drainage basin will significantly impact the ability of these systems to function as an inland PNA. The value of a PNA cannot be measured in fisheries catch per unit effort alone.

Special conditions for the Department of the Army Permit No. 198899449 and DWQ issued Water Quality Certification #3092 included three conditions stating PCS must perform appropriate studies to assess whether there are water quality impacts or hydrologic impacts of the tributaries of South Creek and the Pamlico River due to the removal of drainage area from these tributaries. PCS requested CZR Incorporated (CZR) and Dr. Wayne Skaggs to prepare a stream monitoring plan. This plan, "NCPC Tract Stream Monitoring Program", has been implemented and reported to state and federal agencies for six years. Included in this plan were the monitoring and data comparison of Huddles Cut, Tooley, and Jacks creeks. As a result of the issued permit, the drainage basins for these streams were significantly altered. The drainage area for Huddles Cut was reduced from 872 acres to 651 acres (25.3%); Jacks Creek was reduced from 528 acres to 331 acres (37.3%), and Tooley Creek from 498 acres to 431 acres (13.5%). Review of these data has shown elevated levels of cadmium (Cd) within Huddles Cut and Jacks Creek as compared to background levels of Cd in the open areas of the Pamlico River estuary. Cd is a priority pollutant with no known biological function and a host of known adverse effects, including mutagenicity, teratogenicity and suspected carcinogenicity. The "NCPC Tract Stream Monitoring Program" reports state, "*We may predict, within the limits of established guidelines, that Cd concentrations in sediments from Jacks Creek may occasionally cause adverse biological effects*". These results were found in only six years of study, with 37.3% of the total drainage area reduced. Therefore, it can be concluded that the predicted long term effects would be greater when the drainage area is significantly reduced again. One explanation of the increased levels of Cd within the sediment of Huddles Cut was that the sediment is rich in fine grained, clay material. This result may be due to recent deposition or part of an overall patchy distribution of sediment in the area. A reduction of wetlands adjacent to surface waters would once again greatly reduce the opportunity for removal of these sediments prior to reaching the creeks and river.

The FEIS states drainage area impacts are considered temporary for those areas where mine configuration allows drainage areas to be restored throughout the approximate 15-year land reclamation process. However, due to the importance of these systems and lack of examples and references on reconstructing functional drainage basins especially on reclaimed mines containing high levels of nutrients and contaminants we feel the impacts will likely be much more far reaching and these systems may never recover. The FEIS states the area impacted will be reclaimed, not restored. Therefore essential components such as headwater drainages, riparian wetlands, and transitional areas that lead to coastal marshes that support the highly productive Pamlico estuarine system will be directly impacted and permanently removed, indirectly impacting the entire South Creek and Pamlico River systems.

Alternative L has less impact than AP / EAP, but still significantly impacts wetlands and watersheds with the meandering path between creeks and watersheds. We do not concur that appropriate avoidance and minimization has been conducted prior to consideration of mitigation. Reduction of impacts to these valuable systems would allow mitigation to be considered appropriate and adequate. We understand the

applicant does not have to demonstrate "no impact", but we feel impacts within the current proposal will be significant and could not be adequately offset even with compensatory mitigation.

The FEIS contains a section that provides information on several proposed mitigation sites located near the South Creek area and within the Tar / Pamlico River Basin. The NCWRC appreciates the effort PCS has put forth to show commitment in moving forward to mitigate impacts that cannot be avoided and minimized. However, we believe impacts could be reduced significantly and are concerned with the ability to mitigate for the loss of wetlands, streams, stream buffers, and the biological and chemical functions of the systems within Alternative L. The mitigation strategy proposed in the FEIS does not appropriately compensate for the proposed impacts to submerged aquatic vegetation (SAV), shallow water habitat, essential fish habitat (EFH), riparian wetlands, coastal marsh, inland PNAs, and the role of drainage basin areas to these important inland and estuarine systems immediately adjacent the Pamlico River system in the NCPC tract. Direct removal of some of these resources may not occur with the proposed actions, but the indirect, secondary, and cumulative impacts with the removal and degradation of the system leads to the impacts and the potential functional removal of these resources. The FEIS states impacts to jurisdictional areas under Alternative L within the NCPC and Bonnerton tracts would be mitigated at approximately a 1.8:1 ratio. This ratio is used to help calculate the cost models and therefore the expense of mitigation for each alternative and was obtained by giving 1:1 to poor-fair valued systems, 2:1 to good systems, and 3:1 to excellent systems. NCWRC has reviewed the provided information and does not agree that the proposed 1.8:1 ratio is adequate for the impacts the project will have on the ecosystem.

The potential mitigation sites at Bay City Farm, Hell Swamp, and Scott Creek may be good wetland enhancement or restoration sites for the wetlands and streams they once were, but may not replace the valuable wetland and aquatic habitats and functions lost within the NCPC and Bonnerton tracts. We still do not believe the FEIS adequately addresses the differences in complexity and function between ecosystems within the NCPC tract and the proposed mitigation areas. Replacement of lost functions is a critical consideration as well as general availability of lands in the area appropriate for wetland, stream, and buffer mitigation. Due to the inability of the applicant to find adequate area to mitigate and restore mined buffers, PCS is proposing to present "flexible buffer mitigation" before the Environmental Management Commission. We do not support this proposal especially for the proposed area of impact versus conventional buffer mitigation. This discrepancy could be resolved by avoiding and minimizing impacts to these areas.

The FEIS states continued mining of the NCPC tract would have temporary impacts that would be mitigatable. However, due to the importance of these systems, NCWRC disagrees. The FEIS states the area impacted will be reclaimed, not restored. Therefore, essential components such as headwater drainages, riparian wetlands, and transitional areas that lead to coastal marshes that support the highly productive Pamlico estuarine system will be directly impacted and permanently removed, indirectly impacting the entire South Creek and Pamlico River systems. We continue to question how the functional loss of three inland PNAs would be mitigated.

The NCWRC has reviewed the compensatory mitigation section contained within the FEIS. At this time, we are not providing detailed comments about these proposals. These options are being pursued with the understanding from the applicant that they may not be accepted as adequate mitigation for the proposed mining plan. We will provide more detailed comments on the individual mitigation sites during the 401(b)(1) review process of the NC Division of Water Quality. Concerns and comments for overall proposed mitigation as well as individual sites would include inability to mitigate the complexity and function of areas in the South Creek estuary with proposed mitigation areas, inability to mitigate the

functional loss of PNAs, restoration versus enhancement, insuring restored mitigation areas are not limited in their function by downstream constraints, grading, planting, and site specific construction conditions.

Due to the afore mentioned concerns, we cannot concur that Alternative L is an appropriate mining option on the NCPC tract because of significant degradation of fish and wildlife resources and the uncertainty in providing adequate, functional compensatory mitigation. We have made this statement for alternatives AP, EAP, SCR, SJA, and Alternative M on the NCPC tract as well. This concern also extends to the significant wetland areas on Bonnerton.

The concerns we have with the impacts of mining important ecosystems adjacent the South Creek, Durham Creek, and Pamlico River systems and the inability to adequately mitigate those impacts could be addressed with more intense avoidance and minimization. Once avoidance and minimization has been satisfied, a detailed mitigation plan for unavoidable impacts should be submitted detailing the ability to mitigate for the loss of important wetland habitat areas as well as water quality functions. The mitigation plan should include specific details for any areas impacted including potential SAV, shallow water habitat, EFH, inland PNAs, perennial streams, intermittent streams, coastal marsh, riparian wetlands, and riparian buffers. All impacts should be considered when developing such a plan, including direct, indirect, secondary, and cumulative impacts.

We appreciate the opportunity to participate in the commenting process and review of the FEIS. We also look forward to any additional information, response, and discussion of our comments during this process. If you have further questions or comments, please contact Maria Dunn at (252) 948-3916.

cc: Lekson, D. – US Army Corps of Engineers
Wicker, M. – US Fish and Wildlife Service
Fox, B. – US Environmental Protection Agency
Sechler, R. – National Marine Fisheries Service
Moye, D. – NC Division of Coastal Management
Rynas, S. – NC Division of Coastal Management
Peed, R. – NC Division of Land Resources
McKenna, S. – NC Division of Marine Fisheries
Dorney, J. – NC Division of Water Quality
Barnes, K. – NC Division of Water Quality
Emmerling, D. – Pamlico-Tar River Foundation
McNaught, D. – Environmental Defense
Cooper, S. – CZR, Inc - Wilmington
Furness, J. – PCS Phosphate Co.

North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

April 24, 2009

Jim Giattina, Director
Water Protection Division
United States Environmental Protection Agency, Region 4
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, GA 30303-8960

Dear Mr. Giattina,

I am responding to your email message and request for comments on the letter from Colonel Jefferson M. Ryscavage of 24 February 2009 regarding AID 200110096. This letter was provided to me in your e-mail message dated April 23, 2009.

The North Carolina Wildlife Resources Commission (NCWRC) has reviewed and formally commented on the Final Environmental Impact Statement for the PCS Mine Continuation AID 200110096. Our staff visited the project site to evaluate the fish and wildlife resources found in the project area. Our attached comments of 1 July 2008 are based on those site evaluations. These comments remain applicable and stand as the official position of the NCWRC. We do not concur with the findings of the FEIS for this project, partially based on our concerns with impacts to the headwaters of Jacks, Tooleys, and Drinkwater creeks. All three of these creeks are designated Inland Primary Nursery Areas. As stated in our comments:

> *......The critical input to and function of PNAs are not contained just with public trust waters, but includes the headwater drainages. Biologists with NCWRC conducted a site visit on November 1, 2006 to determine the species present within Jack's, Jacob's, and South Creeks. Although collected fish included red drum and American eel, data collected showed a high contribution of inland species relative to estuarine species. In terms of numerical catch and biomass, the data we collected does not support that fish production originates from downstream estuarine environments. The ENTRIX report provided by PCS in January 2008 did not adequately address freshwater species nor did it establish a linkage between biota and previous mining impacts in the area, including watershed reduction and ground water draw-down from mining operations. Therefore, the ability to predict further watershed reduction impacts based on the report alone was negated. The report used data collected after Jack's Creek watershed had already been diminished by almost 20% as "pre-data". Small reductions in watershed area, less than 10%,*

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

may have large biotic impacts and therefore is problematic when comparing watershed reduction and biota in the South Creek system if "pre-data" includes significantly impacted areas.

Further:

Removal of headwater streams and drainage areas would directly alter flow from ground water and stormwater runoff, therefore decreasing fresh water input, increasing salinity through estuarine tidal influences, impact filtration of nutrients and other contaminants from decreased wetlands, increase sedimentation, and reduce the input of organic materials. The disruption of these functions in the drainage basin will significantly impact the ability of these systems to function as an inland PNA. The value of a PNA cannot be measured in fisheries catch per unit effort alone.

Maintenance of intact watershed areas surrounding coastal rivers and creeks is a basic and widely accepted tenet to protecting water quality and habitat for aquatic organisms. The degree and extent to which riparian areas are protected is directly related to the degree and extent to which creeks and rivers maintain their ecological functions. The North Carolina General Assembly acknowledged the importance of maintaining ecological functions in public waters when they passed legislation in 1996 to create the Clean Water Management Trust Fund (CWMTF). Since then, grants from the CWMTF have protected nearly half-million acres and 4,859 miles of riparian buffers in North Carolina. The NCWRC has received millions of dollars of grant monies from the CWMTF and other sources for acquiring coastal wetlands with the specific goal of protecting water quality and fish and wildlife habitat through perpetual protection of riparian zones.

The official agency position for this project is clearly articulated in our comments from 1 July 2008. No other information can supplant those comments. I hope this letter clarifies our position on this project. If you have additional questions please don't hesitate to contact me at (919) 707-0221.

Sincerely,

Robert L. Curry

Robert L. Curry, Chief
Division of Inland Fisheries

attachment

Palmer Hough/DC/USEPA/US
04/26/2009 12:50 PM

To Ann Campbell/DC/USEPA/US@EPA, Brian Frazer/DC/USEPA/US@EPA, Chris Hoberg/R4/USEPA/US@EPA, Dawn

cc

bcc

Subject Letter from Enviros to ASA-CW and AAOW re: PCS

Folks:

In case you did not see this, attached is a letter to Army and EPA from five environmental organizations regarding the PCS elevation.

-Palmer

Palmer F. Hough
US Environmental Protection Agency
Wetlands Division
Room 7231, Mail Code 4502T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Office: 202-566-1374
Cell: 202-657-3114
FAX: 202-566-1375
E-mail: hough.palmer@epa.gov

Street/Courier Address
USEPA
Palmer Hough
EPA West -- Room 7231-L
Mail Code 4502T
1301 Constitution Avenue, NW
Washington, DC 20460
----- Forwarded by Palmer Hough/DC/USEPA/US on 04/26/2009 12:47 PM -----

From: Geoff Gisler <ggisler@selcnc.org>
To: Palmer Hough/DC/USEPA/US@EPA, "'william.L.James@usace.army.mil'" <william.L.James@usace.army.mil>, Dawn Messier/DC/USEPA/US@EPA
Date: 04/24/2009 12:48 PM
Subject: FW: PCS Phosphate mine permit elevation - Permit AID 200110096

From: Geoff Gisler
Sent: Friday, April 24, 2009 12:41 PM
To: 'rock.salt@us.army.mil'; 'Shapiro.mike@epa.gov'
Cc: 'Chip.Smith@HQDA.Army.Mil'; 'craig.schmauder@us.army.mil'; 'Patricia.Morris@us.army.mil'; 'Suzanne.L.Chubb@us.army.mil'; 'Meg.E.Gaffney-Smith@usace.army.mil'; 'William.L.James@usace.army.mil.'; 'Jennifer.A.Moyer@usace.army.mil'; 'Garrett.L.Dorsey@usace.army.mil'; 'Michael.Pfenning@us.army.mil'; 'John.Hurley@us.army.mil'; 'Lance.D.Wood@usace.army.mil'; 'Meiburg.stan@epa.gov'; 'Giattina.jim@epa.gov'; 'Peck.gregory@epa.gov'; 'Schwartz.suzanne@epa.gov'; 'Hough.Palmer@epa.gov.'; 'welborn.tom@epa.gov'; 'evans.david@epa.gov'; 'wood.robert@epa.gov'; 'messier.dawn@epa.gov.'; 'derby.jennifer@epa.gov'; 'fox.rebecca@epa.gov'; Derb Carter
Subject: PCS Phosphate mine permit elevation - Permit AID 200110096

Mr. Salt and Mr. Shapiro,
Please accept the attached letter providing comments on the PCS Phosphate's permit application requesting authorization to expand its phosphate mine near Aurora, North Carolina (Permit AID 20010096). In sum, the letter identifies substantial information within the administrative record that demonstrates that:

- EPA has properly elevated the permit decision;
- EPA's proposed alternative is practicable;
- The Wilmington District's modifications to the practicability analysis in the FEIS are arbitrary;
- Alternative L would result in unacceptable adverse effects on aquatic resources of national importance; and
- PCS's proposed mitigation will not offset the proposed impacts.

We appreciate the opportunity to submit this information for your consideration.

Sincerely,

Geoff Gisler
Staff Attorney
Southern Environmental Law Center
200 W. Franklin St. Suite 330
Chapel Hill, NC 27516
Ph: (919) 967-1450
Fax: (919) 929-9421
www.southernenvironment.org

04-24-09 PCS Phosphate expansion comment letter.pdf

SOUTHERN ENVIRONMENTAL LAW CENTER

200 WEST FRANKLIN STREET, SUITE 330
CHAPEL HILL, NC 27516-2559

Telephone 919-967-1450
Facsimile 919-929-9421
selcnc@selcnc.org

Charlottesville, VA
Chapel Hill, NC
Atlanta, GA
Asheville, NC
Sewanee, TN

April 24, 2009

Terrence C. "Rock" Salt
Principal Deputy Assistant Secretary of the Army
108 Army Pentagon
Room 3E446
Washington, D.C. 20310-0108

Michael H. Shapiro
Acting Assistant Administrator
U.S. Environmental Protection Agency
Office of Water (4101M)
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Re: Region 4 Environmental Protection Agency elevation of Wilmington District, COE permit decision on PCS Phosphate Mine in Beaufort County, North Carolina

Dear Mr. Salt and Mr. Shapiro:

Region 4 of the Environmental Protection Agency has elevated to EPA headquarters under the 404(q) MOA a decision by the Wilmington District of the U.S. Army Corps of Engineers to proceed with the issuance of a Section 404 permit to PCS Phosphate, Inc. to mine 3,953 acres of wetlands and approximately five miles of streams adjacent to the Pamlico River and estuary in coastal North Carolina. EPA has concluded that issuance of the permit would result in unacceptable adverse effects to aquatic resources of national importance. EPA is advocating for additional wetland avoidance to prevent significant degradation of aquatic resources and an improved mitigation plan for unavoidable wetland impacts. EPA's proposal would allow uninterrupted mining for at least 29 years. PCS Phosphate has responded to the elevation of the permit decision and to EPA's proposal.

This letter is submitted on behalf of the Pamlico-Tar River Foundation, Environmental Defense Fund, North Carolina Coastal Federation, and Sierra Club in response to PCS's contentions that its proposed mining plan would not result in unacceptable adverse effects to aquatic resources, that additional avoidance of wetlands and streams is not practicable, and certain procedural issues. The response below includes appropriate reference to the permit administrative record, PCS Phosphate documents, and applicable laws and regulations.

In summary, it provides support for the following conclusions:

- **The EPA is not required to refer its objections to PCS's unacceptable environmental impacts to the Council on Environmental Quality under Clean Air Act Section 309.**
- **PCS has delayed the permitting process by insisting that the AP Alternative – an alternative that cannot be permitted under state law – was the only practicable alternative.**
- **EPA's Proposed Alternative is Practicable Under the Wilmington District's Practicability Analysis in the DEIS, SDEIS, and FEIS.**
- **The Wilmington District's determination that all practicable alternatives must provide 15 years of mining north of highway 33 is arbitrary and indefensible.**
- **The Albemarle-Pamlico Sound estuary and associated wetlands are aquatic resources of national importance.**
- **PCS proposes to mine substantial parts of the watersheds of five fishery nursery areas and impair the functions of these vital, priority habitats and aquatic resources of national significance.**
- **PCS's proposed mitigation will not offset the unacceptable adverse impacts to aquatic resources of national importance.**

We appreciate the opportunity to submit this information for your consideration.

Sincerely,

Derb S. Carter, Jr.
Senior Attorney-NC/SC Office Director
Southern Environmental Law Center

Geoffrey R. Gisler
Staff Attorney
Southern Environmental Law Center

EPA PROPERLY ELEVATED PCS'S PERMIT APPLICATION

The EPA is not required to refer its objections to PCS's unacceptable environmental impacts to the Council on Environmental Quality under Clean Air Act Section 309.

- PCS's contention that EPA "has not complied with requirements to refer any 'unsatisfactory' environmental effects to CEQ" has no merit because the 309 referral process is not relevant to the Section 404 Clean Water Act permit application elevation.
- The Memorandum of Agreement between the EPA and Corps establishes the procedure for proceedings under Clean Water Act Section 404(q) and PCS does not contest that the EPA has not complied with that procedure.
- Section 309 of the Clean Air Act, 42 U.S.C. §7609, may impose requirements on EPA during review of Clean Air Act permits, but does not require the EPA to refer objections to Clean Water Act projects to the Council on Environmental Quality. Regulations promulgated under Clean Air Act Section 309, i.e. 40 C.F.R. § 1504.3, are irrelevant to the Section 404(q) process.

PCS has delayed the permitting process by insisting that the AP Alternative – an alternative that cannot be permitted under state law – was the only practicable alternative.

- PCS and the Wilmington District have consistently compared all potentially practicable alternatives to the AP Alternative, a 15-year alternative that would illegally mine salt marsh.
- The state announced early in the permitting process that it could not and would not issue a permit for the AP Alternative:
  - "Mr. Dorney [from the N.C. Division of Water Quality] stated that mining of the creeks will never be permitted, and that proposing such an action as a 'straw man' is a waste of time." Meeting Notes from 28 February 2001, DEIS Appx. A-5.
- PCS objected, insisting on pursuing the AP Alternative:
  - "Mr. Smith [PCS Environmental Affairs Manager] reminded the group that the current proposal is appropriate to PCS Phosphate's stakeholders, considering the high value of the ore body on the NCPC Tract." *Id.*
- Rather than altering the mine plan, PCS sued the State of North Carolina to defend the illegal mining. *See* Meeting Notes from 26 February 2003, DEIS Appx. A-72. That case did not settle until October 2006, delaying the permitting process for years.
- Even after the lawsuit, PCS continued to push for the AP Alternative in spite of the Division of Water Quality's refusal to issue a permit for it:
  - "[T]he applicant preferred alternative is not acceptable to DWQ since (as outlined in our September 14, 2006 letter to PCS Phosphate and repeated at several meetings with

the company), this alternative proposes to mine through about 34 acres of salt marsh." 31 January 2007 comments of North Carolina Division of Water Quality, FEIS J-IV.A.4.

  - "[W]e strongly urge the company to present an applicant preferred alternative which is permittable by the Division of Water Quality in order to move this important project forward." *Id.*

- The Wilmington District continued to ignore the state permitting agency's comments rejecting the AP Alternative as not permittable under state law, delaying the permitting process by postponing serious consideration of reasonable alternatives:

  - "[T]o the Corps' knowledge, neither the NCDWQ nor the NCDCM have formally refused to process or denied any permit or certification." Wilmington District's response to comments, FEIS J.II-22.

- PCS insisted that Alternative L was impracticable as recently as December 19, 2007, delaying consideration of reasonable alternatives to Alternative L. PCS comments on SDEIS, FEIS J-VII.B.1.

- PCS modified its permit application on April 25, 2008 – less than one year ago – to request the 37-year Alternative L as its preferred alternative in place of the 15-year AP Alternative that it insisted on, and sued to defend, for the first 7.5 years of the permitting process.

- Yet PCS still uses the clearly unlawful AP Alternative to compare its claimed "concessions" on reducing wetland impact.

EPA'S PROPOSED ALTERNATIVE IS PRACTICABLE

EPA's Proposed Alternative is Practicable Under the Wilmington District's Practicability Analysis in the DEIS, SDEIS, and FEIS.

- The DEIS and SDEIS found that the SCRB Alternative is practicable. DEIS 2-19, *see* SDEIS at 2-3 (stating no change in economic analysis).

- "The . . . SCRB . . . alternative[] provide[s] for approximately 15 years of mining at operating costs similar to the current national averages and PCS's historic mine operating costs." DEIS 2-19, *see* SDEIS at 2-3, FEIS at 2-30.

- The SCRB Alternative provides approximately 7.5 years of mining north of Hwy 33 before requiring relocation to the South of Hwy 33 ("S33") tract. FEIS Appendix D. The EPA Alternative provides 8 years of mining north of Hwy 33 before requiring relocation to the S33 tract.

- The EPA Alternative provides more mining north of Hwy 33 than SCRB and allows more expansive mining than SCRB in the S33 Tract. Therefore it is practicable under the DEIS and SDEIS economic practicability analysis.

- The Wilmington District stated in response to comments in the FEIS that "[t]he Corps has not altered the economic analysis." Wilmington District's response to comments, FEIS J-V.B.2(R71). To clarify, the Wilmington District confirmed that "[t]he Corps has continued to use the DEIS approach in the FEIS." *Id.*

- Thus, any alternative that was practicable in the DEIS and SDEIS must be practicable under the analysis in the FEIS since the "[t]he Corps has not altered the economic analysis." *Id.*

- Since the EPA Alternative is practicable under the DEIS analysis and is practicable under the SDEIS analysis and "the Corps' approach to determining practicability have remained consistent throughout the DEIS, the SDEIS and the FEIS," the EPA Alternative must be practicable under the FEIS's practicability analysis. Wilmington District's response to comments of Dr. Douglas Wakeman, FEIS J-V.B.2 Exh.F(R1).

The Wilmington District's determination that all practicable alternatives must provide 15 years of mining north of highway 33 is arbitrary and indefensible.

- As discussed above, based on the economic practicability analysis in the DEIS, SDEIS, and FEIS, the Wilmington District concluded that 7.5 years of mining north of NC Highway 33 during the initial 15 years of mining is practicable. In the FEIS, however, the Wilmington District introduced an arbitrary and indefensible requirement that alternatives must – in addition to providing 15 years of mining within PCS's historical operating cost – include at least 15 years of mining north of NC Highway 33 to be considered practicable. This requirement was not introduced or discussed in any of the discussions of the Review Team or in the DEIS or SDEIS.

- The decision to require 15 years of mining north of Hwy 33 is critical to the assessment of impacts on the aquatic ecosystem. Not only is the area north of Hwy 33 adjacent to the tidal creeks, primary nursery areas, a secondary nursery area, and the Pamlico River estuary, it includes more than 3,400 of the 3,953 acres of wetlands that PCS proposes to mine.

- The 15-year requirement added to the economic analysis in the FEIS is erroneously and arbitrarily based on the applicant's decision to initially apply for a 15 year permit.
  - The purpose and need only requires a long-term mine expansion, the Wilmington District has failed to explain why less than 15 years is not long-term.
  - The FEIS states that "the applicant demonstrated that . . . 15 years presents an adequate planning horizon," but does not demonstrate that less than 15 years is not an adequate planning horizon. FEIS 2-31.
  - PCS's current permit was issued in 1997 and the company has stated it will exhaust all ore under that plan in 2009. This conclusively demonstrates that the company can operate on a 12-year planning horizon.

- Alternative L is not the "least environmentally damaging practicable alternative" because the company can – at a minimum – operate on a 12-year planning horizon and has not demonstrated that less than 12 years is not sufficiently long term to meet the purpose and need.

- The 15-year requirement introduced in the FEIS is erroneously and arbitrarily based on the "cash cost model" that was specifically rejected by the Wilmington District in responses to comments in the FEIS.

    - Following the DEIS, PCS submitted a new "cash cost" model that "eliminates the amortization of [costs]" and posts those costs in "the actual years of expenditures." PCS comments on DEIS, FEIS J-VII.A.1.

    - The Wilmington District incorporated the "cash cost" model's findings into the FEIS's practicability analysis, adopting the applicant's contention that "an alternative must not involve the incurring of costs that are not recouped [within the first 15 years]." FEIS 2-30. To further clarify, the FEIS states "[t]he key factors that make AP practicable are that all costs associated with mining the 15-year period are recouped within the same 15 years and that the 15 years does not involve mining at unreasonable costs." FEIS 2-29.

    - The Wilmington District clearly used the "cash cost" model as the basis for Alternative L: "Alternative L was developed to . . . provide 15 years of mining with no substantial capital and/or development costs that was not recovered in the same period." Wilmington District's response to comments, FEIS J-V.B.2(R51).

    - In response to comments criticizing the "cash cost" model, the Wilmington District denounced the model as inappropriate and uninformative, but then admitted using it. The response states "the Corps determined that the [cash cost model] was not informative or appropriate; however, some information was relevant in the Corps approach to practicability . . . this information was used in the Corps approach to determining practicability." Wilmington District's response to comments, FEIS J-V.B.2(R71).

    - The Wilmington District repeatedly rejected the "cash cost" model that formed the basis for the 15-year requirement in the FEIS, stating:

        - "The Corps agrees that there is no rationale or benefit in adopting the 'Cash Cost' model." Wilmington District's response to comments J-V.B.3(R12).

        - "The Corps agrees that the 'cash cost' analysis further complicates the economic analysis of alternatives. The Corps has not used the cash cost analysis in its approach to determining alternative practicability." Wilmington District's response to comments, FEIS J-V.B.2(R50).

        - "After fully considering the appropriateness and relevance of the cash cost model data . . . the Corps finds that . . . the results are, at best uninformative in determining the practicability of alternatives." Wilmington District's response to comments of Dr. Douglas Wakeman, FEIS J-V.B.2 Exh.F(R1).

    - "The Corps finds the use of the "cash-cost" model data to be, at best, uninformative in determining alternative practicability." Wilmington District's response to comments of Dr. Douglas Wakeman, FEIS J-V.B.2 Exh.F(R5).

    - "The Corps has not used the cash cost analysis in its approach to determining alternative practicability therefore, we do not attempt to justify, clarify or defend its use." Wilmington District's response to comments of Dr. Douglas Wakeman, FEIS J-V.B.2 Exh.F(R1).

  - The Wilmington District's FEIS analysis ultimately relies on an indefensible, arbitrary finding that "there is no rationale or benefit in adopting the 'Cash Cost' model" yet that "some information" from that model "was relevant" and "was used in the Corps approach to determining practicability." This internally contradictory treatment of the "cash cost" model cannot be supported.

  - Further, the Wilmington District refused to respond to substantive comments on the economic practicability analysis used in the DEIS and SDEIS based on the premise that it had not altered the analysis:

    - "This comment letter contains several manipulations of cost data using cash cost and discounting techniques. The Corps has not used the cash cost analysis in its approach to determining alternative practicability therefore, we do not attempt to justify, clarify or defend its use. Comments relevant to the overall approach and NEPA/CWA are addressed." Wilmington District's response to comments of Dr. Douglas Wakeman, FEIS J-V.B.2 Exh.F(R1).

- The 15-year requirement introduced in the FEIS is erroneously and arbitrarily based on the Wilmington District's contradictory treatment of the practicability of mining in the S33 tract.

  - Mining in S33 was included in the development of alternatives because PCS contends that mining there will be practicable in the future.

    - "The applicant has also indicated that it believes the market will eventually become favorable [for mining in S33]; a reasonable position based on USGS information regarding the rate of depletion of domestic production capacity and the applicant's future shift to higher margin products. The Corps has determined that it is therefore appropriate to include [S33] in the evaluation." FEIS 2-26.

    - "The applicant has made clear its desire to mine the entire project area if suitable market conditions exist. The applicant has developed a master plan which details their preferred sequential progression for the accomplishment of this goal. The applicant has also made clear that, if granted a permit for the AP Alternative, it would then seek a permit to mine Bonnerton and S33." FEIS 2-9.

- The Wilmington District even added areas adjacent to S33 to alternatives because mining in S33 was presumed to be practicable: "The Corps, the Review Team and the applicant agreed that it was reasonable to include these areas since they were readily accessible from the S33 area and they increased the minable area without a significant increase in environmental or socioeconomic impact." FEIS 2-9.

- The Wilmington District's FEIS analysis rejects the very assumption that justified including mining in S33 in any alternative – that mining in S33 will be practicable – and arbitrarily concludes that future mining in S33 is impracticable. Although previously describing that assumption as "a reasonable" position – and relying on it to include S33 in Alternative L – the Wilmington District eliminated less environmentally damaging practicable alternatives based on an arbitrary, contradictory finding.

  - "[T]he lower cost depicted for the initial 6-7 years of mining in the S33 Tract are only realized if the entire alternative boundary within the S33 Tract is mined." FEIS 2-30. That finding should not limit the practicable alternatives analysis since the "applicant has also indicated" it will be able to mine the entire S33 Tract.

  - "The Corps finds that SCRA, SCRB, and SJAB are not practicable alternatives due to the required commitment to higher mining costs . . . without the expectation of fully recovering these development costs." FEIS 2-30.

  - "Alternatives that relocate into the S33 Tract within 15 years confront the applicant with a commitment to several years of mining at a cost not currently considered practicable. Therefore, alternatives that involve relocation to the S33 Tract within the initial 15 years are not practicable." FEIS 2-31.

- The Wilmington District arbitrarily contradicts itself in the practicability analysis, finding that mining in S33 is practicable for the purpose of including that tract in mine plans, but impracticable for purposes of the practicability determination. It is the same land, mined through the same process, during the same time period, thus its practicability must be the same throughout the analysis.

PCS'S PROPOSED MINE EXPANSION WOULD CAUSE UNACCEPTABLE ADVERSE HARM TO AQUATIC RESOURCES OF NATIONAL SIGNIFICANCE

The Albemarle-Pamlico Sound estuary and associated wetlands are aquatic resources of national importance.

- In the Water Quality Act of 1987, Congress directed that the Administrator of EPA give priority consideration to designation of Albemarle Sound as an estuary of national significance and to convene a management conference to develop a comprehensive management plan to recommend priority actions to restore and maintain water quality, fish and shellfish resources, wildlife, and recreational uses of the estuary. *33 U.S.C. 1330(a).*

- In October 1987, the State of North Carolina and Environmental Protection Agency designated Albemarle and Pamlico Sounds as an estuary of national significance and convened a management conference to assess trends in water quality and natural resources, determine the causes of changes, and develop a comprehensive management plan with recommendations for priority actions. *State/EPA Conference Agreement for National Estuary Program Designation Under the Water Quality Act of 1987 (NEP Designation).*

- Justifications for designation of Albemarle-Pamlico Sounds as an estuary of national significance include the following:

    - Declines in fisheries productivity including major declines in commercial fisheries. *NEP Designation at 5.*

    - Eutrophication from excessive nutrient inputs. *NEP Designation at 5-6..*

    - Habitat losses which "have greatly affected ecosystem functions of estuarine habitats and tightly-linked wetlands habitats. *NEP Designation at 6.*

- The Albemarle-Pamlico Sound management conference issued its comprehensive conservation and management plan in 1994. *Environmental and Economic Stewardship in the Albemarle-Pamlico Region – A Comprehensive Conservation and Management Plan 1994 (NEP Plan).* The Plan identifies goals and priority actions including the following:

    - Conserve and protect vital fish and wildlife habitats and maintain the natural heritage of the Albemarle-Pamlico Region. *NEP Plan at 23.* Identified vital habitats include rare natural communities, wetlands and primary nursery areas for fisheries. *NEP Plan at 24-25.* Protection rare natural communities "is vital to the survival of species and to the maintenance of the region's natural heritage. *NEP Plan at 24.* "North Carolina has lost more than 50 percent of its original 10 to 11 million wetland acres." *NEP Plan at 24.*

    - Promote the protection and conservation of valuable natural areas in the APES region. *NEP Plan at 28.*

    - Maintain, restore and enhance vital habitat functions to ensure the survival of wildlife and fisheries. *NEP Plan at 29.*

    - Enhance the ability of state and federal agencies to enforce existing wetlands regulations. *NEP Plan at 29.*

- Strengthen regulatory programs to protect vital fisheries habitats. *NEP Plan at 29.*

PCS proposes to mine substantial parts of the watersheds of five fishery nursery areas and impair the functions of these vital, priority habitats and aquatic resources of national significance.

- Primary fishery nursery areas "are of critical important to the propagation of over 75 species of fish and shellfish [in Albemarle-Pamlico Sound]. The functions of these nurseries can be impaired by freshwater drainage, land use changes, and excessive algal growth. Nursery areas are most threatened by nonpoint sources of pollution and by development on nearby lands." *NEP Plan at 25.*

- PCS proposes to mine substantial parts of the watersheds of four tidal creeks designated by the State of North Carolina as primary fishery nursery areas:

    - Porter Creek: 71% drainage basin reduction

    - Jacks Creek: 84% drainage basin reduction

    - Jacobs Creek: 75% drainage basin reduction

    - Tooleys Creek: 55% drainage basin reduction

- Primary nursery areas are "areas inhabited by embryonic, larval, or juvenile life stages of marine or estuarine fish or crustacean species due to favorable physical, chemical or biological factors." 15A NCAC 10C.0502.

- The EPA is not alone in determining that the proposed mine expansion will have unacceptable adverse effects on aquatic resources of national importance. State and federal agencies alike have opposed impacts like those proposed under Alternative L throughout the permitting process.

    - "Such large-scale wetland impacts located directly adjacent to the Pamlico River . . . will act to exacerbate the impacts of eutrophication while altering local food web stability; both of which have important implications for estuarine productivity." U.S. Fish and Wildlife Service comments on DEIS and SDEIS, FEIS J-III.A.4.

    - "Both Alternative L and Alternative M . . . would indirectly impact estuarine habitats associated with South Creek, Pamlico River, Durham Creek, and Porter Creek." Therefore, "[m]ining activities within the NCPC and Bonnerton tracts shall not be authorized." National Marine Fisheries Service comments on SDEIS, FEIS J-III.B.3.

    - "Overall, the Division of Coastal Management has serious concerns regarding the two new alternatives described in the SDEIS as well as the prior alternatives in the DEIS because of their significant adverse impacts to the environment." North Carolina Division of Coastal Management comments on SDEIS, FEIS J-IV.B.3.

- "All the examined alternatives [in the SDEIS] would have significant adverse impacts on water quality, estuarine resources, wetlands, and public trust waters." North Carolina Division of Marine Fisheries comments on SDEIS, FEIS J-IV.B.7.

- "[W]e recommend that neither the AP, EPA, SCR, or SJA alternatives be considered as appropriate mining options on the NCPC tract because of significant degradation of fish and wildlife resources and the inability to provide adequate compensatory mitigation." North Carolina Wildlife Resources Commission comments on DEIS, FEIS J-IV.A.10.

- "Losses of these non-coastal wetlands and waters will affect downstream coastal waters and public trust resources under the jurisdiction of the [Marine Fisheries Commission]. . . . The additional proposed loss of headwaters wetlands would add to the significance of habitat losses that affect coastal fisheries production." North Carolina Marine Fisheries Commission comments on DEIS, FEIS J-IV.A.11.

- PCS contends that a report by its consultant ENTRIX establishes that mining the headwaters and dramatically reducing the drainage basins of tidal creeks and primary nursery areas will have "no significant indirect effects" on the downstream waters and aquatic ecosystem. While generally attempting to diminish the importance of headwaters to downstream waters in advocating for mining these areas, PCS proposes to do all its proposed compensatory mitigation in headwaters areas of watersheds significantly inland from the estuary.

- The Pamlico-Tar River Foundation and other agencies have submitted comments to the Wilmington District explaining why the conclusions in the ENTRIX report are misplaced. Key shortcomings of the report include:

    - A fundamental shortcoming of the ENTRIX report is that is selects data from studies not designed to assess the effects of drainage basin reduction to draw conclusions about the effects of drainage basin reductions and support unsubstantiated claims that mining through headwaters of estuarine creeks will have no discernable effects on the function of those creeks as primary nursery areas. *See, e.g., Rulifson 1991 (study of finfish utilization of man-initiated and natural wetlands); West (2000) (study comparing created marshes to natural marshes).*

    - In assessing the potential impacts of drainage basin reductions, the ENTRIX report fails to examine or evaluate the full range of potential effects of substantial drainage basin reductions on downstream estuarine systems, including organic carbon export, fishery productivity, biogeochemical processes, and overall ecological integrity, which are important factors which must be assessed to determine significant degradation under the 404(b)(1) guidelines.

- The ENTRIX report's reliance on a created marsh system with a limited drainage basin to draw conclusions about the effects of substantial drainage basin reductions on a natural creek and marsh system is inappropriate. Moreover, this study postulated that a primary factor in the faunal characteristics of the created system was that it was surrounded by aquatic systems it was intended to mimic, thereby providing sources of infaunal recruits. There is no assessment of the cumulative effects of substantial drainage basin reductions of all the creeks and primary nursery areas on the western shore of South Creek, as proposed by PCS.

PCS proposes to mine 3,953 acres of wetlands adjacent and linked to primary fishery nursery areas and other waters of the Pamlico estuary, including nonriverine hardwood forests designated by the State of North Carolina to be of national ecological significance.

- The Albemarle-Pamlico Sound designation identifies loss of wetlands as a priority environmental concern and enhancing protection of remaining wetlands as a priority action. *NEP Designtion at 6 and NEP Plan at 29.*

- The PCS proposal to mine and destroy 3,953 acres of wetlands, if authorized, would constitute the largest permitted destruction of wetlands in the Albemarle-Pamlico watershed and in the State of North Carolina.

- PCS proposes to mine parts of the Bonnerton nonriverine wet hardwood forest.

- NatureServe ranks nonriverine wet hardwood forests as a G2 or globally imperiled natural community, meaning there are between only 5 and 20 viable sites remaining. *See www.NatureServe.org/Explorer* (Ecological System ID: CES203.304, *Quercus michauxii - Quercus pagoda / Clethra alnifolia - Leucothoe axillaris* Forest). The remaining nonriverine wet hardwood forests are among the most scarce and endangered wetland systems in the United States and an aquatic resource of national importance.

- The North Carolina Natural Heritage Program was established by the North Carolina General Assembly to "include classification of natural heritage resources, an inventory of their locations, and a data bank for that information." "Information from the natural heritage data bank may be made available to public agencies and private persons for environmental assessment and land management purposes." NCGS 113A-164.4.

- The North Carolina Natural Heritage Program has designated the Bonnerton nonriverine wet hardwood forests as a natural community of national significance as one of the five best remaining examples of this type of wetland in the world. *Schafale, Nonriverine Wet Hardwood Forests in North Carolina – Status and Trends, January 2008.*

- The North Carolina Division of Water Quality has designated the Bonnerton nonriverine wet hardwood forests as a wetland of state or national ecological significance under wetland water quality standards. *401 Certification; 15A NCAC 2H.0506(e).* Activities that would alter wetlands of state or national ecological significance may only be authorized if the activities are for a public purpose. *15A NCAC 2H.0506(e).*

- The primary conclusion of PCS's consultant Dr. James Gregory, in his "rapid forest assessment," is that Dr. Schafale's determination that the Bonnerton tract is a nonriverine wet hardwood forest is incorrect. Dr. Schafale conducted a detailed examination of the site. Dr. Schafale also co-authored the accepted scientific report defining the nonriverine wet hardwood forest natural community (cited by Dr. Gregory). *See Schafale and Weakley, Classification of the Natural Communities of North Carolina 1990.* In sum, Dr. Gregory, a watershed hydrology consultant, contends Dr. Schafale, the Plant Community Ecologist with the North Carolina Natural Heritage Program who wrote the accepted definition and description of a nonriverine wet hardwood forest, did not, after carefully examining the Bonnerton tract, correctly determine it is a nonriverine wet hardwood forest. Not only did Dr. Schafale correctly determine the tract is a nonriverine wet hardwood forest, he concluded it is one of the best five remaining examples of the imperiled natural community remaining.

- To support his contentions, Dr. Gregory cites the definition of nonriverine wet hardwood forest in the EPA/Corps guidance on silvicultural activities but overlooks, or fails to note, footnote 7 which clearly states that the definition used for this forest type in the guidance is "a subset of those described in Schafale and Weakley, 1990." There is no requirement in Schafale and Weakley that a nonriverine wet hardwood forest have a greater than 50% basal area per acre of oak species. *EPA and Corps, Application of Best Management Practices to Mechanical Silvicultural Site Preparation Activities for the Establishment of Pine Plantations in the Southeast 1995.*

PCS's proposed mitigation will not offset the unacceptable adverse impacts to aquatic resources of national importance.

- Unacceptable adverse effects means impact on an aquatic or wetland ecosystem which is likely to result in significant degradation of ... or significant loss of or damage to fisheries, shellfishing, or wildlife habitat or recreational areas. In evaluating the unacceptability of such impacts, consideration should be given to the relevant portions of the section 404(b)(1) guidelines. 40 C.F.R. § 231.2(e).

- Under the 404(b)(1) guidelines, compensatory mitigation is only appropriate for unavoidable wetland impacts. 40 C.F.R. § 230.10(a). Practicable alternatives exist that would avoid wetlands and impacts to primary nursery areas and Bonnerton nonriverine wet hardwood forests.

- Under the 404(b)(1) guidelines, even if no practicable alternative exists, no discharge of dredged or fill material shall be permitted which will cause or contribute to significant degradation of waters of the United States. 40 C.F.R. § 230.10(c). In addition, no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem. 40 C.F.R. § 230.10(d).

- Significant adverse impacts to the tidal creeks and primary nursery areas include significantly adverse effects on fish, wildlife and special aquatic sites; significantly adverse effects on life stages of aquatic life and wildlife dependent on aquatic ecosystems; significantly adverse effects on aquatic ecosystem diversity, productivity and stability; and significantly adverse effects on recreational and economic values. 40 C.F.R. § 230.10(c).

- None of the proposed compensatory mitigation for any of the adverse effects to the tidal creeks and primary nursery areas will be conducted within the immediate watersheds of these tidal creeks and primary nursery areas, resulting in unmitigated significant degradation of these aquatic resources of national importance.

- PCS inappropriately relies on proposed compensatory mitigation in the headwaters far removed from the estuary to mitigate the significant adverse effects of its mining operations on the tidal creeks and primary nursery areas and connected wetlands in the immediate watersheds that will be destroyed and severely degraded by its proposed mine plan.

- Destruction of the Bonnerton nonriverine wet hardwood forest will result in significantly adverse effects on a special aquatic site; adverse effects on aquatic ecosystem diversity, productivity and stability; and unmitigated significant degradation of an aquatic resource of national importance.

- Federal and state agencies agree that PCS has not provided adequately detailed mitigation plans and the mitigation it has proposed will not offset the proposed impacts:

    - "[T]he proposed compensatory mitigation is insufficient to offset adverse impacts to the aquatic environment except in the area south of Hwy 33." U.S. Fish and Wildlife Service comments on DEIS, FEIS J-III.A.4.

    - "The applicant's historical performance to ensure that adequate mitigation occurs for past mining efforts precludes NMFS from having reasonable assurance at this time that impacts from mining the NCPC tract will be satisfactorily mitigated." National Marine Fisheries Service comments on DEIS, FEIS J-III.A.6

    - "[T]he applicant has not developed a compensatory mitigation plan and, instead, continues to offer only a general strategy . . . we do not believe that the applicant has demonstrated that sufficient mitigation will be provided in a timely manner for the proposed project." National Marine Fisheries Service Comments on SDEIS, FEIS J-III.B.3.

- "Detailed mitigation plans must be provided in the final EIS, with adequate opportunity for thorough review." North Carolina Division of Marine Fisheries comments on DEIS, FEIS J-IV.A.8
- "Detailed mitigation plans need[] to be provide[d] in the final EIS." North Carolina Division of Marine Fisheries comments on SDEIS, FEIS J-IV.B.7.
- "[W]e conclude adequate mitigation in NCPC and Bonnerton has not been proposed." North Carolina Wildlife Resources Commission comments on DEIS, FEIS J-IV.A.10.
- "A detailed mitigation plan for permittable impacts has not been addressed." North Carolina Wildlife Resources Commission comments on DEIS, FEIS J-IV.B.11.

"Robert K. Peet"
<uniola@email.unc.edu>
04/26/2009 10:05 PM

To Palmer Hough/DC/USEPA/US@EPA
cc Mike Shapiro/DC/USEPA/US@EPA, Stan Meiburg/R4/USEPA/US@EPA, Jim Giattina/R4/USEPA/US@EPA, Gregory
bcc
Subject Letter pertaining to PCS Phosphate permit

I attach a signed letter, the text of which follows

April 26, 2009

US Army Corps of Engineers
Terrence C. Salt
Principal Deputy Assistant Secretary of the Army (Civil Works)

Dear Sir:

It is our understanding that the US Army Corps of Engineers and the US Environmental Protection Agency are considering whether PCS Phosphate should be permitted to mine a tract of Nonriverine Wet Hardwood Forest (Schafale & Weakley 1990; 198-199) in Beaufort County, North Carolina. We are botanists and ecologists who focus much of our work on the natural communities of North Carolina. We have reviewed materials prepared by the North Carolina Natural Heritage Program on the Nonriverine Wet Hardwood Forest community and the tract of Nonriverine Wet Hardwood Forest proposed for mining. We have individually worked with the North Carolina Natural Heritage Program for many years and consider the program to be the most authoritative, scientific and unbiased source of information in North Carolina on rare or endangered plants, animals and natural communities. Based on this information, and our individual knowledge of this natural community type, we strongly encourage the responsible federal agency to provide the maximum protection afforded by applicable laws and regulations to all remaining significant examples of Nonriverine Wet Hardwood Forests.

Nonriverine Wet Hardwood Forests are wetland communities occurring on poorly drained mineral soils in broad inter-stream flats more generally associated with peat-lands on the Atlantic Coastal Plain. These distinctive natural communities have a climax canopy with oak species (Quercus michauxii, Q. laurifolia, Q. pagoda) typically associated with bottomland hardwoods and an understory and herb layer consisting of plants more associated with pocosin wetlands (e.g., Persea palustris, Clethra alnifolia) (Schafale and Weakley 1990 Classification of the natural communities of North Carolina. NC Natural Heritage Program , Rheinhardt and Rheinhardt 2000 J. Torrey Bot. Soc 127:33). The hydrology of these wetland systems is driven by seasonal fluctuations in the water table, with the plant community adapted to seasonally high water table conditions. Because Nonriverine Wet Hardwood Forests occur on mineral soils suitable for agricultural, silvicultural and other uses, this distinctive wetland community has been much reduced in extent through hydrological modification and conversion to other land uses. In 1897, Ashe and Pinchot reported that this community type was common. In 1982, Peacock and Lynch reported that it was one of the most threatened community types on the NC Coastal Plain. Between 1998 and 2006, 42% of the remaining acreage of this community type was destroyed (M. Schafale, personal communication). The North Carolina Natural Heritage Program is aware of only a few scattered remaining tracts of Nonriverine Wet Hardwood Forests, all in North Carolina and Virginia. Only five of these sites in NC comprise 200 acres or more. The PCS Bonnerton Road site is one of those five.

NatureServe classifies Nonriverine Wet Hardwood Forests as a G2 or globally imperiled natural community, meaning that there are between 5 and 20 viable sites left, and all of these are considered threatened. Clearly, this is one of the most imperiled wetland types in the United States, and all efforts should be made to protect the remaining significant examples by management on public lands, acquisition, and/or regulatory means.

The remaining significant Nonriverine Wet Hardwood Forest sites are important for preservation of our natural biodiversity as well as scientific research and education. We are not aware of any successful efforts to restore a Nonriverine Wet Hardwood Forest that has been converted to another more intensive land use. While restoration efforts may be attempted in the future, loss of the few remaining significant sites jeopardizes even having adequate reference and study sites to guide future restoration efforts.

In summary, Nonriverine Wet Hardwood Forests are an exceedingly rare natural community unique to NC and adjacent VA. They are globally imperiled as a result of hydrologic modification and conversion to other more intensive land uses. We strongly encourage the federal agencies responsible for insuring protection of the nation's wetlands and aquatic ecosystems to provide the maximum protection the law affords to preservation of this imperiled natural community.

We appreciate the opportunity to provide these comments.

Robert K. Peet
Professor of Biology, University of North Carolina at Chapel Hill
President, International Association for Vegetation Science

Alan S. Weakley,
Curator Univ. North Carolina Herbarium, North Carolina Botanical Garden
[former] Chief Ecologist, The Nature Conservancy
[former] Chief Ecologist, NatureServe

Peter S. White
Director, North Carolina Botanical Garden
Professor of Biology, University of North Carolina at Chapel Hill

Norman L. Christensen
Professor of Ecology (and formerly Dean), Nicholas School of the
Past President, Ecological Society of America

==
Robert K. Peet, Professor — Phone: 919-962-6942
Department of Biology, CB#3280 — Fax: 919-962-6930
University of North Carolina — Cell: 919-368-4971
Chapel Hill, NC 27599-3280 USA — Email: peet@unc.edu
http://www.bio.unc.edu/faculty/peet/

EPA.pdf

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

COLLEGE OF ARTS AND SCIENCES
DEPARTMENT OF BIOLOGY

ROBERT K. PEET, PROFESSOR
DEPARTMENT OF BIOLOGY
COKER HALL, CAMPUS BOX 3280
CHAPEL HILL, NC 27599-32780 USA

PHONE: 919-962-6942
FAX: 919-962-6930
EMAIL: peet@unc.edu
WEB: http://www.bio.unc.edu/faculty/peet/

April 26, 2009

Palmer F. Hough
US Environmental Protection Agency, Wetlands Division

Dear Sir:

It is our understanding that the US Army Corps of Engineers and the US Environmental Protection Agency are considering whether PCS Phosphate should be permitted to mine a tract of Nonriverine Wet Hardwood Forest (Schafale & Weakley 1990; 198-199) in Beaufort County, North Carolina. We are botanists and ecologists who focus much of our work on the natural communities of North Carolina. We have reviewed materials prepared by the North Carolina Natural Heritage Program on the Nonriverine Wet Hardwood Forest community and the tract of Nonriverine Wet Hardwood Forest proposed for mining. We have individually worked with the North Carolina Natural Heritage Program for many years and consider the program to be the most authoritative, scientific and unbiased source of information in North Carolina on rare or endangered plants, animals and natural communities. Based on this information, and our individual knowledge of this natural community type, we strongly encourage the responsible federal agency to provide the maximum protection afforded by applicable laws and regulations to all remaining significant examples of Nonriverine Wet Hardwood Forests.

Nonriverine Wet Hardwood Forests are wetland communities occurring on poorly drained mineral soils in broad inter-stream flats more generally associated with peat-lands on the Atlantic Coastal Plain. These distinctive natural communities have a climax canopy with oak species (*Quercus michauxii, Q. laurifolia, Q. pagoda*) typically associated with bottomland hardwoods and an understory and herb layer consisting of plants more associated with pocosin wetlands (e.g., *Persea palustris, Clethra alnifolia*) (Schafale and Weakley 1990 Classification of the natural communities of North Carolina. NC Natural Heritage Program , Rheinhardt and Rheinhardt 2000 J. Torrey Bot. Soc 127:33). The hydrology of these wetland systems is driven by seasonal fluctuations in the water table, with the plant community adapted to seasonally high water table conditions. Because Nonriverine Wet Hardwood Forests occur on mineral soils suitable for agricultural, silvicultural and other uses, this distinctive wetland community has been much reduced in extent through hydrological modification and conversion to other land uses. In 1897, Ashe and Pinchot reported that this community type was common. In 1982, Peacock and Lynch reported that it was one of the most threatened community types on the NC Coastal Plain. Between 1998 and 2006, 42% of the remaining acreage of this community type was destroyed (M. Schafale, personal communication). The North Carolina Natural Heritage Program is aware of only a few scattered remaining tracts of Nonriverine Wet Hardwood Forests, all in North Carolina and Virginia. Only five of these sites in NC comprise 200 acres or more. The PCS Bonnerton Road site is one of those five.

NatureServe classifies Nonriverine Wet Hardwood Forests as a G2 or globally imperiled natural community, meaning that there are between 5 and 20 viable sites left, and all of these are considered threatened. Clearly, this is one of the most imperiled wetland types in the United States, and all efforts should be made to protect the remaining significant examples by management on public lands, acquisition, and/or regulatory means.

The remaining significant Nonriverine Wet Hardwood Forest sites are important for preservation of our natural biodiversity as well as scientific research and education. We are not aware of any successful efforts to restore a Nonriverine Wet Hardwood Forest that has been converted to another more intensive land use. While restoration efforts may be attempted in the future, loss of the few remaining significant sites jeopardizes even having adequate reference and study sites to guide future restoration efforts.

In summary, Nonriverine Wet Hardwood Forests are an exceedingly rare natural community unique to NC and adjacent VA. They are globally imperiled as a result of hydrologic modification and conversion to other more intensive land uses. We strongly encourage the federal agencies responsible for insuring protection of the nation's wetlands and aquatic ecosystems to provide the maximum protection the law affords to preservation of this imperiled natural community.

We appreciate the opportunity to provide these comments.

Robert K. Peet
Professor of Biology, University of North Carolina at Chapel Hill
President, International Association for Vegetation Science

Alan S. Weakley,
Curator University of North Carolina Herbarium, North Carolina Botanical Garden
[former] Chief Ecologist, The Nature Conservancy
[former] Chief Ecologist, NatureServe

Peter S. White
Director, North Carolina Botanical Garden
Professor of Biology, University of North Carolina at Chapel Hill

Norman L. Christensen
Professor of Ecology (and formerly Dean), Nicholas School of the Environment, Duke University
Past President, Ecological Society of America

Rebecca Fox /R4/USEPA/US
04/30/2009 04:24 PM

To "Heather" <riverkeeper@ptrf.org>
cc
bcc
Subject Re: support letters from fws and nmfs on elevation

Here you go. bf

NMFS_PCSPhosphateCorp_200110096_3(d).pdf FWS_20090416_3f1_withdraw_no_attachments.pdf

Becky Fox
Wetland Regulatory Section
USEPA
Phone: 828-497-3531
Email: fox.rebecca@epa.gov
"Heather" <riverkeeper@ptrf.org>

"Heather"
<riverkeeper@ptrf.org>
04/30/2009 02:13 PM

To Rebecca Fox/R4/USEPA/US@EPA
cc
Subject support letters from fws and nmfs on elevation

Becky,

Do you have copies that you could forward on the letters sent from FWS and NMFS in support of EPA's elevation?

Thanks.

Heather Jacobs Deck
Pamlico-Tar Riverkeeper
Pamlico-Tar River Foundation
Phone: (252) 946-7211
Cell: (252) 402-5644
Fax: (252) 946-9492
www.ptrf.org
Waterkeeper Alliance Member

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
(727) 824-5317; FAX (727) 824-5300
http://sero.nmfs.noaa.gov/

APR 17 2009

F/SER4:RS/pw

Colonel Jefferson Ryscavage
District Engineer, Wilmington District
Department of the Army, Corps of Engineers
Regulatory Division
P. O. Box 1890
Wilmington, North Carolina 28402-1890

Attention: Tom Walker

Dear Colonel Ryscavage:

NOAA's National Marine Fisheries Service (NMFS) reviewed the letter dated March 30, 2009, from the Corps of Engineers, Wilmington District (COE) which NMFS received April 2, 2009, concerning the COE's Final Environmental Impact Statement (FEIS) "*Potash Company of Saskatchewan, Inc. (PCS) Phosphate Mine Continuation at Aurora in Beaufort County, North Carolina*" (Action ID No. 200110096). The COE's letter, which included a draft Record of Decision and draft permit conditions, indicates that the COE concludes that issuance of a permit for the modified Alternative L alignment would not result in substantial and unacceptable impacts to aquatic resources of national importance, and based on the compensatory mitigation that would be required by the permit, adverse impacts to essential fish habitat (EFH) would not occur from the project. The letter was provided to NMFS in accordance with Part IV, Section 3(c)(2) of the 1992 Memorandum of Agreement between the Departments of Commerce and Defense regarding Clean Water Act section 404(q) and in accordance with 50 CFR Part 600, which describes how federal agencies will coordinate to protect, conserve, and enhance EFH. The comments below summarize NMFS' principal concerns, including areas where NMFS continues to differ with the COE regarding the impacts expected to result from the project. However, in light of factors described below as well as constraints on staff time, NMFS will not appeal the COE's decision under the terms of the 1992 Memorandum of Agreement. This letter therefore constitutes NMFS' response to the COE in accordance with Part IV, Section 3(d)(1) of the Memorandum of Agreement that NMFS will not request higher level review.

Previous letters from NMFS and the Wilmington District describe the project, list project authorities, review consultation history, and identify the expected impacts to EFH and fishery species. Throughout the review process, NMFS consistently focused on the project's likelihood of degrading the nationally significant fish and wildlife resources of the Albemarle-Pamlico Estuary Complex (APEC) within which the proposed mine expansion is located. The review process identified at least 11 action alternatives for consideration; the COE has concluded that Modified Alternative L represents the least environmentally damaging practicable alternative (LEDPA) for PCS to expand its mine. This alternative includes mining within three tracts referred to as NCPC, Bonnerton, and S33. Modified Alternative L would impact 11,909 acres, including approximately 3953 acres of jurisdictional wetlands and 25,727 feet of streams. In comparison to other alternatives, Modified Alternative L would avoid direct impacts to 141 acres of EFH that includes wetlands associated with South Creek within the NCPC tract and Porter Creek within the Bonnerton tract. NMFS' comments are divided into three sections: (1) identification of EFH; (2) sequential mitigation; and (3) monitoring and adaptive management.

Identification of EFH
The Bonnerton and NCPC tracts include tidally influenced forested wetlands, creeks, and salt marsh designated as EFH by the South Atlantic Fishery Management Council and Mid Atlantic Fishery Management Council for federally managed fishery species, including penaeid shrimp, gray snapper, summer flounder, and bluefish. A subset of the areas designated as EFH is recognized by the North Carolina Wildlife Resources Commission (NCWRC) as inland Primary Nursery Areas (PNAs). Pursuant to the designations of EFH by the Councils, PNAs are also designated as Habitat Area of Particular Concern (HAPC), the subset of EFH that warrants the highest protection under the Magnuson-Stevens Act. The PNAs within the project area are Porter Creek, Tooley Creek, Jacobs Creek, and Jacks Creek. The latter three creeks empty into South Creek, which is designated a Special Secondary Nursery Area by the State of North Carolina and is also designated as an HAPC.

As acknowledged in past correspondence from both of our offices, the upper limits of PNAs has not been delineated in the field. In the absence of this delineation, the COE referenced the North Carolina state statute that defines PNAs, and the COE concluded the upper limit of the PNAs equates to the boundary between perennial and intermittent flows within the creeks named as PNAs. The Modified Alternative L for the proposed mine expansion avoids direct impacts to PNAs under this definition. While NMFS believes that substantial ecological services are provided to fishery resources from the portions of the creeks that have intermittent flows and from their headwater wetlands, NMFS accepts the COE's interpretation of the relevant North Carolina state statute as reasonable. As a result of close coordination among the applicant, resource agencies, and the COE, NMFS has determined direct impacts to HAPCs are no longer likely.

Sequential Mitigation
Avoidance and Minimization of Impacts
The LEDPA must be identified before evaluating compensatory mitigation. The US Environmental Protection Agency (EPA) contends in its comments on the EIS and subsequently submitted materials that Alternative L/Modified Alternative L is not the

LEDPA because there are less environmentally damaging alternatives. The COE contends that the less environmentally damaging alternatives are not practicable, and that Alternative L (according to the FEIS) and Modified Alternative L (according to the ROD) is the LEDPA. Both agencies maintain their economic analysis is thorough and appropriately peer reviewed within their respective agency. Given the significant differences in the outcomes of these analyses and that the COE is proposing to authorize the largest wetland destruction within North Carolina under the Clean Water Act, an external peer review is clearly needed to provide the public with assurance that the laws and programs put in place to protect public trust resources, such as APEC, were rigorously followed. NMFS recommends the COE conduct this review even if it is done after a final decision on the application from PCS is rendered, because the different approaches that EPA and the Wilmington District took in their respective analysis will likely trigger substantive disagreements on future projects.

Relative to alternatives earlier promoted by the applicant, Modified Alternative L reflects avoidance and minimization of direct impacts to wetlands that NMFS believes represent the higher value to fishery species. While these steps are noteworthy, additional avoidance and minimization appear practicable. On March 30, EPA, NMFS, and the US Fish and Wildlife Service proposed to the COE and applicant an alternative boundary for the mine. In addition to reducing impacts to habitats that support nursery areas, this alternative would provide opportunities for on-site compensatory mitigation to be pursued within PNAs. NMFS believes this alternative would benefit fishery resources within South Creek as well as the larger APEC. The applicant expressed a desire to review the new alternative and noted that its evaluation could take a month or longer. NMFS recommends the COE withhold its final determination on the application until the applicant's review is complete and vetted through resource agencies and stakeholders. At the very least, NMFS continues to recommend exclusion from the mine seven areas totaling approximately 50 acres that serve as headwaters of tidally influenced creeks which NMFS believes are significant nursery areas for fishery species.

Functional Assessment of the Compensatory Mitigation
The mitigation plan (FEIS Appendix I) involves multiple sites and strategies to compensate for the ecosystem services lost over the life of the project. The proposed restoration efforts primarily focus on croplands and drained forested wetlands underlain by hydric soils which, therefore, are expected to be good candidates for wetland restoration. The proposed mitigation would occur at sites south of the Pamlico River (primarily south, east, and west of the S33 tract) and at sites north of the Pamlico River. Under the plan, 7968, 756, and 2472 acres of wetlands would be restored, enhanced, and preserved, respectively. To guide their evaluation of the proposed compensatory mitigation, replacement-to-loss ratios used by the COE are 2:1 for restoration, 3:1 for enhancement, and 8:1 to 10:1 for preservation. The replacement ratio used for determining stream replacement is 1.8:1. In this regard, it is important to note that 71 percent of the NCPC tract, 76 percent of the Bonnerton tract, and 20 percent of the S33 tract are wetlands. By 2011, the applicant plans to complete construction of all the compensatory mitigation projects needed to offset the losses from mining the NCPC and Bonnerton tracts. To implement this schedule, the applicant has expended considerable

effort to identify, acquire, and develop off-site mitigation through restoration of previously impacted waters and wetlands.

The applicant's proposal to provide mitigation up front and on an ambitious schedule is commendable. While tallies summarizing the overall mitigation are persuasive, NMFS believes a quantitative, functional assessment, using a habitat equivalency analysis or a similar method, should be performed. Decisions relying mostly upon best professional judgment should be avoided for a project of this scale and significance of potential impacts. While a formal, functional assessment would also rely upon best professional judgment, it would do so in a manner that greatly increases precision (in the sense of repeatability) and transparency, identifies and quantifies uncertainties and assumptions, facilitates sensitivity analyses, includes benefits from reclamation, and establishes key milestones for use in an adaptive management program that ultimately focuses on whether the compensatory mitigation yields ecological services to South Creek, Durham Creek, and Pamlico River on a scale commensurate with the losses at Jack, Jacob, Tooley, Porter, and other creeks within the NCPC and Bonnerton tracts. A formal functional assessment would also clarify whether wetlands within the subset of the Bonnerton tract, which is a nationally significant Natural Heritage Area, can be mitigated and, if so, at what relative cost.

Monitoring and Adaptive Management

Monitoring

NMFS remains concerned about the loss of headwater wetlands associated with PNAs under the Modified Alternative L alignment. Based on input regarding the designation of these areas as HAPCs, PCS agreed to avoid direct impacts to these creeks. However, as noted by the COE, resource agencies, and NOAA's Center for Coastal Fisheries and Habitat Research (Beaufort Laboratory), substantial indirect impacts to PNAs and other tidal creeks would result from the proposed loss of headwater wetlands and intermittent streams on the NCPC and Bonnerton tracts. To address this concern, NMFS recommended that prior to initiation of land clearing activities in the headwater wetlands of state-designated nursery areas located along the NCPC shoreline of South Creek, PCS develop a plan of study to address the effects of a reduction in headwater wetlands on the utilization of these nursery areas by resident fish and invertebrates. In these systems, resident fish and invertebrates are important prey for estuarine-dependent species that seasonally frequent estuarine creeks during sub-adult development stages. Monitoring changes in these populations should prove a reasonable indicator of the effect of losses of headwater wetland on changes in resident species that support the nursery area function of these creeks. NMFS is pleased to see that the draft permit conditions require, within six months of permit issuance, development of a detailed plan for such a monitoring program. NMFS offers to continue to work with the COE, PCS, and other interested parties to further refine these conditions into a detailed plan.

Adaptive Management

The scales of the proposed mine and compensatory mitigation are large and the impacts and benefits that would actually accrue from these actions (as opposed to predicted to accrue) are subject to variables that can only generally be forecasted at the time of a permit decision. Proper and timely execution of the monitoring programs followed by responsive adjustments of mining and mitigation plans would be essential to ensure expansion of the PCS mine under Modified Alternative L is done in a manner that is in the public interest. Requiring the applicant to adhere to a process that allows the COE and resource agencies to substantively engage in the oversight of the project, and in adjustments to project design, is necessary for NMFS to have reasonable assurance that impacts to NOAA trust resources would be adequately compensated.

NMFS is pleased to see that the draft permit conditions require the applicant to establish an independent panel of scientists and engineers to annually review the project and determine if direct and indirect impacts and benefits are accruing at the rates forecasted at the time of a project authorization. Data and reports should be placed in a publicly accessible location, such as a website, and be freely available. The panel will also annually provide the COE and applicant with recommended changes to the mining and mitigation that are necessary to bring the project into alignment with expectations. NMFS offers to continue to work with the COE, PCS, and other interested parties to further refine and implement the adaptive management plan, should a permit be issued.

Thank you for the opportunity to provide these comments. Related questions or comments should be directed to the attention of Mr. Ronald Sechler at our Beaufort Field Office, 101 Pivers Island Road, Beaufort, North Carolina 28516-9722, or at (252) 728-5090.

Sincerely,

Roy E. Crabtree, Ph.D.
Regional Administrator

cc:

FWS, Mike_Wicker@usfws.gov
EPA, Becky.Fox@epa.gov
SAFMC, Roger.Pugliese@safmc.gov
NCDCM, Doug.Huggett@ncmail.net
NCDMF, Sara.Winslow@ncmail.net
F/SER4, Miles.Croom@noaa.gov
F/SER47, Ron.Sechler@noaa.gov, Pace.Wilber@noaa.gov

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1875 Century Boulevard
Atlanta, Georgia 30345

In Reply Refer To:
FWS/R4/ES

APR 16 2009

Colonel Jefferson M. Ryscavage
District Engineer, Wilmington District
U.S. Army Corps of Engineers
69 Darlington Avenue
Wilmington, North Carolina 28403-1343

RE: Department of Army Permit AID 200110096, Potash Corporation of Saskatchewan Phosphate Division, Aurora Operation (PCS) Mine Continuation

Dear Colonel Ryscavage:

This letter is provided under Part IV, paragraph 3(f)(1), of the 1992 Memorandum of Agreement (MOA) between the Department of the Interior and the Department of Army, under Clean Water Act (CWA) Section 404(q). The Fish and Wildlife Service (Service) has decided not to seek higher level review of the proposed decision by the Army Corps of Engineers' Wilmington District to issue a CWA Section 404 permit to the Potash Corporation of Saskatchewan, Phosphate Division, Aurora Operation. Nonetheless, the Service has substantial unresolved concerns regarding the proposed project and our decision to not seek higher level review is not an indication that these concerns have been resolved. The Service fully concurs with and supports the concerns expressed by the U.S. Environmental Protection Agency in their letter to the Assistant Secretary of the Army (Civil Works)(ASA (CW)) dated April 3, 2009.

The Wilmington District (District) issued a Notice of Intent to Proceed letter regarding this permit under paragraph 3(c)(3) of the MOA on March 2, 2009; this letter was received by our Southeast Regional Office on March 5, 2009. The proposed project is an expansion of the mine's 1997 CWA permit. The expansion, as currently proposed, will impact 3,953 acres of wetlands and 25,727 linear feet of streams, including a portion of a Significant Natural Heritage Area designated as "nationally significant." In addition, the project is adjacent to the Pamlico River and will result in a loss of approximately 70 percent of the watersheds of the project area streams which drain to the Albemarle-Pamlico Estuary Complex.

The March 2, 2009, Notice of Intent to Proceed letter included some provisions intended to minimize impacts through project footprint reduction and increase compensatory mitigation. The Wilmington District concluded that these provisions would adequately address our concerns for the project. Both the Service's Raleigh, North Carolina Field Office and Southeast Regional Office staff carefully considered these measures, and responded on March 20, 2009, pursuant to

Part IV, paragraph 3(d)(2) of the 1992 MOA. That response stated that the Service does not concur that our concerns have been adequately addressed.

Pursuant to Part IV, paragraph 3(f) of the 1992 MOA, the Department of the Interior had until April 9, 2009, to notify the ASA (CW) that the Department of the Interior was requesting higher level review. On April 3, 2009, the District provided the Service with an 80-page draft Record of Decision containing information not previously reviewed by the Service. In response the Service requested, via a letter dated April 8, 2009, an extension of the MOA timeframe in order to allow a review of the new information. The Corps denied that request, and the Service was unable to complete its review within the timeframe prescribed by the MOA.

In our continuing effort to assist the Corps in making a timely decision in this matter, we have completed an expedited review of the draft Record of Decision. We note the draft Record of Decision contains the same flaws the Service previously noted in the Final Environmental Impact Statement (FEIS). Specifically, it is our opinion that the Corps has consistently drawn inappropriate conclusions from limited data that are contrary to, and not supported by, the vast body of knowledge regarding the functioning of estuarine systems.

The FEIS, the March 2, 2009, Notice of Intent to Proceed letter, and the draft Record of Decision rely heavily on monitoring data and studies of local estuaries to support the conclusion that project-related reductions of approximately 70 percent of the watersheds of project area streams would not substantially impair the functioning of those stream or their associated estuaries. The Service has consistently noted the limitations of these analyses.

To summarize, it has been pointed out by the Service and others that these studies are of insufficient scope, duration, and design to provide a basis for determining the effects of project-related drainage basin reduction on the creeks and estuaries of the project area. The Corps appears to acknowledge this in the FEIS with statements such as those appearing on page 4-14 of the FEIS: "...although a definitive conclusion cannot be made because the pre-drainage basin reduction monitoring data on flow and salinity for this creek covers less than a year." The FEIS further states (page 4-16) "it is difficult to draw any definite conclusions because there was no control site for Stanley's 1990 statistical study and there was only one year of baseline water quality and flow data for Jacks Creek." Also in Appendix J.II-7 of the FEIS it is stated in reference (in part) to a report by Entrix: "Although the Corps does not endorse or agree with all of the conclusions and statements found in either of these reports, both have been included in Appendix F in their entirety and the relevant information from these reports has been used as appropriate in the discussion of potential impacts found in Section 4.0 of the FEIS. Additionally, the Entrix report was supplied to the Review Team and their comments have been considered." We note that this is apparently in response (at least in part) to a critique of the Entrix study provided by NMFS following the February 12, 2008, interagency meeting (see enclosed). We concur completely with the NMFS comments, and note that although the Corps states that these comments were "considered" we can find no specific evidence of such consideration in the FEIS or draft Record of Decision.

Despite acknowledgement of the limitations of these studies, the Corps consistently overlooks these limitations and draws definitive conclusions that the project will not result in substantial adverse impacts to the Albemarle-Pamlico Estuary. We view this as an inappropriate use of the available information. We point again to the comments submitted throughout the process by the state and Federal agencies responsible for the management and conservation of the Albemarle-Pamlico Estuary including the Service, NMFS, EPA, NC Wildlife Resources Commission, and NC Division of Marine Fisheries (see enclosed comments of the NC WRC and NC DMF) that have noted the limitations of these studies, and drawing on their accumulated expertise and the vast body of available scientific information have concluded that one cannot deprive a waterbody of 70 percent of its watershed and expect it to function normally.

We remain committed to working with the Corps to effectively address our concerns. We are hopeful that a reasonable outcome can be achieved that satisfies the economic interests of the applicant while sustaining the ecologically and economically vital resources of the Albemarle-Pamlico Estuary.

Thank you for your consideration in this matter. Should you have any questions regarding these comments or wish to discuss this matter further, please contact Pete Benjamin, Supervisor of the Raleigh Field Office, at (919) 856-4520 extension 11.

Sincerely yours,

Sam D. Hamilton
Regional Director

Enclosures