US Army
Corps of Engineers

Ministerie van Verkeer en Waterstaat
Rijkswaterstaat

FLOOD AND COASTAL ZONE MANAGEMENT

AND PROTECTION MEASURES

TECHNICAL WORKSHOP

10-12 July 2006
The Hague, the Netherlands

INTRODUCTION:

The US Army Corps of Engineers (USACE) and the Dutch Rijkswaterstaat (RWS) signed a Memorandum of Agreement (MOA) in May 2004 to collaborate on a range of technical and policy related areas that might prove to be mutually beneficial for the two organizations. A wide range of topic areas focused on water resources planning and management were identified in the agreement. In May 2005, a high-level contingent from RWS visited New Orleans and coastal Louisiana to gain insight on a delta region that in many ways is analogous to their own. The aftermath of Hurricanes Rita and Katrina have given particular credence to this partnership, as both parties seize the opportunity that disasters of this magnitude provide stand to learn a great deal from one another on matters related to coastal zone protection and management.

This report contains the results of the first of a planned series of workshops related to coastal zone protection and management. A team from the US met with Dutch officials on 10-12 July 2006 to share ideas and issues on:

- modeling methodologies,
- soft (deltaic) soils,
- risk-informed decision making, and
- structural/non-structural measures.

The results of those exchanges, apart from soft soil measures, follow.

Future workshops are in the planning stages with additional topics focused on:

- operations and maintenance,
- design-build contracting measures,
- evacuation policy and planning, and
- alternate designs.

Any and all feedback on how to improve these exchanges is encouraged.

Paul Bourget
USACE MOA Program Manager

Jean-Marie Stam
RWS MOA Program Manager

AGENDA
FLOOD AND COASTAL ZONE MANAGEMENT AND PROTECTION MEASURES: TECHNICAL WORKSHOP

10-12 July 2006; The Netherlands

Monday, July 10

- Welcome and introductions
- Post-Katrina MOA related activities
- Workshop goals and objectives
- Introduction to workshop focus areas:
    - Modeling Methodologies (MM): identification of hydrodynamic conditions, model development/selection, calibration, verification and application
    - Advanced Dredging Technologies (ADT): identification of new and innovative dredging technologies (e.g., long distance pumping) and related contract specifications
    - Deltaic Soils (DS): technologies and procedures for managing projects in soft soil environments
    - Risk-Informed Decision Making (RIDM): approaches to safety, risk and reliability; engineering, environmental, economic and social consequences of changing dynamics (subsidence, sea level rise, severe storms, etc.).
    - Structural/Non-structural Methodologies (SNSM): relates to the Dutch "safety chain" with an emphasis on evacuation procedures
- Workshop procedures
- Lunch
- Afternoon: break-out groups
- First day wrap-up
- Evening: Joint dinner

Tuesday, July 11

- Short all-hands meeting
- Continue with break-out groups
- Lunch
- Break-out groups report on their findings and recommendations
- Overall discussion on next steps
- Second day wrap-up
- Drinks Netherlands Water Partnership
- Evening: free

Wednesday, July 12

- Field trip Delta works; focus theme integrated approach
- Workshop wrap-up
- Evening: Farewell dinner hosted by RWS

MODELING METHODOLOGIES GROUP

10 July 2006

The Modeling Methodologies Group (MMG) started in conjunction with the Risk Assessment Group to participate in Don Resio's presentation on the Interagency Performance Evaluation Team (IPET) risk assessment approach. The IPET risk methodology consists of: a. prediction of storm threat; b. engineering design considerations; c. response to storm threat; d. consequences of selected design. Numerical modeling plays a vital role in this methodology.

After the IPET risk methodology presentation, the MMG began their independent session. Several presentations were given.

a. Ty Wamsley presented on the modeling methodology followed for the LACPR preliminary technical report.
b. Tony Minns of Delft Hydraulics presented on a DELFT3D simulation of Hurricane Katrina that was done shortly after the storm.
c. Bas Reedijk of the Dutch Marine Institute gave a presentation on an analysis of Terrebone Bay barrier island restoration impacts on storm surge. The analysis was done with the Danish Hydraulics Institute's MIKE21 modeling technology. It was concluded from this work that substantial extra length of barrier islands reduces flooding due to hurricanes, small changes had little impact.
d. Herman Gerristsen of Delft Hydraulics presented on the Delft numerical model validation methodology. The methodology is based on the IAHR Guidelines on Validation Documents, published in 1994. The Guidelines provide verifiable and quantifiable information on the quality of a model and to assess fitness for use for a given application. The methodology also assesses uncertainties in model formulation, inputs, and forcing.

11 July 2006

On day 2, technical presentations continued.

a. Rinus Schroevers presented on field measurements. Safety levels for the Dutch protection system are prescribed in the form of hydraulic boundary conditions. The extreme water levels are calculated by extrapolation of the 150 year record. For waves, data is only available from the 1960s for storm conditions and the measurements are only offshore. There is not enough data. New measurement campaigns include buoys in the Ameland tidal inlet (a 3-yr program) and measuring poles for shallow water near levee measurements. There is also currently a fisheries study being conducted that includes the measurement of wave propagation across wetlands. The RWS would like to know about USACE's experience in shallow water measurements.

b. Ap von Dongeren presented on modeling near coastal features. The application of the numerical wave transformation model SWAN is questionable in the Wadden Sea barrier island system as swell penetration is a problem. In the model, swell does not propagate through the channel but refracts out over the tidal flat. The question is whether or not this is realistic and measurements are needed.
c. Herbert Berger presented on the Tai Hu wave measurement project. Tai Hu is a shallow lake surrounded by dikes in China that is impacted by typhoons. The purpose of the project is to investigate the wave growth limit and is measuring waves and winds. Sediment resuspension is a big issue and the project could be extended to look at this and dredging. This situation could be similar to Lake Pontchartrain and could possibly be another field site.
d. Marcel Zijlema presented on wave attenuation over marsh vegetation. The objective of the study is to quantify the wave attenuation over a mangrove forest. Drag force on plants is schematized as a cylinder and averaged over the plant height. The drag coefficient requires calibration. The density of the vegetation is more important in attenuating waves than is the diameter of the plants. The magnitude of the drag coefficient estimated from measurements of wave reduction in Vietnam were small compared to those found in the literature.
e. Vladimir Makin presented on sea surface drag at hurricane winds. This work is based on measured data measured which shows that drag coefficient cutoffs are appropriate at high winds.

After the morning sessions, the MMG rejoined the Risk Assessment Group for three additional technical presentations.

a. Herbert Berger presented on determining hydraulic design criteria for flood defences. The hydraulic boundary conditions are published every five years and are based on statistics about river discharges, winds, sea level, lake level, and failure changes of barriers (based on inspection). The design condition does not equal the hydraulic boundary conditions as the design also incorporates consideration of climate change, new insights in physical processes (i.e. numerical modeling), natural changes (e.g. morphology change), man made changes, and evaluation of safety policy. An integrated concept for determining design conditions is just now being developed.
b. Hans de Waal presented on wind input for assessment of storm surges and waves. Uncertainty in winds is magnified in uncertainty in design. A consistent approach to water roughness (i.e. wind drag) is needed for wind, wave, and surge models. Wind drag is an important parameter but hidden in various models and hard to calibrate.
c. Dr. Kok of HKV Consultants presented on statistical modeling of hydraulic design loads. The flooding probabilities for the Dutch system are estimated with the probabilistic assessment program HYDRA. A database of waves and water levels is developed based on alternatives, data and modeling. The data is then input to HYDRA along with alternatives and climate scenarios to

produce flooding probabilities. Different HYDRA models are applied for different natural systems.

d. Henk van den Brink presented on high extremes in low countries. A method for using synthetic climate simulations for estimating future probabilities was presented.

Summary

Overall, modeling of surge and waves is relatively accurate given accurate boundary conditions. Many difficult issues exist, however, and cooperation between the Rijkswaterstaat (RWS) and the U.S. Army Corps of Engineers (USACE) on addressing these issues would be beneficial. Specific areas for cooperation were identified:

- Consistent model validation guidelines
- Instrumentation for observations and the sharing of measured data
- Research on attenuation of storm surge and waves by vegetation
- Development of appropriate drag formulation
- Communication and management of uncertainties in inputs and outputs

There is a need for modelers and field data collection experts of the RWS and USACE to meet, educate, link, and leverage efforts. The MMG proposes that periodic technical workshops be arranged to facilitate exchange between the two organizations. The technical workshops would serve as a venue for exchange of plans, identification of areas to leverage efforts, peer review, etc.

July 10 Attendees

Ty Wamsley	USACE-CHL
Robert Bass	USACE-MVN
Martin Verlaan	RWS-RIKZ
Herman Gerritsen	WL/Delft Hydraulics
Tony Minns	WL/Delft Hydraulics
Bas Reedijk	Dutch Marine Institute

July 11 Attendees

Ty Wamsley	USACE-CHL
Robert Bass	USACE-MVN
Martin Verlaan	RWS-RIKZ
Ruud Schroevers	RWS-RIKZ
Marcel Zijlema	RWS-RIKZ
Herbert Berger	RWS-RIZA
Hans de Waal	RWS-RIZA
Ap van DOngeren	WL/Delft Hydraulics
Vladimir Makin	KNMI
Henk van den Brink	KNMI
Mathijs Kok	HKV

ADVANCED DREDGING TECHNOLOGIES GROUP

Monday, July 10

Dunes for Defense.

Mr. Hans Otten gave an introduction and presented "Maintaining Soft Sea Defenses". The heart of Holland depends on dunes for sea defense as approximately half of the Netherlands can be loosely interpreted as in a coastal zone. In the 1960s, research started to give the Dutch insight on how the dunes really worked. Dune effectiveness depends on a complex relation between:

- Maximum wave height
- Water depth
- Sediment grain size
- Gravity
- Prevailing winds

This relation leads to an equilibrium bottom profile for each set of circumstances. This equilibrium profile is used to assess where the base coastline will be in the case of the design storm, the maximum conditions the sea defences should be able to withstand. Parliament passed a law setting this set of circumstances at a level of a return frequency of 10.000 years. On eroding stretches of coastline, sand nourishment is necessary to maintain the base coastline.

In the past, almost all the sand for this defence was provided by beach nourishment where the sand was pumped directly up upon the beach. But now, based on understanding the equilibrium bottom profile, more of the sand is being placed in the foreshore (Figure 1).

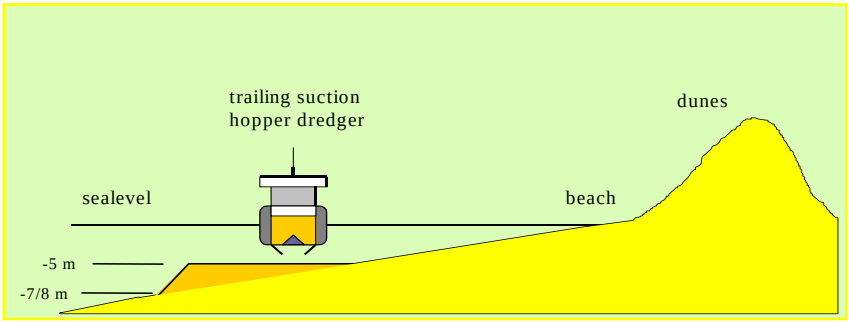

Figure 1. Foreshore sand placement

The net result is that the required sand volume in the littoral zone, beach and on the dune is reached at approximately ½ of the cost of beach nourishment. This cost reduction is accomplished by reducing time, labor, and equipment requirements necessary to transport and distribute sand directly upon the beach. Approximately 1.5 Mm^3/year of sand was placed by foreshore nourishment in this manner from 1970 to 1990. The volume of sand placed in this manner increased to 6 Mm^3/year from 1991 to 2000, and then to 10 Mm^3/year from 2001 to 2006.
The team made a field trip to Ter Heyde to view the dune defense at two different locations to augment this discussion. By understanding the physical processes at hand, and designing their dredging operations to make them (physical processes) work for them, the Dutch have been able to reduce their dredging costs. Once the sediment borrow and placement sites have been identified in Louisiana, insights on these placement sites' respective physical processes should be investigated and, if applicable, utilized by intelligent dredge operation design in order to optimize the benefit to cost ratio.

Tuesday, July 11

Long pipeline transport of sediments
Ecosystem restoration projects located in the interior of vast wetland areas render transport by hopper dredge, barge, conveyor belt, or truck inefficient and will require large scale transport of sediments by pipeline.
After the introduction was made, it was agreed upon that the group would focus on the technical problem statement of addressing issues associated with efficient long pipeline transport for wetland restoration and barrier island dune construction.

We exchanged information on innovative dredging technologies with regard to

- existing methods/technologies,
  best practices / lessons learned,
- technical challenges, and
- R&D needs to advance science and engineering practices as enablers for real-world application in addressing complex problems.

For discussion purposes, the proposed definition of innovation was an idea, practice, or object that is perceived new by the adopting agency. Technology could be defined as a design for instrumental action that reduces the uncertainty in the cause-effects relationships involved in achieving a desired outcome. The technology can involve a "hardware" aspect consisting of a tool that embodies the technology as a material or physical object, and a "software" aspect consisting of an information base for the tool. So our definition of innovative technology was not to be constrained to just dredging equipment (hardware), but included items such as contracts, dredging operational practices, or management strategies.

Aspects Discussed

While it was recognized that in theory and practice long distance pumping can be achieved by long pipe lengths and booster pumps, the unit costs of long-distance pipeline

construction are a function of throughput and management strategy. There are uncertainties about how the material can be most effectively transported efficiently over these long distances and ultimately distributed within marsh habitats. Specific aspects discussed included:

a. use of steel vs HDPE pipe and effect of pipe scour and rust

b. booster pump construction, and remote control that would facilitate its operation in extremely remote locations.

c. slurry density control to optimize hydraulic transport

d. dredging, pipeline pumping, and sediment distribution strategies, techniques, and equipment to optimize sediment transport and redistribution in wetlands (e.g., jet spray for thin layer sediment application)

e. design analyses for construction on soft foundations.

f. information on wetlands placement strategies to optimize functionality

g. risk analyses to reduce uncertainty in planning, executing, and maintaining huge multiyear projects

h. contractual strategies and specifications to reduce risk to contractor and facilitate investment in acquire large quantity of pipeline and multiple year contracts

Future Work

While the group discussed the aspects presented above, it was very apparent that for future work:

- specific project information (i.e., volume of dredged material required, geotechnical information on dredged material, time required to complete contract, transport distances and possible route characteristics, etc.) would be required (or at least dredging scenarios generated) before dredging project specifics could be discussed in detail.
- that it will be *critical* to include the dredging contractors early in the planning process in considering details of the contract(s) to perform the work, as a huge portion of the expertise for excavation, transportation and distribution of sediments lies, for the most part, with dredging contractors.

Other future work aspects to be included are:

- Expand on innovative solutions
- Massive sediment transport
- Investigate research on hydraulic transport optimization

July 10 Attendees

Hans Otten	RWS NZ
Niek Berg	RWS NZ
Tim Welp	USACE CHL

July 11 Attendees

Hans Otten	RWS NZ
Niek Berg	RWS NZ
Tim Welp	USACE CHL
Arno Talmon	TU Delft/WL Delft
Wim Rosenbrand	Boskalis Dredging
Ruud van Maastrigt	Boskalis Dredging
Cees van Rhee	Van Oord Dredging

RISK-INFORMED DECISION MAKING GROUP

Monday, July 10

Joint Presentation with modelling methodologies workshop:
Don Resio: 'Description of the IPET risk model and hurricane risks'
Discussed IPET risk model and modelling of hurricane risks, illustrating uncertainties in hurricane modelling and link with risk model.

Presentation Jonkman: 'flood protection Netherlands': general overview of flood protection approaches in the Netherlands: ***current safety assessment and backgrounds and possibilities for (future) risk based approach***

Discussion by prof. Jurjen Battjes (member of External review panel of IPET): perspectives following from IPET. He described the (personal) Impact of seeing the devastation and questioned whether such effects were sufficiently taken into account in cost benefit analysis that resulted in the hurricane protection system, as it had a too low nominal level of safety. The engineering design should clearly reflect such considerations. The system consisted of fragmented components and did not perform as a system, possibly also related to budgeting issues.
Prof. Battjes discussed whether the use of a Standard Protection hurricane (a 'reasonably characteristic' hurricane) for design was appropriate. In general the system showed lack of resilience, redundancy (second line of defences) and adaptability (weak soil; long term developments: population,). There are question about the design approach and the inclusion of failure mechanisms in the design (some mechanisms foreseen and analysed; some were foreseeable but not analysed). Especially seepage problems were underestimated in the design.
Prof. Battjes discussed the need for transfer of knowledge into the design. In general he expressed his concern about 'outsourcing' of work and the lack of expertise within organisations leading to a degredation of capabilities of institutions such as Rijkswaterstaat.

Presentation by Prof. Ton Vrouwenvelder: **'Application of risk analysis and dealing with uncertainties' (slides)**

Tuesday july 11
Presentation Alex Roos Flood risk analysis of Dutch flood defences: results, applications and issues
Presentation Ge Beaufort 'Risk based design of storm surge barriers & Linking risk analysis and practical design' (no slides)
Presentation Piet Dircke: New Orleans: IHNC flood gates conceptual study
Presentation Kevin Knuuti: Addressing Sea level rise changes

Tuesday afternoon 1300 - 1430: Joint session with modelling methodologies:
Presentation Herbert Berger: determining hydraulic design criteria for flood defences
Presentation Hans de Waal: Wind input for the assessment of storm surges and waves
Presentation Matthijs Kok: statistical modelling of hydraulic design loads
Presentation van den Brink 'high extremes in low countries'

General discussion 1430 - 1530

Points discussed during the workshop meetings:

•Risk analysis

- risk analysis steps in NL are similar to IPET
- risk analysis steps (presentation Vrouwenvelder) are useful for a structured approach of risk based decsion making

Links between risk analysis and hydraulic modeling

- hydraulic models are input for risk analysis and therefore important
- hydraulic models also give input for design of flood defence systems (e.g. design water level and waves)

•Risk management of existing systems

- risk based approach in the NL is useful for US. Also because the approaches focuses at the system and includes several failure mechanisms
- Safety assessment in Netherlands is useful approach for management of flood defence systems

•Risk acceptance and decision making
Safety framework would be relevant for LACPR, linking risk studies and planning to decision making -> USACE and RWS coudl jointly develop a risk based decision framework (see outcomes)

•Linking risk analysis and design and uncertainties in scenario based planning

- How to include various uncertainties in planning such as:
  - Sea level rise, subsidence
  - Social and economical developments, e.g. population (re) settlement

  -> Scenario based analysis seems a good approach

•Storm surge barriers and planning of flood defences
Long term planning (50 to 100 years) is important, link to uncertainties
How can storm surge barriers be incorporated in planning of flood defence lines.

Outcomes:
General: (Technical) exchange on methods for risk analysis and safety assessment (RWS will send translated reports and guidelines) and treatment of sea level rise in planning.

1.Joint risk based decision-making framework by RWS and USACE / LACPR
•How do we assess the risk and use it in decision-making
•Joint USACE-RWS document in late august
approach might also be applied to other areas in the US
2.Dutch plan for New Orleans and SE Louisiana
•General conceptual plan
•Identify expertise
•Schedule: october / november
3.Participation in risk workshops in the US in july or august?

Presenting Dutch approach of flood protection, possibly linking it to the joint risk based decision making framework

<u>July 10 Attendees</u>:

Kevin Knuuti	USACE CHL
Dennis Mekkers	USACE SAM
Don Resio	USACE CHL
Edmond Russo	USACE CHL
Jon Porthouse	State of Louisiana
Bas Jonkman	RWS-DWW
Diederik Timmer	RWS-DWW
Alex Roos	RWS- DWW
Richard Jorissen	RWS-RIKZ
Ge Beaufort	RWS-BD
Piet Dircke	Arcadis
Ton Vrouwenvelder	TNO / TU Delft
Jurjen Battjes	TU Delft

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Kevin Knuuti	USACE CHL
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Piet Dircke	Arcadis
Matthijs Kok	HKV / TU Delft

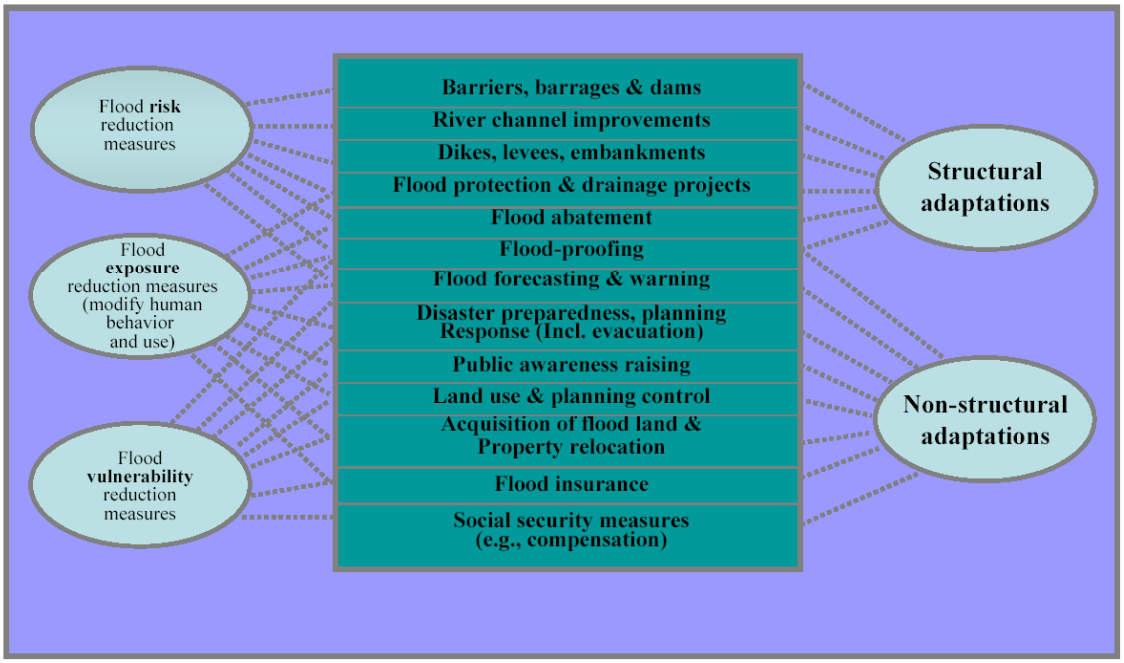
STRUCTURAL/NON-STRUCTURAL FOCUS GROUP

10 July 2006

After introductions were made, it was decided that the group would focus on the safety chain (Dutch term), which translates into a phased approach to flood management broken down as: pro-action, prevention, response, recovery and preparation. The US approach to emergency management refers similarly to emergency management involving the stages of response, recovery, preparedness and mitigation. These are essentially the same way of addressing the hazard life cycle. Although the safety chain was referred to throughout the discussions, the stages were often addressed interchangeably.

The group was then asked to list some of the sub-areas related to structural and non-structural measures. This resulted in a discussion of whether initiatives such as beach nourishment and ecosystem restoration should be classified as structural or non-structural solutions between the two countries. It was decided that any human tampering with the physical environment should be viewed as a structural measure. To guide the discussion the following figure was presented.

Range of Flood Management Options



(Source: D.J. Parker)

The list that was eventually compiled on the first day included:

- Risk awareness and communication
- Flood proofing
- Flood insurance
- Land use planning (zoning)
- Regional sediment management: a.o. using dredged material for restoration projects
- Relocation
- Economic justification
- Structural measures

All issues were addressed for the US, especially Louisiana, and the Netherlands.

Economic Justification. The given level of flood protection stimulates development within vulnerable areas. In the US, decisions are generally made at the local (state and municipal) levels. Projects are often cost-shared, which will be the case with the Gulf Coast recovery efforts (25% local, 75% federal). Louisiana coastal protection measures vary geographically – generally between Category 2 and 3 hurricane events. River-based flood protection measures in Louisiana are comparable to the Netherlands. This is an extremely sensitive issue at the present time in that part of the US because there is not enough economic justification to provide Category 5 protection to everyone in the affected area. People will come to accept this message because they will be given protection better than pre-Katrina conditions. Those areas that fall outside of the eventual inclusion zone, which will be determined by the revised flood maps of the Federal Emergency Agency (FEMA), will have to live with those decisions. In the case of Mississippi, those most vulnerable to coastal storms are not taken into account in the cost-benefit analysis but are addressed in evacuation planning. In the Netherlands, warning times for coastal storms are considered to be too short to allow for efficient evacuations. The same probably holds for floods from the Lake IJssel area. For the Dutch rivers, however, evacuation planning is considered an appropriate means for flood risk management since warning times are considered to be sufficiently long.

The Dutch participants of the workshop like to know who will make the decisions on how the $20 billion will eventually be spent to protect New Orleans. From the state's perspective, if there is no level of protection no one else will return to the area, so the discussion relates to what level of protection to provide. No matter what is decided, population within the metropolitan area will be significantly diminished. Those people who do return will be much more aware of their protection system.

Flood Insurance. In the Netherlands, it is at present impossible to issue insurance for flooding. The debate is on-going on whether or not a system of insurance (maybe similar to the US's National Flood Insurance Program (NFIP)) can be developed. Prior to 1968, flood assistance in the US was only available through disaster grants and loans. In

Louisiana, flood and property insurance is limited within the coastal zone, and that is severely hampering re-development because people can't get mortgages without insurance. These flood zones are being re-delineated by FEMA, and new elevation heights will be defined. Coastal Mississippi is devising plans to relocate critical services, such as hospitals, completely outside of these vulnerable areas.

Land Use Planning/Zoning. In the US, land use planning is conducted at the local level. The Lousiana Coastal Protection and Restoration Authority (LACPR) / State perspective is to develop a land use plan that includes coastal defense measures.

In the case of the Netherlands, the provinces make master plans for development. Land usage (zoning) is delineated by the local governments. In the master plans and the zoning plans, water management is taken into account much more than it used to be. Special attention is paid to the shorefront and non-protected areas. Within the Port of Rotterdam, for instance, the harbor is built 5 meters higher. Also, at the national level water and coastlines are addressed at the national policy level, not only in water policy but since 2005 also in the national planning policy. The integration of water measures in Europe will continue to increase. For example, member states have to develop flood risk maps.In the Netherlands, other measures, like additional compartment dams that split up flood prone areas in smaller parts, are taken into account in spatial planning.

Coastal Restoration/Sediment Management. From a regional approach, dredging the navigation channel and using the material for rebuilding wetlands is preferred. Therefore a "No-net-loss" permitting policy is needed for dredging in the State of Louisiana, which is not in existence at the moment. Louisiana has no laws that say that material dredged out of the system has to be re-used within the system. Therefore, they tend to lose a lot of sand. State-controlled waters extend three-miles out to sea. In Louisiana, all restoration projects are purely for environmental purposes, and no storm surge impacts were taken into consideration so far. At the present time, restoration projects are more of a research-based initiative. In 1990, a 30-year plan for restoration was launched in Louisiana, and was projected to cost $14 billion. Flood protection was not included in the planning. The Corps of Engineers does not have a regional sediment plan (RSM) for Louisiana. The State should play a role in encouraging the Corps to promote RSM, in addition to their traditional mission areas of navigation. Katrina provides an excellent opportunity to apply the principles of RSM. USACE and others need to recognize the vital links between wetland restoration and flood protection.

In the Netherlands, coastal management is sand management. The focus of coastal sediment management is on 'no net loss' of the total volume of sand in the coastal system. To compensate erosion losses a volume of appr 16 million cubic yards is added to the coastal foundation zone every year. The coastal foundation zone is the area that is considered to be the active coastal system, bordered by the –20m depth line and landward edge of the dunes. Main purpose of the nourishments is to project the hinterland from flooding at the long term and therefore to let the coastal system rise with the sea level rise. As sea level rise increases in the future, the amount of sand needed for compensation is

expected to rise as well. The nourishments are conducted in the near shore close to the surf zone, or on the beach when necessary for safety reasons.
So far, dredged material from the navigation channels is not used for the nourishments. In the downstream parts of the Dutch rivers it is even taken out of the system and sold as building-material. In the upstream parts of the Dutch rivers there is a different policy: dredged sand is dumped back in deeper areas to stop the erosion of the bed. In the past, dredged material has not been used for beach nourishments because of possible contamination of the material with heavy metals. In the North Sea and the Rotterdam Harbour areas are designated for the storage of contaminated dredged material.
The restoration of wetlands in the Netherlands is limited to small-scale inter-tidal areas. The Western Scheldt is an example of environmental mitigation for dredging.

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It was decided that a joint project between the US and the Netherlands focused on Regional Sediment Management would prove beneficial, such as an EU project under the auspices of COMCOAST focused on coastal safety, and salt marsh restoration in the Eastern and Western Scheldt.

Communications and Awareness Raising. How do you communicate risks? Public awareness is a clear necessity. By not properly informing the public of the risks the government is responsible. In Louisiana, we advise the general public. In the US, we bring in the politicians and educate them and rive them the support that they need. We host public meetings and bring in the experts to communicate the risk. Attendance at these meetings differs with different interest groups present. There are always objections, so different techniques are applied in an attempt to reach consensus. Public input is needed but it can be frustrating at the same time. You don't want to unnecessarily panic the public, so the form and content of the message being conveyed is critical. The public is often better able to cope with the information than we experts and politicians might think. The use of the Internet and mass e-mailings is different from the information that is provided through public (face-to-face) meetings. One technique that has proven to be effective is an open door policy that involves an all-day meeting with the public. By providing a drop-in environment where one-on-one discussions prevail confrontations are diminished. This type of discussion forum should be encouraged as opposed to the traditional two-hour group gathering.

Relocation. Hurricane Katrina demonstrated that the US has a long way to go in terms of short-term relocation. It is still too early to determine the extent and effect of relocation in terms of Katrina. The various lines of protection that have yet to be drawn will dictate the extent of long-term relocations throughout the affected region. The best evidence of the effectiveness of relocation in the US is with the Mississippi Flood of 1993. Sections of small towns were physically relocated, as were a number of individual families that experienced repetitive losses. Several agencies in the US become involved in the relocation process. In the Netherlands, relocation has not been practiced and there is not a good policy in existence. The approach is "Solidarity Against the Sea" and law suits

are not considered. That may change in the future, as compensation is being increasingly considered. These types of issues are starting to stall the progress of many of our projects

11 July 2006

There were new Dutch participants on the second day, so introductions were made and two new items for discussion were identified:

- Risk maps
- Advising decision makers

Structural Measures. In the Netherlands, standards for structural measures are set by law. There is a two-tier system of governance – the Rijkswaterstaat at the national level and the Water Boards at the regional level. The Water Boards are responsible for ensuring that the flood defenses meet national standards. At present, there are 27 separate Water Boards that work together well and are responsible for individual sub-watersheds. In recent years, there has been a huge consolidation of the number of Water Boards, which used to number 2700. There are approximately 3500 kilometers of primary dikes (dikes that protect flood prone areas from flooding from the sea, the main rivers and the Lake Ijssel area), 3000 of which are owned and maintained by the Water Boards. Additionally, there are approximately 14.000 kilometers of regional (secondary) dikes (dikes that protect the land from flooding from smaller water bodies). The primary dikes have to meet safety standards set by law. For the regional dikes also safety standards are determined but these do not have a legal status.
The Water Boards are responsible for performing maintenance, improvements and new construction of the primary and regional dikes. The Water Boards are responsible for raising taxes within their respective regions. The members of the Water Board are elected officials, elected by the residents of the regions (every four years). Every Water Board has a permanent technical staff. With the tax money they pay for the maintenance of the levees. Major improvements and new constructions are funded by the national government. The large structures, such as the Delta Works, and coastal sediment management are the responsibility of the Rijkswaterstaat (national government) For the nourishments in the coastal foundation zone a yearly amount of appr 45 million Euro is available.

The Water Boards are supervised by the provinces, which is similar to the newly formed CPRA in Louisiana. For the primary dikes, design criteria in the Netherlands are made at the national level. Water Boards are free to follow these guidelines or not for the design, as long as they meet the standards set by law. Sometimes the relocation of people is necessary to improve dikes. The boundary conditions are set by the national government. The Water Boards have to use these conditions to test if the dikes meet the stated standards. Based on these tests, the provinces report every five years to the national government on the status of the dikes and dunes.

Water policy in the US is a state responsibility. Louisiana is the only State with separate entities that are responsible for flood management: the Levee Boards. In Louisiana, the Levee Boards are appointed by the governor (political appointments). Louisiana State ensures that the right technical information is made available to those officials. This is important because the Levee Boards do not have to adhere to any national policy or set of standards. This is a big difference from the Netherlands. Another difference from the Netherlands is that water quality is a municipal responsibility. Levee Boards in Louisiana extend far up north to the Red River. A new state law created the Coastal Protection Restoration Authority (CPRA), and the Levee Boards will now report to them. CPRA will provide technical and financial supervision, pulling staff from various state departments to answer particular questions. In Mississippi, there is no extensive levee system and no comparable local governing body. Mississippi is considering the construction of two large structures that will close off channels during storm events. Louisiana has devised a "quick-take" approach to some of its relocations, which equates to a stream-lined process to buy out landowners at a fair market price. The entire process is designed to take less than one year.

Advising Decision Makers. The challenge is presenting the right technical information to the decision makers. This is particularly critical in terms of evacuation planning and execution. In the US, the National Response Plan (NRP) has been developed by the Department of Homeland Security, which FEMA now falls under, to address all types of emergency situations. The National Incident Management System was produced by DHS in parallel with the NRP to issue guidance procedures to state and local authorities. The National Weather Service is responsible for issuing flood and hurricane forecasts and warnings. Along with FEMA, the NWS manages the Emergency Alert System, which is designed to alert the general public of pending disasters of hydro-meteorological origin. These federal agencies work with the state and local governments to advise the decision-making community. Each state is responsible for preparing its own emergency management plans, including plans for evacuation. Once the state feels its capacity to respond to a disaster is exceeded it requests assistance from FEMA. FEMA, in turn, decides whether or not to recommend the president declare a disaster. Ideally, the NRP is to be fully implemented once that decision is reached. The National Emergency Management Association (NEMA) is a non-governmental organization that was formed to improve inter-state emergency management procedures. There is no national plan in the Netherlands, as disaster management is largely a local responsibility. Table top drills for decision-makers are performed by both countries.

Flood Proofing. This topic relates to the various measures that are performed to reduce the effects of flooding on housing and infrastructure. The Corps of Engineers, FEMA, the Dept of Housing and Urban Development (HUD), the Institute for Business and Home Safety (http://www.ibhs.org/) and the Association of State Floodplain Managers (www.floods.org) all play lead roles in advancing flood proofing in the United States. They provide incentives (grants, low-interest loans, tax breaks) and conduct campaigns to promote the diffusion of flood proofing within high-risk areas. In the Netherlands, flood proofing is also catching on, as evidenced by the emergence of "floating" houses. In the case of Katrina, there is a problem with what to do with the existing structures. On a

case-by-case basis we have to decide whether it's more cost effective to raise the elevation of a house or to raze the house altogether. In Mississippi, it was pointed out that there are 5 primary lines of defense being devised: the barrier islands, beach elevations (sand dunes), Highway 90, the railway, and Interstate 10. Critical facilities will now be built behind these lines of defense.
Flood proofing also refers to the infrastructure. In the US, flood defense plans for Louisiana include the option of using a railroad track as one of the defense lines. In the Netherlands, upgrading existing infrastructure (railroad tracks, highways) or building new infrastructure in such a way that these constructions can also function as dikes, is being discussed at the moment.

Risk Maps. FEMA's Map Modernization (http://www.floodsmart.gov/floodsmart/pages/map_modernization.jsp) is the leading effort in the US to devise something akin to a risk map. The "Map Mod" program was initiated to improve upon FEMA Flood Insurance Rate Maps, which are woefully out of date and very basic to begin with. The Corps has recently been producing storm surge maps for vulnerable coastal areas within the US. An all-hazards mapping approach has been discussed in the US but it has not been implemented.

Suggested Further Actions:
Regional Sediment Management (in coordination with the results from the dredging workshop)

- The Regional Sediment Management should be one of the critical areas identified for future collaboration between USACE and RWS. The experiences on both sides deliver useful examples, such as: The experiences with fifteen years of coastal sediment management and the large scale / long term approach in The Netherlands, and the experiences with the morphological impacts of the closure of the tidal inlets in Zeeland.
- The experience in the US with cost benefit analysis and the cost sharing of other parties for the nourishment projects.
- Assessment of ecological impacts of nourishments;
- The impacts of and interaction between (flood protection) measures, storm surge and dredging and coastal (wetland) restoration.

Other issues to address for further action are connected to the on-going discussion in Louisiana and the Netherlands on providing cost effective safety levels and raise awareness of the politicians and the public for mitigation measures such as flood proofing and insurance.

It was concluded that the organization and finance of the maintenance of flood defenses in the US is less well advanced than in the Netherlands. This may be one of the items where the US can benefit from hundreds of years of expertise at the Dutch Water Boards. The problem that arises is that the Dutch Water Boards are not part of the collaboration between USACE and RWS whereas they are the main actor in the Netherlands for the maintenance of flood defenses. This point was brought to the table at the plenary session at the end of the workshops. Basically, the question to be addressed is: will the

collaboration focus on the expertise that is related to the responsibilities of USACE and RWS, or will the collaboration focus on expertise on water (a.o. flood risk) management in both countries. If the latter is the case, the collaboration needs to be wider and the expertise of, for instance, the Water Boards needs to be included as well.

July 10 Attendees:

John Baehr	USACE- ERDC
Hans Balfoort	DGW
Ed Berendsen	RWS-BD
Benno Koehorst	RWS-BD
Wilfried ten Brinke	RWS-RIZA
Paul Bourget	USACE
Hermine Erenstein	RWS-RIKZ
Chris Knotts	State of Louisiana
J.B. Smith	USACE
Peter Wijsman	Arcadis
Stan Woodson	USACE
Martine Leewis	Arcadis
Klaas van de Wielen	

July 11 Attendees:

John Baehr	USACE ERDC
Hans Balfoort	V&W DGW
Ed Berendsen	RWS-BD
Wilfried ten Brinke	RWS-RIZA
Paul Bourget	USACE
Hermine Erenstein	RWS-RIKZ
Sjoerd Hoornstra	V&W-DGW
Chris Knotts	State of Louisiana
Roelof Moll	Royal Haskoning
Niels Roode	RWS-RIKZ
Judith Scholtes	Union of Waterboards
J.B. Smith	
Peter Wijsman	Arcadis
Stan Woodson	USACE
Marc Bökkerink	Dept. of Foreign Affairs
Geesje Saeijs	Institute for safety security and crisis management

Attachment 1: Invitational Letter

June 24, 2006

Dear Workshop Participants:

Thank you for agreeing to contribute to the first technical workshop associated with the Memorandum of Agreement (MOA) that exists between the Dutch Rijkswaterstaat (RWS) and the US Army Corps of Engineers (USACE). The workshop will focus on five central themes related to coastal zone management and protection measures. It will be convene on Monday, July 10 and adjourn on Wednesday, July 12 and will be held in the offices of the Rijkswaterstaat in the Hague, the Netherlands.

The preliminary program, workshop guidance, list of participants, and map of the hotel (for US attendees) is attached. From the Dutch viewpoint, we are pleased that the program is taking shape and we are eager to provide USACE and the State of Louisiana with tangible results. At the same time, we realize there is great pressure to meet the deadlines for the Louisiana Coastal Protection and Recovery reports. From RWS's perspective, our working together provides a rare opportunity to benchmark our knowledge and learn from your experience.

Given the time constraints we would like to propose a practical approach to the workshop. You are therefore encouraged to contact members of the focus area for which you are assigned in advance of the workshop in order to make the most effective use of time. Email addresses for all attendees with their respective focus areas are provided herein. The Risk-Informed Decision Making (RIDM) focus area has already put together a framework document describing their mutual areas of interest. Please try to work with your focus area counterparts to develop a similar document. This will help to ensure that we are focused and able to make the best use of our time together. These preliminary contacts will also be helpful so that relevant site visits in the Netherlands can be identified beforehand.

If you have any questions or recommendations to improve the workshop don't hesitate to contact us. Thank you and we look forward to seeing us all together.

Paul Bourget and Jean-Marie Stam

Attachment 2

WORKGROUP ORGANIZATION AND PROTOCOLS

FLOOD AND COASTAL ZONE MANAGEMENT AND PROTECTION MEASURES
TECHNICAL WORKSHOP
10-12 July 2006; The Netherlands

- **Organization**
  - Each focus area is responsible for appointing Co-Chairs and Co-Secretaries
  - Co-Chairs establish agenda and lead discussion, Co-Secretaries record and consolidate minutes
  - The aim is to have leadership representation between US (Corps and State) and Dutch to ensure discussion is balanced, properly advanced and documented
  - Memorandum of Agreement Coordinators will be responsible for producing workshop report, which will contain deliberation findings and recommendations
- **Protocols**
  - Purpose and Scope: explore and describe areas of mutual interest for advancing practices on how technical investigations are conducted in relation to flood and storm damage reduction, ecosystem restoration, and navigation, to support coastal restoration and protection, such as:
    - technical problem statements,
    - existing methods/technologies,
    - best practices / lessons learned,
    - technical challenges, and
    - R&D needs to advance science and engineering practices as enablers for real-world application in addressing complex problems.
  - Product: decide on what would be the outcome of holding US and Dutch technical workshops into the future, such as co-developed technical reports on specific areas of interest
  - Shared Opportunities: identify collaborative ways the US and Dutch could work together, such as in periodic meetings with set timeframes for producing deliverables directly applicable to team members for use in conducting coastal protection and restoration investigations
  - Next Steps: decide on format for proposal of further collaboration to US and Dutch Government senior leaders in their consideration of approval and receipt of further guidance to proceed

Attachment 3

PARTICIPATING ORGANIZATIONS

Tbe Netherlands

Government

- Ministry of Foreign Affaairs
- Directorate General Water (DGW)
- Union of Waterboards
- Royal Meteorological Institute (KNMI)
-

Rijkswaterstaat (RWS)

- Civil Engineering Institute (BD)
- Institute for Inland Water Management and Wastewater Treatment (RIZA)
- National Institute for Coastal and Marine Management (RIKZ)
- Road and Hydraulic Engineering Institute (DWW)
- Zeeland (Z1)

Laboratories

- National Institute for Geo-Engineering (Geo-Delft)
- Centre for Mechanical Engineering (TNO-Delft)
- Delft University of Technology (TU-Delft)

Sector

- Arcadis
- Boskalis Dredging
- Dutch Marine Institute
- HKV
- Institute for safety security and crisis management
- Van Oord Dredging

United States

US Army Corps of Engineers (USACE)

- Coastal Hydraulics Laboratory (CHL)*
- Geotechnical and Structures Laboratory (GSL)*
- Institute for Water Resources (IWR)
- Mississippi Valley Division, New Orleans District (MVN)
- South Atlantic Division, Mobile District (SAM)

- Southwest Division, Galveston District (SWG)

<u>State of Louisiana</u>

- Louisiana Coastal Protection and Restoration Authority (LCPRA)
- Louisiana Department of Natural Resources (DNR)
- Louisiana Department of Transportation and Development (DOTD)

* Labs within USACE's Engineering Research and Development Center