OPTIMISING INLAND WATERWAYS
the rebirth of rivers and their waterfronts

ANALYSIS & AUDITS OF JOB SAFETY
how to create an injury-free workplace

NATURE RECREATES NATURE
an island grows as dredged material drifts
Guidelines for Authors

*Terra et Aqua* is a quarterly publication of the International Association of Dredging Companies, emphasising “maritime solutions for a changing world”. It covers the fields of civil, hydraulic and mechanical engineering including the technical, economic and environmental aspects of dredging. Developments in the state of the art of the industry and other topics from the industry with actual news value will be highlighted.

- As *Terra et Aqua* is an English language journal, articles must be submitted in English.
- Contributions will be considered primarily from authors who represent the various disciplines of the dredging industry or professions, which are associated with dredging.
- Students and young professionals are encouraged to submit articles based on their research.
- Articles should be approximately 10-12 A4s (4000 to 6000 words). Photographs, graphics and illustrations are encouraged. High quality, original photographs are acceptable. Digital photographs should be of the highest resolution (300 dpi and at least 1 Mb, preferably more).
- Articles should be original and should not have appeared in other magazines or publications. An exception is made for the proceedings of conferences which have a limited reading public.
- In the case of articles that have previously appeared in conference proceedings, permission to reprint in *Terra et Aqua* will be requested by the editor.
- Authors are requested to provide in the “Introduction” an insight into the economic, social and/or environmental drivers behind the dredging project by the editor.
- An emphasis is placed on articles which highlight innovative techniques and applications.
- By submitting an article, authors grant the IADC permission to publish said article in both the printed and digital versions of *Terra et Aqua* without limitations and remuneration.
- For the digital version, authors are requested to provide extra material such as additional photos, links to reports from which articles have been excerpted or short videos. These can be embedded in the digital version under the same provisions as above.
- The digital version will contain a link to the LinkedIn page of the author. In case the author does not agree, please inform IADC (rauwerda@iadc-dredging.com).
- All articles will be reviewed by the Editorial Advisory Committee (EAC). Publication of an article is subject to approval by the EAC and no article will be published without approval of the EAC.

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**COVER**

A satellite photo shows Horseshoe Bend on the lower Atchafalaya River in Louisiana, USA where an island is being self-designed by strategically placing dredged sediment upriver and allowing the river’s energy to disperse the sediment, contributing to the natural growth of the island (Photo: Wings of Anglers) (see page 26).
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AQUAPUNCTURE®: SUSTAINABLE FUTURE OF INLAND WATERWAYS
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BUILDING A PROACTIVE SAFETY CULTURE THROUGH THE USE OF JOB SAFETY ANALYSIS AND JOB SAFETY ANALYSIS AUDITS
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New tools for improving safety have led to a change in attitudes and an incident and injury free (IIF) culture.

CREATING HORSESHOE BEND ISLAND, ATCHAFALAYA RIVER, LOUISIANA
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As mounds of dredged material placed upriver are dispersed by the river’s current, an island with enriched wildlife has emerged.

BOOKS/PERIODICALS REVIEWED

Beyond Sand & Sea, a limited edition photo book that covers 50 years of dredging history through 50 iconic projects in more than 200 pages; and a review of a newly revised and updated Facts About Turbidity & Dredging are featured.

SEMINARS/CONFERENCES/EVENTS

The IADC Seminar in Indonesia, the next CEDA Dredging Days and the deadlines for Abstracts for papers for WODCON XXI and the PIANC-COPEDEC IX Conference are coming up soon.
Part of celebrating the 50th anniversary of an organisation is taking a look back at what has been accomplished in that half century and looking forward to see where its work is going in the future. One of IADC’s key goals has been to attract the next generation of professionals to the dredging industry. Those of us working in various aspects of the industry know that dredging is unique. It is filled with unsung heroes, who make tremendous contributions to the world’s maritime infrastructure, with engineers who demonstrate a wide range of expertise, from civil, mechanical and environmental backgrounds.

The question is: how can today’s maritime specialists inspire others to enter the field? How can they convey the excitement of being on a cutter or a trailer or a backhoe, working in the machine room, standing on the bridge, helping to create land out of water, erecting a windmill on shoal banks, laying pipelines deep below the sea for the oil & gas industry, deepening and canals linking a river or access channel to make it safer for navigation or building monumental works like the Panama or Suez canals.

One component of “passing the torch to the next generation” is to encourage young professionals working in dredging and related fields to investigate, make new discoveries and present their findings to a wider audience. With this in mind, the IADC developed the Young Author Award to stimulate the promotion of new ideas amongst young researchers. Each year at selected conferences, the IADC grants an award for the best paper, written by an author younger than 35 years of age, which make a significant contribution to the literature. Since its inception in 1987, 35 such awards have been presented. These award winners are listed to the right – many of them are names you may recognise as colleagues who have gone on to make distinguished careers in the dredging industry.

This year’s award – number 36 – will be presented at the CEDA Dredging Days taking place in November in Rotterdam, The Netherlands. If you are 35 years of age or younger, we look forward to receiving your contribution. Also important to remember: The winner of an IADC Young Author Award receives €1,000 and a certificate of recognition and the paper may then be published in Terra et Aqua.

All the articles published in this issue of Terra et Aqua share the innovative thinking described above – starting with the introduction of Aquapuncture®, a concept similar to Building with Nature, which is being applied to inland waterways and waterfleets. The second article tackles the demands for a safer workplace. It presents new approaches to creating a proactive safety culture and monitoring safety improvements. And lastly, a new environmental study demonstrates how dredged material can be used beneficially to nourish a naturally forming river island. In all three articles, the awareness of emerging challenges is apparent.

Capitalising on past experience, the industry is reaching out to diversify and remain dynamic, transforming itself to meet the demands of the future.

IADC Young Author Award Winners

E. Maglie, K. Townsend, R. Thomas, J. Miller, T. Campbell, L. Lin, S. Willey and S. Wood at the 31st PIANC World Congress, San Francisco, California, June 1-5, 2014 for “Reducing Shoaling in the Gulf Intracoastal Waterway and Erosion of Barrier Islands along West Galveston Bay”.

Max Rademaker at WODCON XX, Brussels, Belgium, June 7, 2013 for “The Art of Screening, Effectiveness of Sift Screens”.

Arnaud Verschelde at the CEDA Dredging Days, Abu Dhabi, December 13, 2012 for “Emulsion Behaviour of a Draghead”.


Brianne Cohen at the WEDA XX/ I TAMU 42 Annual Dredging Conference & Exhibition, Gaylord Opryland in Nashville, Tennessee, June 5-8, 2011 for “Reducing Shoaling in the Gulf Intracoastal Waterway and Erosion of Barrier Islands along West Galveston Bay”.

Yoshitani Hasayama at WODCON, Beijing, China, September 8-12, 2010 for “Establishing a stone-dumping process for constructing manmade underwater ridges”.

Katrin McCarville at WEDA 30/TAMU 41, Puerto Rico, June 6-8, 2010 for “Maxedville Dredged Material Containment Facility: Environmental Planning, Compliance and Compensatory Mitigation”.


Jelmer Brakoma at CEDA Dredging Days, Rotterdam, the Netherlands, November 4-6 2009 for “Estimating the inmeasurable: Soil properties”.

Stephanie Jansen at the CEDA Dredging Days, Antwerp, Belgium, October 1-3 2008 for “Conceptual Model for Partnering in the Dredging Industry”.


Stefan G.J. Aarninkhof at the CEDA Dredging Days 2007 in Rotterdam, the Netherlands for “The day after we stop dredging: A world without sediment plumes?”.

Stephanie M. Doorn-Green at WODCON XVII, Orlando, Florida, USA, May 27- June 1, 2007 for paper “Environmental Monitoring and Management of Reclamation Works Close to Sensitive Habitats”.

Khalid El Khali at the CEDA African Section Dredging Days, Tangier, Morocco, November 2006 for “Morphological and electronic study of the lagoon of Sidi Mousa”.

Carmen Casado-Martínez at the 31st PIANC Congress, Estoril, Portugal, May 2006 for “Sediment toxicity assessment in ports affected by metallic pollution”.

Andreas Wursts at the CEDA Dredging Days, Rotterdam, The Netherlands, November 2005 for “A Study on Analysing Changes in the Bottom- Topography at dredged material disposal sites and the interaction between disposed matter and the surrounding density currents”.

Leaf Erickson at the 25th WEDA Conference in New Orleans, Louisiana, USA, June 2005 for “Case study on local sediment management at Seaward-going-through in Providence, Turks and Caicos”.

Eliaj Ohrnman at the World Dredging Congress (WODCON), Hamburg, Germany, September 2004 for “Environmental impacts of dredging in the Niger Delta”.

M. Zwavern at the CEDA Dredging Days, Amsterdam, the Netherlands, November 2003 for “The Exploitation of Cockle Shells”.

S. Kularatne at COPEDEC, Colombo, Sri Lanka, September 2003 for “Sediment Re-suspension And Cycling To Wave Groups”.

C. Bier at the CEDA Dredging Days, Casablanca, Morocco, October 2002 for “Geographic Information Systems (GIS) for modelling sediment transport and deposition in harbours”.

S. Vandycke at the 30th PIANC-APCNC Congress, Sydney, Australia, September 2002 for “Drifting stilt to very still clay in the Wielingen, using the DRACULA® system on a hopper dredger”.

Jaoumou Ambróse at WODCON XVII, Kuala Lumpur, Malaysia, April 2001 for “Displacement filling at Lumut, Sg. Dinding, Malaysia”.

Alvin Allan at the WEDA XX Conference, Rhode Island, USA, June 2000 for his paper “Effect of various terminal velocity equations on the result of friction loss calculation”.

Nicola Sullivan at the CEDA Dredging Days, Amsterdam, the Netherlands, November 1999 for “The use of agitation dredging, water injection dredging and siebding in the UK”.

Akinori Sakamoto at WODCON XV, Las Vegas, Nevada, USA, June 1998 for “Cement and soft mud mixing technique using compressed air-mixture pipeline: efficient solidification at a disposal site”.

Martin Kuulsan at the International Conference on Contaminated Sediments, Rotterdam, the Netherlands, September 1997 for “Emissions of porewater compounds and gases from the subaqueous sediment disposal site ‘Rodehuischaaf’, Hamburg harbour”.

Stefaan Vandycke at the 11th International Harbour Congress, Antwerp, Belgium, June 1996 for “New developments in environmental dredging: from scarp to sweep dredge”.

V. Matsou at WODCON XV, Amsterdam, the Netherlands, November 1995 for “Solids transportation in a long pipeline connected with a dredge”.

N.C. Evans at the AAPP Conference, Kuala Lumpur, Malaysia, September 1994 for “Effects of dredging and dumping on the marine environment of Hang Kong”.

A.R. Ahmed at the CEDA Dredging Days, Amsterdam, the Netherlands, November 1993 for “A low cost dredging device: a laboratory and field study”.

S. Becker at WODCON XII, Bombay, India, April 1992 for “The closing process of Camshile dredges in water-saturated sand”.


J. M. Meindema at WODCON XII, Orlando, Florida, USA, May 1990 for the paper “The cutting forces in saturated sand of a seagapping cutter suction dredger”.

T. Bisland at the CEDA Dredging Days, Hamburg, September 1988 for “Determination of dredging-induced turbidity”.

J. Marco Groot at the CEDA Dredging Days, Amsterdam, the Netherlands, November 1987 for “Criteria for the backfilling of excavated trenches for pipelines, transmission lines and immersed tunnels”.

EDITORIAL
ABSTRACT

Waterways have always been a focal point for settlements and economic activities and were used for a great variety of functions. All the inland waterways formed a slow waterway system, going through city centres and connecting them in a direct way. To a certain extent this changed with the rise of the much faster railway and road system through and around the cities. The waterway transport system became obsolete and its main function was taken over by land transport. The spatial relation between the waterway and urban development became neglected. Now the significance of this unique relation between the waterways and the adjacent urban and rural habitats is becoming apparent. Through the development of Aquapuncture© this waterway network is being rediscovered and revitalised.

INTRODUCTION

Aquapuncture is an instrument for the optimal use, adaptation and management of inland waterways and their waterfronts (Figure 1). It is an instrument for the benefit of safety, navigability, economy, employment, spatial quality and environmental values. Whereas Acupuncture is applied to revitalise the nervous system and the human organs, Aquapuncture is applied to revitalise the inland waterways and their waterfronts (Figure 2).

Above: The Vliet-Schie marina in Delft was the first project developed in the Netherlands following the principles of Aquapuncture. Guest berths for transient vessels were built and the waterfront enhanced, which stimulated the economy. At the same time it led to improvement of the water quality in the waterway system.

Inland waterways have always linked urban and rural areas. These waterways were always a focal point for settlements and economic activities. Worldwide a slow waterway system went through cities and lakes. These waterways were used for everything from drainage and irrigation, water level regulation, defence, drinking water supply, beer production, fishing, transport of persons and goods, but also as open sewers. Furthermore, many industrial activities along these waterways were present and resulted in added emissions in the water.
Later on the faster railway and road transport systems in and along cities came into being. To a certain extent the inland waterway systems became obsolete and their main transport function was taken over by the faster rail and road system. The spatial relation between the waterway and urban development was neglected. Nowadays the significance of this unique relation between the inland waterways and the adjacent urban and rural habitats is again gaining attention. In the meantime the water quality has been improved considerably through various measures and regulations. Therefore rediscovering and revitalising the waterway

Figure 2. Left, Acupuncture: revitalises the human body. Right, Aquapuncture: revitalises waterways and their waterfronts.

Figure 3. Aquapuncture: Waterways as a vital backbone in the urban and rural landscape.
For the optimal use, adaptation and management of the waterways and their waterfronts the six actual and potential user groups in and along the waterways should be considered (Figure 4). These User Groups in and along the waterways are:

1. Commercial shipping for persons and goods
2. Tourism and recreation
3. Special nautical events (“Sail”, floating flower shows, regattas of heritage ships, dragon boat races, concerts on water, special cruises)
4. Water related sports (sailing, surfing, rafting, rowing, canoeing, fishing, swimming)
5. Waterfront users and developers
6. Aquatic / terrestrial flora and fauna and micro-organisms

To achieve Aquapuncture for these user groups, physical adaptations (interventions) (Figure 5) and organising measures are necessary (Figure 6).

Physical Adaptations / Interventions in and along the waterways are:
1. Height of bridges above water level
2. Dredging depth via environment-friendly dredging
3. Expanding sluice capacity and bridge and sluice servicing
4. Dike / Levee adaptation, River/Canal widening - Room for the River
5. Aqueducts and boat conveyors
6. Water level regulation via sluices, pumping stations & weirs
7. Facilities for drainage / irrigation
8. Pier / Jetty / Quay wall / Moorings and Berths with facilities
9. Loading/unloading platforms
10. Yachting harbours and inland container terminals
11. Introduction of environment friendly banks / shores
12. Waste Water Purification
14. Introduction of hotel, restaurant, café/ pub, museum, companies along the waterway
15. Linking inland waterways
16. Urban Development with connecting waterways
17. Infrastructure, including bicycle lanes and footpaths and parking space along the waterway
18. Enhancing blue-green spatial qualities of urban & rural areas
19. Restoring & purposeful using cultural heritage values in and along the waterway
20. Introduction of environment-friendly powered vessels

Organising measures (Figure 6) are:
1. Stakeholder analysis and participation
2. Public-private partnership (PPP)
3. Societal costs-benefits analysis
4. Cooperation with 5 levels of Government
5. Trias Politica: legislative, executive and judiciary system
6. Knowledge and education
institutes, and environment – nature – landscape – society is necessary.

Hydrological Cycle
This first discussion has focused on the usage, adaption and maintenance of inland waterways and their waterfronts. The role water plays can be described on macro, meso and micro levels. In all cases the starting point is water in all its forms and expressions as a central element in the hydrological cycle and the role water plays in the climate cycle, biological cycle and the environment in general. Aspects like water retention, water storage and drainage, irrigation, drinking water supply, cooling and process water, water purification have to be taken into account. Prevention of waste dumping into the water is absolutely necessary.

The role of water in and around the cities needs special attention. The quick run-off of water, due to a high percentage of sealed surfaces in urban areas, especially in periods of heavy rainfall, is what causes the danger of flooding and this has to be remedied. In dry periods the potential use of retention basins proves to be of great importance. Therefore, the aim is to improve the situation by sensible interventions and at the same time stimulate recreation, tourism and inspirational experiences.

Blue-green arteries are valuable assets in the urban fabric and the surrounding rural landscape for sustainable climate-proof liveable cities. They are slowing down the water flow, provide a habitat for bio-based diversity and are connecting people. In the end they improve the environment and strengthen simultaneously directly and indirectly the economy. Their existence is a source of inspiration and education.

In close cooperation with artists, architects, landscape architects and engineers, Herbert Dreiseitl and his studio/workshop have introduced water in all its forms and expressions in and around built-up areas. He retains the water for a longer period, allows it to circulate in a special ways visibly, audibly and tangibly and plays with the water. He increases the drainage surfaces by creating beautiful parks and roof gardens. He combines well thought-out integral water management and urban beautification, while promoting the awareness of water as life bringing element in the hydrological cycle. Furthermore, Dreiseitl is of the opinion that in a city playing with water by children (and their parents) serves an educational purpose and proves to be beneficial all around. His views have been applied worldwide.

WORLDWIDE APPLICATION OF AQUAPUNCTURE
The method of Aquapuncture is applicable to rivers, canals and lakes, both in coastal and delta areas as well as in the existing hinterland in all of the five habitable continents. Active introduction of the method has already taken place in Europe and other parts of the world.
A selection of case studies is presented below.

**The Netherlands: Aquapuncture for Liveability and Economy**

*The Frisian Lakes Project – Water Leisure Paradise*

The Frisian Lakes Project (Figures 7 and 8) aims to make Fryslân (as Friesland is known in its own language) even more attractive as a water sports area. In doing so, the Frisian economy and employment will also be stimulated. The project was initiated in 2000 and will be completed in 2015. The total project costs were estimated at € 495 million.

The objective of the Frisian Lakes Project is anchored, amongst other things, in the improvement of employment in the Frisian water sports branch. The target is to realise 30% more employment versus the reference date in the year 2000. Furthermore, the Frisian Lakes Project wishes to improve liveability and to attract more business to Fryslân, through, for example, improved road traffic flow and shorter waiting times for bridges and locks. Nature and the environment play a central role, as does recreation. In other words, the project is good for everybody: whether you are a resident, visitor or holidaymaker.

Since the start of the Frisian Lakes Project, employment in the Frisian water sport sector has grown by 22.7% (2009 figures). In terms of jobs, this translates as 844 structural jobs (fulltime and part-time). Furthermore, the project has already been beneficial for recreational boating: new sailing routes and areas, new aqueducts, new mooring facilities, bridges, locks and harbours. It has also meant less waiting times for bridges and locks. The Frisian Lakes Project has also helped reduce traffic in many tourist villages thanks to the construction of ring roads and aqueducts. Car drivers in Fryslân have also profited from an improved traffic flow, thanks to the raised bridges and aqueducts. Of course improved accessibility of water sports centres and villages is a benefit for the residents themselves.

Achievements of the Frisian Lakes Project include:
- 1600 moorings
- 36 new, raised or movable bridges
- construction of 5 new aqueducts
- 462 km of sailing channels have been dredged for maintenance
- 164 km of sailing channels have been deepened for upgrading for navigability
- 146 km of extra channels have been created for “large” boats
- 6 water sports centres and 15 marinas have been constructed or improved
- 31 km of new cycle paths and footpaths

**Holland Lake District – Entrepreneurs Activating the Waterway Network**

The Holland Lake District is situated in the heart of the metropolitan area of the Netherlands. The waterway network is defined by eight different lakes with mutual corridors, complemented with urban canals of Amsterdam, Utrecht, Haarlem and Leiden (Figure 9). The Lake District offers many unique opportunities for recreational and tourist activities on and along the water (Figure 10) although the area is still less well known to the general public in comparison with the Frisian Lakes.

Therefore the Entrepreneurs Platform Dutch Lakes (OPHP) was formed. This alliance of business organisations with interest in recreation and water sports in and around the Holland Lake District, has the overall objective to enhance the regional and local economy along the waterways. Two ways to achieve this objective are: to increase awareness of the area via marketing and promotion and to improve the physical accessibility via the project “Map of Opportunities” (Figure 11).

The “Map of Opportunities” is a strategic document outlining how to enhance the waterway network of the Holland Lake District. From a long list of interventions the entrepreneurs of the OPHP selected the ones with the most potential. This resulted in a list for each lake and an overall Priority List:

1. Harmonisation of operation times for bridges and locks in several provinces and municipalities and extension of operating times, especially during the tourist season. This leads towards an extended use of the waterway network.
2. Necessity of a network of high-quality moorings for visitors. These moorings
should be located in the landscape and in the various city centres.

3. Adaptation of low fixed bridges by pivoting or raising them. In this way a larger area of the waterway network will be navigable.

4. Necessity of nautical signs along the waterways and of better general and tourist information, in combination with multimedia (Internet and Apps).

**Watervision Greenport Boskoop – Seizing Opportunities**

Greenport Boskoop is an area for horticulture. Based on a survey of the waterways and all the bridges a potential waterway network was visualised with several ‘Aquapuncture’ points. From three different scenarios the town council choose to preserve the existing navigable waterway network in good condition and enhance it as soon as new opportunities appear (Figures 12 and 13).

This resulted in:
- Keeping intact two locks which connect the polder with the regional waterway network;
- Accepting the tasks and responsibilities of managing the waterways;
- Making new bridges pivoting on strategic locations;
- Stimulating the usage of waterways for the promotion of the Greenport (including Floating Flower Shows).

**Heineken: Inland Container Terminal**

Heineken as one of the largest breweries in the world has the ambition to become the greenest brewery with the smallest global footprint. This means striving for a climate-proof, sustainable economy with regard to mobility and logistics (intermodal shift from road to waterway transport); energy (wind,
solar, biogas); water (water supply, water storage, water purification); raw materials (barley, hop, yeast, water); liveability (environment – nature – landscape – society).

Heineken is exporting bottled beer from one of its large production centres in Zoeterwoude via the ports of Rotterdam and Antwerp, originally using 100,000 truck rides. Through a public-private partnership a decision was made to create an inland container terminal (OTA “Overslag Terminal Alphen”). This was coupled with an intermodal shift from road to waterway transport by using container vessels, leading to a large environmental gain (Figure 14). These waterways are also used for the import of barley and hop. The residue of the beer production is used as feed for the cows in “het Groene Hart” (the Green Heart), the agricultural district near Zoeterwoude. The resulting manure is used for the production of biogas. Biogas and wind energy are applied by Heineken factory. Attention is paid to water supply, water storage and water
EU Water Framework Directive. With the help of the Province of South-Holland this was the first successful project of Aquapuncture within the Association Region Water (Figure 15).

In all the aforementioned cases River / Canal Classification has shown to be a valuable instrument for Aquapuncture to develop both maintenance and upgrading plans (Figure 16).

**Sweden: Sea-To-Sea Connection**

For the optimal adaptation, safety and use of the waterway connection in Sweden between Kattegat and the Baltic Sea Aquapuncture can be applied. This long, 614 km waterway connects Kattegat - Göteborg - Göta älf - Trollhätte kanal - Vänern - Göta kanal - Vättern - Göta kanal - Söderköping - Baltic Sea (Figure 17). This sea-to-sea connection transverses Sweden running through beautiful landscapes and waterscapes. It is ideally suited for tourism and recreation.

Specifically for freight transport between Göteborg and the ports along the shores of Vänern the waterway has to have cross-section and sluice adaptations. An intermodal shift from road transport to water transport can thus be achieved with substantial environmental gain. To promote tourism and recreation along the waterway use can be made of multimedia, including Internet & Apps. One thinks of “Nils Holgerssons underbara resa genom Sverige”, the story of Nils Holgerssons’ journey on the neck of a goose across Sweden, written by Nobel Prize winner Selma Lagerlöf (1914), who lived in that area. It gives a fantastic overview of the whole region, seen from the air and it gives the opportunity to zoom in on all the attractions and special sites along and near the water.

**Germany: Transformation of the Ruhr Area**

The Ruhr Area as a polycentric metropolis was developed as a major bastion for the economy and employment with intensive mining activities and related heavy industries. However, in due time this area was confronted with serious environmental problems. This was illustrated by the deplorable transformation of the once meandering clean Emscher River into an open sewer in a concrete gutter, flowing through purification. Special care is taken with regard to nature development in “het Groene Hart” with flowering plants and fertilising insects (bees with honey production, butterflies) as well as predatory insects. Adaptation of the inland waterways through Aquapuncture plays a significant role in the total concept for achieving a smaller global footprint.

**Association Region Water (Vereniging Regio Water): Vliet-Schie Transient Marina**

The Association Region Water promoted the realisation of a transient marina harbour in Delft along the Vliet-Schie waterway. The purpose was to create berths for transient ships complete with facilities for drinking water and electricity supply, intake of wastewater, restrooms and a harbour office.

The initiative was very successful since the people aboard the ships went shopping, visited the old city of Delft with its museums, pubs, restaurants and hotels, thus stimulating the economy and employment. At the same time it led to improvement of the water quality in the waterway system, fitting in the

![Figure 16. River / Canal Classification for recreational boating.](image16)

![Figure 17. Cross-section adaptations will give Sweden a Sea-to-Sea connection. (Courtesy David Edwards-May / Euromapping).](image17)
the heavily polluted, densely populated industrial mining area. As a result, a decision was made to stop out-dated industrial and mining activities and to stimulate the service sector and clean production industries.

Parallel to this, a plan was developed to convert the affected area into a beautiful nature park with a restored Emscher River, meandering through the park with important recreational functions. Industrial heritage elements like blast furnaces, gas storage tanks and mining compounds were transformed with new functions like climbing towers, diving facilities, museums and art galleries. At an earlier stage a vast underground sewer system had to be constructed, coupled to wastewater purification units. The Emscher Park with its renewed relationship between water, greenery, nature and recreation is a great success and shows clearly that through the application of Aquapuncture a once deplorable area can be changed into a very attractive territory.

Scotland: Innovative Canal Connection

Edinburgh and Glasgow were once connected through the Union Canal and the Forth & Clyde Canal; these were mainly used for transport of coal, iron and other materials & goods. These two canals were connected by a series of 11 locks with a difference in height of 35 m. By the 1930s the canals had fallen into disuse and the locks were dismantled in 1933.

In the 1990s British Waterways made plans to regenerate these canals (Figures 18 and 19).

They became part of an overall strategy to reconnect Edinburgh and Glasgow with a navigable waterway, complete with a landmark fitting for the 21st century. Thus, the concept of the Millennium Link came into being. A brilliant design was made to replace the 11 locks by a boat conveyor in the form of the Falkirk Wheel. For the realisation of the Millennium Link many public and private parties were successfully involved. The waterway is mainly used for tourism and recreation. Interestingly, the Falkirk Wheel...
itself became a great tourist attraction as well as the areas parallel to all the waterfronts which were appealingly developed, including cycle and footpaths.

**Italy: Revitalisation of the Navigli Lombardi**
The city of Milan is, through a number of canals, linked to the Ticino & Lago di Como, the Adda & Lago di Maggiore and the Po. These canals are called Naviglio Grande, Naviglio Martesana, Naviglio di Paderno, Naviglio di Bereguardo and Naviglio Pavese. Leonardo da Vinci played an important role in the design of several of these canals and in the construction of elements, related to these canals, like locks, dams, mills, ferries and such. Therefore most of these canals are named together the Da Vinci Canals (Figures 20 and 21).

Originally these canals were mainly used for irrigation, defence and transport. The transport concerned marble, granite, stone, salt, grain, wine, manufactured goods, manure, ash, live stock, cheese, hay, coal, lumber, sand. Much later when the faster road and railroad came into being, the canals became to a certain extent obsolete; parts were covered and filled in. Nowadays the important cultural heritage value of these original waterways and their waterfronts is recognised. Through revitalisation they are being adapted, promoted and used for tourism and recreation.

**Israel–Jordan: Peace & Prosperity via the Red Sea–Dead Sea Connection**
The Dead Sea is a large inland saltwater body with an original surface area of 950 km² and an internal volume of 155 km³ as measured in 1900. The Dead Sea borders Jordan, Israel and the Palestinian Authority. Its main water source is the Jordan River. Since this river has been used increasingly as a source for irrigation and for drinking water the natural balance between the evaporation rate and the water inflow with regard to the Dead Sea has become completely disrupted. As a result the original water level of -390 m MSL declined to -429 m MSL, the surface area shrank to 600 km² and the Dead Sea volume was considerably reduced (as measured in 2014). This process continues. The receding seashores also create major environmental problems, causing sinkholes that endanger structures, roads, flora and fauna (Figure 22).

A Red Sea-Dead Sea connection restores the original surface area and volume of the Dead Sea and can use the hydrostatic difference for the production of desalinated seawater through membrane filtration. In this way, an important partial solution for the existing and predicted water deficit for the region, including Israel, Jordan and the Palestinian Authority can be achieved. The projected alignment is a Red Sea-Dead Sea connection, starting at Aqaba. The project consists of a sea intake lagoon and canal, pipelines, pumping stations, hydropower station and near the Dead Sea a desalination plant. This plant is using the process of hydrostatic reverse osmosis through membrane filtration. In this way desalinated seawater is produced for drinking water supply, while the resulting brine is used to bring and keep the Dead Sea at its original level. Consequently, a major part of the desalinated seawater would be...
pumped through a pipeline to Amman, the capital of Jordan; another part would be pumped to Jerusalem and Hebron.

In 2005 a tripartite agreement was signed between Israel, Jordan and the Palestinian Authority to jointly conduct a feasibility study for the Red Sea-Dead Sea connection as a “Peace Water Carrier”. The study will examine at least four main subjects:

- The environmental impact on the Gulf of Aqaba / Eilat from pumping out water
- The environmental impact on Wadi Arava from the transit of water
- The feasibility of a seawater desalination facility at the Dead Sea, especially to meet the water demands of Jordan and Palestine
- The impact on the water quality of the Dead Sea by an influx of seawater residue.

The proposed project provides a sustainable source of fresh water to Israel, Jordan and the Palestinian Authority. Furthermore, it raises the water level in the Dead Sea to the required level and will then stabilise this water level. It stimulates the economic development in the Jordan Rift Valley. The projected lagoon near Aqaba with its waterfront gives unique possibilities for the development of Aqaba. In addition, it promotes the peace process in the whole region. The World Bank, the USA, Japan and several European countries have expressed interest in participation in this ambitious project.

Further detailed research is necessary, concerning, e.g., the impact of the change in chemistry and chemical concentration of the Dead Sea on the mineral recovery process. The location and shape of the intake along the seashore have to be examined in their relation to the marine eco-system. Hydro-geological surveys in the Wadi Arava / Arava Valley have to be executed. Risk management is absolutely necessary to prevent leakage, sabotage and other attacks. Instead of integrating land into sea, this truly unique project is integrating the intake of seawater into the existing land-water system.

**Indonesia: Sustainable Land-Water Solutions for Jakarta**

Jakarta, capital of Indonesia, is the diamond clasp linking together 17,500 tropical emerald islands. The city has a very high population density, having over 10 million people on a surface area of 650 km². It is situated in a vulnerable, lowland delta of 13 rivers and Banjir Canals with 35 km coastline, facing the Bay of Jakarta. Adjacent in the hinterland are the neighbouring cities of Bogor, Depok, Tangerang, Bekasi (Figure 23).

The greater metropolitan area of Jakarta has a population of around 30 million. The scarcity of space for living, working, infrastructure, recreation and tourism is acute. At the same time the need to preserve or expand valuable environment, nature and landscape is important. Furthermore, Jakarta is in a very vulnerable position because of climate change, resulting in sea level rise, a higher frequency and intensity of storm surges and rainfall (with intermittent periods of drought), salt water intrusion and land subsidence, mainly caused by too much groundwater extraction and a too high percentage of hard surfaces. Potential earthquakes and volcanic activities have to be taken into account. The situation is aggravated by dumping of waste into the rivers and narrowing them by building obstructions in the rivers. A scarcity of blue-green arteries within the city makes a difficult situation worse (Figure 24).

Using Building with Nature® and Aquapuncture concepts, three solutions have been proposed to address the scarcity of space:

1. making better use of the third dimension (high-rise and underground development) combined with the multifunctional use of the existing space and better use of the fourth dimension (e.g., transformation of buildings and building sites);
2. using space in the existing hinterland of DKI Jakarta, insofar possible;
3. extending Jakarta through land reclamations into Jakarta Bay.

The answer will most probably be a combination of all three. The best solution for the scarcity of space is a series of well-designed land reclamations in the Jakarta Bay, using the method of Integrated Coastal Policy via Building with Nature®, striving for new flexible dynamic equilibrium coastlines with a minimum of solid seawall elements and a small maintenance factor. The series of land reclamations should and must be combined with adequate water resources management and Aquapuncture. This means removing all obstacles in the rivers and drainage canals, stopping emissions of liquid and solid waste into rivers and canals, introduction and improvement of sewer systems and wastewater purification, environment-friendly dredging, widening several rivers and canals.

![Figure 23. The original city of Jakarta and existing and proposed land reclamations in Jakarta Bay.](image)
extension of the waterway system, the replacement of existing bridges by higher bridges and/or moveable bridges, creating accessible waterfronts, river level regulation by using weirs, pumping stations and sluices. In some cases the construction of levees/dikes along sea and rivers should also be considered. In addition, calamity storage and retention basins as well as adequate blue-green arteries should be provided. Altogether, this means a huge, but necessary operation, which can only be carried out in a step-by-step approach fitting within a flexible Master Plan. In all cases this must be combined with a social resettlement programme. That is also one of the reasons why in the case of Jakarta Aquapuncture should always be combined with land reclamations. These land reclamations should be separated by waterways and lakes with sufficient width and depth and should include the extension of the Port of Tanjung Priok, building sites for living and working, space for tourism and recreation and with an adequate infrastructure of waterways, roads, railroads, pipelines and cables. The concept of the Great Garuda, an extensive plan for flood protection and land
reclamation (Figure 25) can be considered, but always in combination with Building with Nature® and Aquapuncture as well as being able to fit in a Flexible Master Plan which can be carried out in phases, segment by segment.

Making the improvement and extension of the 13 rivers and Banjir Canal system and their waterfronts a high priority is an absolute necessity in order to stop the periodic flooding of considerable areas within Jakarta. At the same time the challenge to create opportunities for the 6 potential users of the waterways remains.

**Singapore: Active – Beautiful – Clean**

Singapore is an island state, consisting of one large island and 58 smaller islands, with a population of 5.5 million on a surface of 714 km², with 32 rivers and 17 water reservoirs. Originally these rivers were used for transport of persons and goods, but also as open sewers. The rivers and their waterfronts were consequently in bad condition. Some of the rivers became straight, concrete lined, polluted canals. From a physical, chemical and biological point of view the water quality was insufficient.

To improve the situation an initiative was developed under the motto “Active – Beautiful – Clean”: a Master Plan to transform the rivers and canals step by step into blue-green arteries, to create a valuable asset in the urban fabric and the surrounding rural landscape to achieve a vibrant sustainable climate-proof liveable city. The main initiator was Mr Khoo Teng Chye, executive director of Centre for Liveable Cities (CLC). An impressive example was the transformation of a kilometres long section of the Kallang River (Figure 26).

The polluted concrete canal section was completely changed into a meandering river, bordered by green parks on each side with an upward slope towards the apartment buildings. In this way Bishan Ang Mo Kio Park came into being. In the realisation of this park Herbert Dreiseitl played an important role. The park with its river proves to be an excellent habitat for flora and fauna. In times of heavy rainfall there is room for the river to flow outward into the park on both sides. After the rainfall the river will retreat in due time in its riverbed. Furthermore the park provides for infiltration of water; introduction of green roofs give added possibilities for rain infiltration. Visual and audible warning systems are present to warn parents and children during times of heavy rainfall not to come too close to the river.

Altogether the introduction of the Bishan Ang Mo Kio Park considerably improved the liveability of this part of Singapore. Wider stretches of the Singapore and Kallang River, closer to the sea, including Marina Bay and Kallang Basin are ideally suited for the transport of persons and goods and special events like floating flower shows, dragon boat races, regatta of heritage ships, river cruises, with all the adequate facilities on the waterfronts. All the introduced physical adaptations and the necessary organisation measures form together Aquapuncture and can be further applied to the other rivers and water reservoirs with their waterfronts.

**Mexico City: Back to the Future**

Mexico City is one of the largest cities in the world with a population of around 9 million on a surface of 1,485 km². The greater metropolitan area has well over 20 million inhabitants. It is situated on a plateau with an average height of 2,250 m, surrounded by volcanoes. Mexico City was once a city in the middle of a lake, connected by dams to the lakeshores where satellite towns were located.

The original lake largely dried up because of water extraction and a gradual process of town expansion, causing Mexico City gradually to sink into a basin. A remarkable remnant is Lake Xochimilco, with its canals with a total length of 170 km and its 5000 artificial rectangular agricultural plots. These so called chinampas were originally rafts, constructed of juniper branches, covered with lakebed mud and anchored with salix trees.

Today, as in the past, a large number of small, non-motorised boats float on the water of the canals, almost exclusively used for tourism. Apart from Lake Xochimilco, Mexico City had a much stronger relationship with water. It is fascinating to note that nowadays action is taken to restore this historic relationship, be it to a limited extent. As far as possible dilapidated industrial sites are being converted into lakes and waterways with parks, recreational and other facilities, complete with cultural-historical elements.

Tenochtitlan as predecessor of Mexico City used to be the capital of the Aztecs. The city found its origin on an island in a large lake, connected to the lakeshores by a series of
dams with satellite settlements along the shores. The myth tells us that Tenochtitlan was founded on this island after siting of an eagle perched on a cactus with a snake in its beak. As coat of arms, this symbol can be found on the central white band of the Mexican green-white-red flag (Figure 27). The historical map of Mexico City shows its original location in that lake which for 80% has disappeared. Aquapuncture is being used to protect and upgrade Lake Xochimilco as a World Heritage Site and to create more lakes with attractive waterfronts for the benefit of Mexico City.

Colombia: Revitalisation Rio Medellin

Worldwide 80% of the largest cities are situated in a coast or delta position. Therefore, 20% has an inland situation, of which the majority has a relation with water (river and/or canal). A remarkable example within the last category is Colombia, since the three largest cities Bogotá, Medellín and Cali are all situated inland with a river flowing through the city: Rio Bogotá, Rio Medellín and Rio Cauca with their tributaries.

Take for example Medellín with its river. Medellín is the capital of the province Antioquia and the second-largest urban agglomeration in Colombia in terms of population and economy, with more than 3.5 million people. Its river was once used for transport of persons, materials and manufactured goods. In due time its transport function was taken over by the faster road and railroad system. The river became an open sewer and became heavily polluted. The relation between the city and the river was neglected and the necessity arose to clean up the river. Aquapuncture has become an ideal instrument to revitalise the relation between the river, the waterfronts and the city. This means adaptation of the river for the earlier defined six potential user groups in order to achieve a liveable city.

ORIGIN AND DEVELOPMENT OF THE AQUAPUNCTURE CONCEPT

The concept of Aquapuncture was initiated by Jaap Brouwer and further developed in close cooperation with Ronald E. Waterman. It found its first expression in the city of Delft within the Dutch Association Region Water (Vereniging Regio Water) of which Waterman was one of the founders.

Many cities, linked by the waterway system, became members of the association for the promotion of the usage, adaption and management of their mutual waterway system. They became members, because each of them realised that they all would benefit from this association.

In a later stage a coalition was formed with the Dutch Stichting Recreatietoervaart Nederland (SRN, nowadays Waterrecreatie Nederland) in order to take part in the European Programme Waterways Forward. Organisations from 13 countries came together for the promotion of their waterway systems.

CONCLUSION

AQUAPUNCTURE® for the optimal use, adaptation and management of inland waterways and their waterfronts, has been proven to be a successful instrument for stimulating the Blue Green Economy for regional, socio-economic and spatial development, whilst safeguarding navigability, environmental values and nature as well as safety. Adaptation of the inland waterways through Aquapuncture will continue to play a significant role in the total concept for achieving a smaller global footprint. Master classes Aquapuncture have been given in Dublin, Paris and Brussels and other presentations have been made worldwide. A post academic course in cooperation with the Delft University of Technology in the Netherlands is planned as well.

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Figure 27. From Tenochtitlan to Mexico City on the Mexican coat of arms: Tenochtitlan, the predecessor of Mexico City, was founded on an island situated in a large lake, most of which has disappeared and is now being restored. This coat of arms is found in the centre of the Mexican flag.
ABSTRACT

Striving to be an industry leader in developing safety performance and accountability in 2005, Great Lakes Dredge & Dock (GLDD) began their Incident and Injury Free (IIF) culture journey. Since then, incident and injury rates have significantly been reduced throughout all divisions of the company. The use of safety tools such as the Job Safety Analysis (JSA) and Job Safety Analysis Audit (JSA Audit) have been major contributors in the reduction of workplace incidents and injuries. The idea of allowing employees to take extra time to complete a quality JSA before every task was a great stride forward, showing the company’s commitment to their employees’ safety by putting safety before production, emphasising the IIF safety culture.

Continuing to develop and teach proper JSA procedures to all employees of the company led to the development of JSA Audits. This article looks at developing a proactive safety culture, the process of creating quality JSAs and how auditing JSAs across divisions can benefit JSA development and strategies. Furthermore, an example of cross-division JSA and JSA Audit is broken down and discussed. The article originally appeared in the Proceedings of the Western Dredging Association and Texas A&M University Center for Dredging Studies’ “Dredging Summit and Expo 2015”, Houston, Texas, USA, June 22-25, 2015 and appears here in a revised form with permission.

INTRODUCTION

Safety in dredging operations has taken on a new impetus in the 21st century. As seen in Figure 1 in a photo of three men working in 1918 without Personal Protective Equipment (PPE), safety has not always been a crucial part of GLDD’s daily operations. Throughout the company’s history, everyone accepted that the marine construction industry is particularly hazardous owing to the hostile and often unpredictable nature of the work environment both offshore and in busy ports and harbours. Suggesting that the company has grown to be where it is today without taking risks and compromising safety is a gross understatement. Having employees injured at work was previously an expected event where going just one week without an injury was deemed as something that should be celebrated.

Today the company has made great strides in making safety something personal, relevant and important across all divisions of the company and that attitude has changed. As stated in the company’s safety commitment statement: “All GLDD employees are committed to an incident and injury free work environment, in which we return safely to our families”.

In 2005 work began on a project where the client held GLDD accountable for its safety performance. The client’s safety professionals continually monitored the dredging company’s safety performance and held it to the highest level of accountability. If GLDD did not meet the high safety expectations of the client, the project would be terminated. The GLDD’s President at the time, Douglas Mackie, made a decision that would change the company’s values and the way day-to-day operations were run. He chose to elevate safe operations to be the company’s highest priority. “Not on my watch,” he pronounced. “Going forward, we are not going to hurt people who are working for us”.

The company has spent the past nine years...
Rate (TRIR) fell 36% one year after the IIF launch, nearly halved from the incident rate three years prior. Recognising that incidents and injuries were preventable and unacceptable was the large stride towards the continuing transformation of the safety culture at GLDD.

In 2007, incident rates reached a plateau, increasing 3% from 2006. After the drastic decrease in incident rates previously, the company was motivated to continue to evolve the safety culture. The IIF launch worked, fewer employees were getting injured but there were still injuries happening in daily operations. To further the progress of developing a proactive safety culture, the company teamed with consultants at the Hile Group.

The efforts shifted even more to the personal side of safety and embedded safety practices further into daily operations. All employees became involved in the safety programme, including non-operations employees and more involvement was shown from upper management. More focus was applied to awareness and training, shifting further from the rules and enforcement approach. Since teaming with the Hile Group and using safety driving toward an uncompromising “Incident and Injury Free” culture, implementing a wide variety of safety improvement strategies to do so. Elevating the safety of employees to the highest priority was the first step in transforming the safety culture surrounding dredging operations (Figure 2).

SAFETY CULTURE
A positive safety culture is not something that can be purchased or simply acquired; it is something that needs to be developed and grown from within an organisation. It can be witnessed that culturally, the marine construction industry remains a trade where employees feel that taking risks is part of their job and often times may worry about what their peers think about those who do take extra precautions. Building a safe workplace and a proactive safety culture requires constant attention and development and starts at the top. Transforming the safety culture and mindset of employees in the marine construction industry is challenging; it takes strong leaders, persistence and a personal and relevant safety programme to accomplish such a task.

Transformation
In 2005, the decision was made to change how daily operations were run. GLDD teamed up with consultants at JMJ Associates which introduced the concept of IIF (Incident and Injury Free). This introduction began the transformation of an improvident safety culture into a proactive safety culture and the company started to break away from the enforcement mentality, where employees are punished for breaking the rules and safety officers are responsible for “making work safe.” IIF introduced a personal side of safety, reminding employees of their personal relationships which could be affected by taking risks at work that result in injury.

The involvement of upper management with the IIF launch helped transform the safety culture surrounding dredging operations, reinforcing the personal side of safety. With the IIF launch came Job Safety Analysis (JSA), a safety tool regularly used in daily operations that will be explained further below. Quantitatively, the Total Recordable Incident Rate (TRIR) fell 36% one year after the IIF launch, nearly halved from the incident rate three years prior. Recognising that incidents and injuries were preventable and unacceptable was the large stride towards the continuing transformation of the safety culture at GLDD.

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A questionnaire was used to study the ‘communication atmosphere’ in supervisor-worker safety exchanges. They found that safety-related communication between supervisors and subordinates had little direct effect on workers’ safety-related events or in predicting reported injuries. Their conclusion was that safety communication in itself is not sufficient to ensure a low injury rate and that employees may see increased safety communication simply as ‘lip service’ with little commitment from managers.

A study by Meliá and Sesé (2007) distinguished between a supervisor’s ‘lip service’ and behaviour in describing two facets of supervisory safety responses to workers. The first was a supervisor’s self-applied safety response regarding the supervisor’s own safety behaviour (i.e., modelling – what the workers see), and the second was a supervisor’s safety response towards workers (i.e., what the workers hear, such as safety information, instructions as well as feedback toward worker’s safe and unsafe behaviour).

A similar distinction, labeled as Behavioral Integrity was made by Simons (2002), referring to the congruence between espoused and enacted values or between words and actions, ‘walk the talk.’ These behavioural studies suggest that safety communication is part of a larger picture including organisational safety culture, leadership and group climate (Kines et al., 2010).

Open communication is clearly part of a larger safety picture. Continued development of safety tools, along with open communication about safety between front line managers and employees is necessary to ensure the continued reduction in the incident rates in the marine construction industry. Creating an environment in which employees want to participate in and communicate about the safety programmes is a challenge, particularly in a workplace that has many resistant employees that are comfortable with the way things have always been.

When the company initially began rolling out safety initiatives, they gave their word that anyone can pull a “stop card” anywhere and anytime if they feel like it is necessary to take a time out or step back for safety, without repercussion. In a work environment that has typically been rushed and full of risks, this was a large step towards giving employees the

**SAFETY TOOLS**

There are four main components that help develop a proactive safety culture:

1. Good communication, goals and follow up actions.
2. Providing effective safety tools which allow employees to be proactive in their daily work.
3. Having effective training initiatives that teach employees how to use safety tools to their full extent.
4. Supporting safety initiatives with a strong accountability programme.

Communication between managers and employees is a large part of creating a safe work environment. Open communication allows for all employees to be made aware of the goals and expectations of safety efforts and is key to a safety programme’s success. However, studies have shown that open communication alone is not sufficient enough to ensure a low injury rate. In a study by Michael, Guo, Wiedenback and Ray (2006), a
Recognising and breaking down the task into steps is crucial to identifying the potential hazards associated with each step of the task. Identifying the potential hazards can sometimes be less than straightforward. To assist employees with recognising hazards, GLDD created the “6Ts,” which are described in the following sections.

### SAVE A LIFE TODAY

An internally developed tool that is used in daily operations across divisions is Save A Life Today (SALT). SALT is a programme that was created by various departmental managers and field employees geared for six different departments within GLDD. Books were created for employees working in the Engine Room, Tugs and Crew Boats, Dredge and Deck, Shore and Yard, Operations Support and Office Non-Operations that provide mandatory and recommended practices (Figure 4). The SALT safety rule books coordinate the Safety Management System with JSAs and safety videos. Their creation was meant to guide employees clearly and easily in daily tasks and increase consistency from project to project. SALT is a strong tool for employees to use along with JSAs and JSA audits. Since SALT was created primarily from employee input, it is a safety tool that works and provides realistic expectations of how operations should be conducted.

### JOB SAFETY ANALYSIS

What is a Job Safety Analysis (JSA)? A JSA is a procedure for a given task that integrates all known and potential hazards associated with each step of the task. JSAs also involve a meeting of all employees involved in the task where personnel review the JSA before the task is started. JSAs are also commonly referred to as job hazard analysis or job hazard breakdowns. JSAs are used for analysis of a specific task as disassembling an engine and are not meant for something broad such as overhauling an engine or as narrow as removing head nuts and washers.

There are four basic steps to conducting a JSA:
1. Recognise the task to be analysed and those employees that will be involved.
2. Break down the task into a sequence of steps.
3. Identify known and potential hazards associated with every step.
4. Determine preventative measures for each potential hazard associated with every step.

When creating a JSA it is important to include all workers that will be involved in the task, including someone with previous experience if possible. Including a variety of employees helps to ensure that the JSA will be complete and allows for the incorporation of multiple perspectives, which reduces the risk of an element being overlooked.

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<th>Major Job Steps</th>
<th>Potential Hazards</th>
<th>Recommendations to Eliminate or Reduce Hazards</th>
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Figure 5. Job Safety Analysis, Ladder Calibration.
and broken down in detail below in the “Hazard Control and Recognition” section.

Hazard Control and Recognition
The Occupational Safety and Health Administration (OSHA) breaks hazard control methods into three categories. The precedence and effectiveness are as follows, although a combination of all three is likely to be used when hazards cannot be entirely mitigated (OSHA 3071, 2002):

1. Engineering Controls which eliminate or mitigate the hazard through design or isolation, i.e., an enclosed cab, machine guards, exhaust ventilation, and such.
2. Administrative Controls which are written operating procedures, work permits and safe work practices, i.e., alarms, signs and warnings, training, buddy system, and such.
3. Personal Protective Equipment (PPE) which minimises exposure to serious workplace injuries and illnesses, i.e., hard hat, respirator, hearing protection and other personal equipment.

To assist employees with recognising and mitigating potential and existing hazards, the company developed the 6Ts – Today, Task, Tools, Tidy Up, Time Out and Transition – which was created in addition to SALT, JSAs and JSA Audit efforts. Addressing the 6Ts in each JSA has become a standard practice in daily safety operations.

The 6Ts used to identify hazards during the JSA process are:

**Today**
- Assemble the team and ensure everyone is paying attention.
- Meet at the task area to ensure specific hazard awareness of the task area is known.
- Inspect access ways to and from all of the work areas that will be visited in the task. This includes transferring to and from equipment.
- Consider the environmental aspects of the day including temperature, wind, seas, current, precipitation, deck conditions, lighting...

**Task**
- Review the task in steps. If the task is large, consider breaking the task down into several tasks and doing a JSA for each.
- Consult SALT for applicable rules and recommended practices for the task.
- Ensure each crewmember involved knows his/her role in the task.
- Recognise, analyse and mitigate the hazards of each step in the task. Be specific in the identification of hazards, and identify if the task requires permitting such as “lock out tag out”, confined space entry...
- Establish lines of communication amongst all crew members and designate signalers if necessary.
- Emphasise “hand checks,” if a tool or piece of equipment is in motion.
- Confirm how all communications will flow from beginning to the end of the job task, including how deviations from the JSA will be handled as the job proceeds.

**Tools**
- Identify, gather and inspect the tools required for each step of the task. Ask if the crew members are authorised and qualified and/or require certification to use the tools or equipment needed for this task.
- Identify, gather and inspect required PPE.

**Tidy Up**
- Clean up after the task and properly stow all tools and equipment used.

**Time Out**
- Make sure everyone agrees with the plan. If anyone doesn’t understand the task, his/her role in the task or is uncomfortable with the task, then call for a “Time Out,” and address the uncertainties.
- A time out should be called during the task if there is a change in conditions, or in crew members participating in the task or tools needed to complete the task.
- Open communication should be promoted during the JSA revision after the time out is called to ensure all workers involved in the task understand the changes to the JSA.

**Transition**
- Identify the end of the task and identify the next task and its JSA if applicable.

Including the 6Ts in every JSA has helped reduce communication hurdles amongst employees involved in tasks and has aided employees in identifying hazards through a structured format. To assist employees with understanding the importance of JSAs and the 6Ts, the process is sometimes described as something relatable, like a playbook in football. For a play to work you have to have all the players, with the proper equipment and designated responsibilities anticipating what will happen; the same is true for completing a task safely.

One of the least recognised aspects of creating JSAs is proper training and coaching. Without these, conducting an effective JSA is difficult. In addition to SALT, JSAs and the 6Ts, the company also uses an additional coaching resource, JSA Audits.

**JOB SAFETY ANALYSIS AUDIT**
The goal of having an auditing programme that goes along with JSAs is to allow for continued development of hazard recognition and prevention. Acting as an evaluation and coaching tool for JSAs, JSA Audits provide qualitative feedback and ensure JSAs remain a viable and effective safety tool in field operations. JSAs are assessed for both verbal and audible completeness with use of JSA Audits.

To complete a JSA audit successfully, the auditor must follow a general set of guidelines:

1. **Observe.** The auditor should remain just a quiet spectator and avoid participating in the task in any way. Ideally, the task leader and JSA members wouldn’t know the observer was there so it is best for the auditor to avoid taking excessive notes and limit actions. Too much interaction by the auditor may give the impression of silent judgment before the JSA is completed, which may interfere with quality of the JSA being performed.

2. **Evaluate and rate the JSA.** The auditor should complete the JSA Audit form once the JSA and task are complete, taking care to remember how each step went and if the 6Ts were recognised and used in the JSA. The 6Ts are outlined on the JSA Audit form, so noting the particulars of each, whether they are positive or negative, are important for giving feedback.

3. **Provide coaching and feedback to the JSA leader.** It is important for the auditor to give feedback without ridiculing the JSA leader. Schedule a meeting with the JSA leader to discuss the audit as soon as possible after completion of the task. Coaching should be
constructive, not destructive. As such the auditor should portray both the strengths and weaknesses in a positive manner.

4. **Provide feedback to the on-site management team and divisional safety managers.** Both the strengths and weaknesses of the JSA should be presented and the audit conversation between the auditor and JSA leader should be discussed additionally.

Most importantly the auditor should remain neutral when performing an audit. If the auditor is auditing a coworker that is also a friend, it may be difficult to give an unsatisfactory JSA rating. For the JSA Audit programme to work to its fullest capability, auditors have to give honest feedback, regardless of emotions that may be involved. Reminding employees that the programme is meant to make the workplace safer and that there will be no reprimand for an unsatisfactory JSA, is essential for transforming the quality of JSAs and the success of the JSA Audit programme.

The JSA Audit tool is fairly versatile in that it can be used within or across divisions. JSA Audits can be conducted within small groups, i.e., on a dredge for a dredge-related task where the dredge captain audits the JSA on cross-functionally, i.e., where a member of the engineering team audits a dredge-related task for dredge crew members.

Allowing auditors to audit JSAs not typically encountered in their work day has proved to be beneficial, particularly in hazard recognition. Complacency is something easily acquired when the same employees perform the same task and the same JSA day in and day out. Bringing an auditor in that hasn’t performed the task or JSA before allows for a fresh set of eyes to examine the task at hand. This has potential to bring up hazards that a complacent employee may have forgotten about or not recognised.

The JSA Audit programme is something fairly new to GLDD employees and managers. Data is collected for each completed audit and compiled for qualitative analysis. Quantitatively there has been much positive feedback from the programme. As it unfolds further, employees are seeing the benefit to giving honest ratings and feedback and avoiding letting emotions come into play. The accountability policy described below reduces the amount of emotion involved in the JSA Audit ratings. Keeping employees accountable for their actions is a key part of having successful safety initiatives and tools.

**SAFETY ACCOUNTABILITY**

The final safety tool is safety accountability. All of the safety tools used at GLDD are only successful if employees are being held accountable for their own safety and the safety of their fellow coworkers. To establish a safety accountability policy that encompasses all the safety tools used in daily operations, the company created 10 Life Saving Absolutes, or LSAs. The LSAs were generated from the SALT programme and are ten rules that must be adhered to by everyone, 100% of the time. Having an accountability policy that directly incorporates the safety tools used every day by employees is important to the success of all safety tools and to the safety of the employees using them. This accountability policy makes the safety tools and workplace
personal, relevant and important to everyone that uses them.

JOB SAFETY ANALYSIS AND AUDIT BREAKDOWN
A breakdown of a JSA form is shown in Figure 5 and a JSA Audit form in Figure 6 completed for the site engineering team to calibrate the ladder of a cutter dredge. Note that this JSA was written before the integration of the 6Ts into the JSA form. The JSA Auditor was the Chief Engineer of the dredge, who brought an outside look into the site engineering JSA allowing for additional hazard recognition.

The engine department does JSAs a bit differently than the site engineering department. This brought to light other ways in which JSAs could be done for both parties. It can be seen in this audit how auditing can assist new employees in developing their JSA skills by exposing both strengths and weaknesses in the JSA briefing and discussion. This example also illustrates how performing cross divisional audits can teach new and seasoned employees different approaches to using safety tools.

The JSA and JSA Audits allowed for collaboration between two groups within dredging operations. The discussion and comments included positive reinforcement of the areas that were proficient and constructive criticism of the areas that could be improved. Ways to improve new employees JSA skills were also part of the verbal discussion between the auditor and JSA leader. These JSA and JSA Audit are just one example of many that have proven beneficial to the development of safety tools.

In the 4th quarter of 2014, 60% of audits submitted companywide were conducted by front line supervisors. This has demonstrated that management continues to be involved in JSA leadership and coaching, one of the key aspects to a successful safety programme. From data analysis, 4% fewer JSAs were given a rating of unsatisfactory or needs improvement. 8% more JSAs were held at the task site and 7% of JSAS saw betterment in reviewing the task in steps. Quantitatively, these are just a few of the improvements that have been accomplished through the use of JSA Audits enriching JSAs being completed in daily operations.

Notable qualitative achievements so far from using the JSA Audit tool include more focus on the core rules included in SALT, particularly with confined space entry, Lock Out Tag Out and qualified operators and tools. Auditors have increased their attention to ensuring the 6Ts are addressed during the JSA and crews completing JSAs are reflecting on past injuries as part of their hazard reviews. The JSA Audits have alerted GLDD to action items that need to be further addressed in JSAs including complacency of JSA discussion for tasks occurring multiple times a day.

CONCLUSIONS
Safety in the marine construction industry, particularly dredging, has developed into a mandatory practice in daily operations. Revealing that employees can go home safely every day has been a challenge, but with an ever developing safety culture influenced by safety tools such as SALT, JSAs and JSA Audits, it will continue to become second nature.

Just as important as the safety tools and positive safety culture, is support from management. Management showing an interest in operations not only gives vital support to the effectiveness of safety tools but also gives reassurance to employees. Giving employees the comfort that it is okay to step back for safety and pull a stop card if they feel like someone is at risk for being injured is not something that was easily acquired after so many years in which production was considered as the top priority.

Progression of the safety culture transformation depends on the continued development new safety tools, open communication between employees and front line management, and continued positive re-enforcement through coaching and an accountability policy. The safety tools described here are just a few of many tools that are used in day-to-day operations at GLDD. Employees using these safety tools effectively has transformed the safety culture at the company from a workplace where employees feel like it is necessary to take risks, to a workplace where employees feel it is necessary to slow down and get the job done safely.

Continued coaching efforts and safety tool development will further reduce the total recordable incident rate making the workplace Incident and Injury Free.

REFERENCES


ABSTRACT

The capacity for the placement of shoal material dredged from Horseshoe Bend at eight wetland development sites located along the river’s bank lines adjacent to the channel was nearly exhausted in 1999. To meet the anticipated disposal requirements for future channel maintenance, several alternatives were examined. The choice was made for strategic placement of dredged sediment mid-river and beginning in 2002, strategic placement of the sediment dredged from Horseshoe Bend occurred at the mid-river open water placement area. This contributed to the development of an approximately 35 ha island mid-river. This practice of strategically placing dredged sediments upriver of a naturally occurring island aided the island’s growth and produced greater environmental benefits than otherwise would be present using more conventional placement practices.

This article originally was presented at the Western Dredging Association and Texas A&M University Center for Dredging Studies’ “Dredging Summit and Expo 2015”, Houston, Texas, USA, June 22-25, 2015 and received an award for the best project on an environmental topic. It appears here in a revised form with permission.

INTRODUCTION

During the 1990s, placement of shoal material dredged from Horseshoe Bend occurred at eight wetland development sites located along the river’s banklines adjacent to the channel. Capacity of these placement sites was nearly exhausted by 1999. Thus, to meet the anticipated disposal requirements for future channel maintenance, the US Army Corps of Engineers New Orleans District evaluated three placement alternatives:

1. convert the wetland development sites into upland disposal areas;
2. open water placement of dredged material via a long-distance pipeline into the open waters of Atchafalaya Bay; and
3. mounding of material at mid-river open water placement sites within a 350-acre (142 ha) area immediately adjacent to the navigation channel and upriver of a small naturally forming island.

The third alternative was selected on a demonstration basis to investigate the impacts of mid-river placement on shoaling trends downriver of the site. Beginning in 2002, strategic placement of the sediment dredged from Horseshoe Bend occurred at the mid-river open water placement area. Placement of between 0.5 to 1.8 million cubic yards of sediment was conducted every 1 to 3 years which influenced and contributed to the development of an approximately 35 ha island mid-river. The practice of strategically placing dredged sediments upriver of a naturally occurring island was conducted to aid the island’s growth to produce greater environmental benefits than otherwise would be present using more conventional placement practices.

GOALS AND OBJECTIVES

To help understand how and why the island was formed over the last 12 years, the USACE conducted studies to better understand the hydrology of the river used to transfer the mounded material onto the island. Information regarding ecosystem classification and mapping and floral and faunal composition of the island were conducted to document environmental and other benefits being realised. In addition, multiple moderate and high resolution aerial photographs available from prior to 2002 to the present clearly documented the growth of the island. In Figure 1 the changes from 2010, 2011 and 2012 can be seen.
The project objective was to demonstrate how dredged material can be used beneficially to nourish a naturally forming river island. Biology, ecology, geomorphology and hydrodynamics were examined to catalog the island’s maturation for determining the effectiveness of this individual project in terms of restoring, creating, enhancing, and protecting the coastal Louisiana landscape.

**STUDY RESULTS**

A multi-factor ecological assessment of dredged material supported wetlands located within the Atchafalaya River, Louisiana was conducted. Sample locations included:

- Island E – a traditional dredged material supported wetland island,
- Horseshoe Bend Island – a dredged material supported wetland island created based upon Engineering With Nature (EWN) principles, and
- Middle Island – a mature, naturally formed wetland island.

Within each of the three wetlands, multiple ecological assessment factors were evaluated including:

- geomorphic evolution,
- ecosystem classification and distribution,
- floral communities,
- avian communities,
- aquatic invertebrates,
- soils and biogeochemical activity, and
- hydrodynamic and sediment transport processes.

The multi-factor approach provided a comprehensive assessment of each wetland island and facilitated identification of differences between the three study areas. For example, Horseshoe Bend Island and Island E contained forested, scrub-shrub, emergent, and aquatic bed wetland classes; while Middle Island contained only forested and emergent wetlands. Horseshoe Bend Island contained the highest plant species richness (82 species; 85% native vegetation). Surveys of bird populations on Horseshoe Bend Island yielded a high number of breeding wading birds in dense, mixed-species nesting colonies including 79% juveniles, indicating that the island supports a productive nesting colony. Island E and Middle Island did not support wading bird nesting colonies.

Examinining invertebrate communities, the creation of islands using dredged materials supports the formation of emergent aquatic bed habitats that contain significantly higher amounts of fine particles and organic matter than river shoreline sediments, resulting in significantly higher infaunal abundance.

As a result, Horseshoe Bend Island and Island E displayed significantly higher infaunal species richness than Middle Island. Soils at Horseshoe Bend Island and Island E both displayed evidence of frequent inundation (average period of inundation 316-365 days); while Middle Island exhibited fewer indicators of frequent overbank flooding.

Both dredged-material-supported islands provide nutrient cycling functions including estimated nitrogen removal rates of 2,000-3,800 kg NO3-/year, indicating the ability to improve water quality. However, denitrification rates for these recently formed wetland features remain lower than values reported in other published studies from the region.

The strategic placement of dredged materials at Horseshoe Bend has the potential to provide improved navigation benefits, yet no known studies had examined the impact of open water dredged material placement in this riverine setting. To address this data gap, two modelling efforts were undertaken examining the hydrodynamics and sediment transport characteristics occurring at Horseshoe Bend Island. The Lower Atchafalaya River, Louisiana represents an important navigable waterway linking the Gulf of Mexico and inland communities and waterways. The range of hydrological cycles...
and tidal conditions of Atchafalaya Bay provides a typical river-lake-estuary-bay system hydrodynamics response.

The system is thus controlled by hydrology, meteorology and astronomical tides with varying time scales. Upstream, river hydrodynamics near Morgan City, Louisiana remain dominated by hydrological influence and tidal flows that modulate the strong river inflows, especially during the spring and summer wet season. Downstream areas are dominated by micro-tidal circulation patterns influenced by weather patterns.

Figure 2. Mean suspended sediment transport rate from January through March, 2012.

Figure 3. Mean bedload transport rate from January through March, 2012.

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JACOB BERKOWITZ is research soil scientist at the USACE Engineering and Research Development Center. His research focuses on wetland assessment and the biogeochemistry of wetland soils and he has worked in wetlands in over 35 states. He obtained a B.S. in environmental science from the University of North Carolina Asheville, a M.S. in soil and water sciences from the University of California Riverside, and a PhD in wetland biogeochemistry from Louisiana State University.

SUNG-CHAN KIM is a research hydraulic engineer at US Army Engineer R&D Center, Coastal and Hydraulics Laboratory, Vicksburg, Mississippi. He earned BSc in Oceanography and MSc in Geological Oceanography from Seoul National University, Korea in 1977 and 1982, respectively, and received PhD in Marine Science from The College of William and Mary in 1990. Prior to joining USACE in 2001, he worked at National Weather Service in Maryland and Virginia Institute of Marine Science.

NATHAN BEANE is a research forester at the US Army Engineer R&D Center, Environmental Laboratory, Vicksburg, Mississippi. He obtained his bachelor’s degree in Forestry from the University of Arkansas-Monticello, and earned his Master’s and PhD in Forest Resources from West Virginia University. Dr. Beane conducts research throughout the US and in both civil and military arenas, focusing on forest stand and plant community dynamics.
Creating Horseshoe Bend Island, Atchafalaya River, Louisiana

HORSESHOE BEND ISLAND
As part of the Dredged Material Management Plan (DMMP) in force, relocation of the authorised Federal channel through Horseshoe Bend was studied. The proposed relocation of the channel to the east at Crewboat Cut can reduce maintenance dredging over 0.76 million cubic metres (1 million cubic yards) per year. A three-dimensional hydrodynamic model, CH3D, was applied to the Lower Atchafalaya River and adjacent Atchafalaya Bay to assess the formation of the Horseshoe Bend Island in the Atchafalaya River to gain a more complete understanding how the island footprint is being created. A two-dimensional model, RMA-2, was developed to simulate Atchafalaya River flow conditions.

The changes in velocities were analysed to determine potential impacts of relocating the channel. Sediment transport was also simulated to study erosion and deposition. The RMA-2 model utilised the model’s grid and bathymetry data for defining boundary conditions in the area. To assess the formation of the Horseshoe Bend Island, the CH3D hydrodynamic model was developed to gain an understanding about how the island footprint is growing and to serve as input into models determining the transport of sediments from dredged material seed mounds placed upstream of the island. The model analysed the hydrodynamics around the island and determined sediment transport characteristics. The hydrodynamic model will also help identify the processes associated with hydrodynamics and sediment transport of the island’s creation and growth.

The results of the CH3D model proved strongly related to hydrological forcings. When linked with a transport model, GTRAN, sediment transport rates indicated possible deposition toward the northern shore and erosion from the southern shore of Horseshoe Bend Island. Sedimentation rates remained elevated during the wet season with an estimated maximum volume transport rate of 9.66 m3/m/s (Figure 2) and 0.71 m3/m/s (Figure 3) as suspended and bedload sediments respectively.

The hydrodynamic and sediment transport results indicated that the innovative use of dredged materials in this riverine environment supports wetland formation and expansion while providing habitat, hydrologic and biogeochemical functions.

The multi-factor assessment can be used in future studies examining the ecological, societal, and economic value of the strategic placement of dredged material applied in this...
manner. The study demonstrated that each of the factors examined at Horseshoe Bend Island proved comparable or exceeded the other wetland study areas examined, including the naturally formed riverine island and a traditionally created dredged material supported island (Figure 4).

This innovative beneficial use of dredged material for creating Horseshoe Bend Island can be applied in other riverine project scenarios to demonstrate the success and potential benefits of this application of the Engineering With Nature practice of utilising natural processes for improving wetland creation and restoration outcomes.

**Engineering With Nature (EWN)**

EWN is a USACE initiative that seeks to support more sustainable practices, projects, and outcomes. The four key elements of EWN include:

1. use science and engineering to produce operational efficiencies supporting sustainable delivery of project benefits,
2. use natural processes to maximum benefit thereby reducing demands on limited resources, minimising the environmental footprint of projects, and enhancing the quality of project benefits,
3. broaden and extend the base of benefits provided by projects to include substantiated economic, social, and environmental benefits, and
4. use science-based collaborative processes to organise and focus interests, stakeholders and partners to produce more broadly acceptable projects.

**ENVIRONMENTAL BENEFITS**

Previous studies only provided qualitative documentation of the fauna, flora and geomorphology of the island. Recently quantitative surveys of the plant communities that have developed on the island (Figure 5) have been completed. The results of these surveys indicated that Horseshoe Bend Island provides habitat and biogeochemical functions at rates comparable or exceeding observations made at a traditional dredged material supported island and a natural reference island in the area.

Wetland classification and analysis of geomorphic features demonstrated that Horseshoe Bend Island provides a variety of habitat types supporting complex communities of vegetation, invertebrates, soil microbes and higher organisms (i.e., avian species; Figure 6). The distribution of forested, shrub-scrub, emergent, and emergent aquatic bed habitat types corresponds to the natural distribution reported throughout the study area. Horseshoe Bend Island contains a wide variety of vegetation including >85% native species, with species richness values exceeding observations from both traditional dredged material supported and natural reference areas (Figure 7).

The Engineering With Nature design utilised at Horseshoe Bend Island resulted in landscape and landform characteristics (e.g., distance from shore, flooding regime) that support a large, successful wading bird rookery.

Figure 5. Left, The infaunal community sampling locations at Horseshoe Bend Island. Right, Infaunal sampling utilised a 7.5 cm coring device.

Figure 6. A diverse assemblage of native plant and animal life has colonised the island. Left to right, A juvenile tricolored heron, a juvenile snowy egret and an ibis chick were observed in nests on the island during nesting season (July 2014).
Horseshoe Bend Island also supports more invertebrate abundance and diversity than natural islands in the region that lack the emergent aquatic bed landforms resulting from the strategic placement of dredged materials. Finally, the soils at the Horseshoe Bend Island display a capacity to sequester nutrients and other compounds and perform water quality functions at levels comparable to natural wetlands in the region.

**ECONOMIC BENEFITS**

The project uses natural processes to maximum benefits, thereby reducing demands on limited resources, minimising the environmental footprint of the project and enhancing the quality of project benefits. Economic benefits are being realised as the enlarging island has reduced the overall cross sectional area of the river, increasing the river's flow through the navigation channel to velocities that were sufficient to reduce shoaling and maintenance dredging requirements.

Costs were lower than the conventional approach because all other placement alternatives required additional equipment and land-rights to convey dredged material over long distances. Signs of human activity were also noted on the island, as the presence of shotgun shells signified that the island was being used for hunting. Intentionally aligning natural processes in the river with engineering processes via strategically mounding dredged material is realising tangible environmental, social and economic benefits.

**CONCLUSIONS**

The Atchafalaya River island project exemplifies what can be achieved through the application of EWN concepts and practices. Current EWN activities include documenting current USACE projects exemplifying the approach and communicating across the technical community and with USACE partners and stakeholders. Sediment dredged from the adjacent Federal navigation channel during routine maintenance was strategically placed in mounds upriver of the island over a period of 12 years. The mounded material was dispersed by the river’s currents to self-design the island over time.

The transferability of these developments has been established. These investigations further quantifying the multiple benefits of using dredged material to create such riverine islands will provide a more complete understanding of the formation of the island so this concept can be integrated into other dredging projects in coastal Louisiana and elsewhere, thereby providing substantial environmental, social and economic benefits as part of ongoing USACE maintenance dredging activities.

**REFERENCES**


Beyond Sand & Sea: 50 Years of Maritime Masterpieces
Published by IADC.
220 pp. €24.95.

To celebrate the 50th anniversary of the founding of the International Association of Dredging Companies, the staff and members have assembled an impressive array of photographs and information that tells the story of the last 50 years of dredging achievements as depicted through 50 iconic projects.

The book is divided into 5 decades and highlights the major changes that occurred in those periods: 1965-1975: Port renewal, coastal protection and environmental awareness; 1975-1985: Oil exports from the Middle East – from crisis to construction; 1985-1995: An economic boom for Asia and the dredging industry; 1995-2005: Land reclamations you can see from space; and 2005-2015: Onshore and offshore: ports, pipelines and coastal protection.

These chapters reflect the fact that in the last five decades the dredging industry has grown from maintenance of harbour, ports and access channels to major contributors to a broad variety of maritime infrastructure projects. Spanning the globe, these projects represent gigantic land reclamations for airports and new ports and port expansions. They are witness to the development of the offshore oil and gas sectors as well as the emergence of sustainable energy sources such as offshore windmills.

The photographs and satellite images speak for themselves: remarkable shots of artificial islands from SARB oil fields in Abu Dhabi to the Hong Kong airport platform, from the Manifa Field Causeway in Saudi Arabia to the Panama’s Punta Pacifica for residences. All these represent the most important breakthrough achievements of the industry. In addition, environmentally motivated projects such as the Eastern Scheldt barrier and the Maeslantkering in the Netherlands testify to the search for sustainable solutions meeting the challenges of climate change.

What distinguishes the achievements of the IADC members over these past 50 years is their commitment to innovation: new forms of contracts, early contractor involvement, investments in new environmentally sound technologies and support of research institutes such as EcoShape/Building with Nature, the pursuit of quality personnel and encouragement of higher education programmes in dredging. On-the-job safety has also become a central concern. All these subjects are touched upon in this compendium in word and pictures of an industry that is often unseen, but whose influence on world trade, the impacts of climate change and the environment is quite extraordinary.

The book is published as a limited edition and can be ordered directly from the IADC.

For further information:
www.iadc-dredging.com
info@iadc-dredging.com

Online and Interactive: Facts About Turbidity & Dredging
Turbidity is a natural phenomenon, a background quality in all bodies of water. It describes the optical quality of water – its clarity or transparency or lack of. Natural events such as storms, heavy rains and floods can increase the degree of turbidity. But so does dredging. What are the effects of turbidity caused by dredging versus those caused by natural occurrences? One difference is that turbidity or increases in murky water caused naturally are unpredictable and uncontrollable whereas dredgers can predict and implement systems to curb negative impacts. Whatever the maritime project may be, learning about recent developments in compensating for turbidity are well worth taking into account especially when a maritime project is planned in pristine and sensitive environments. Although each project must be considered on a case by case basis, pro-active steps can control and minimise adverse effects. In many cases, the long-term effects are generally less dramatic than is commonly believed. Facts About Turbidity & Dredging will help you discover ways to keep clear water clear and protect indigenous marine fauna and flora. Reducing turbidity related to dredging is a realisable goal.

Facts About is a series of concise, easy-to-read online brochures which give an effective overview of essential facts about specific dredging and maritime construction subjects. Each brochure provides a ‘management summary’ for stakeholders seeking basic knowledge of a particular issue. These brochures are part of the IADC’s on-going efforts to support clients, consultants and others in understanding the fundamental principles of dredging and maritime construction.

51st SEMINAR ON DREDGING AND RECLAMATION
OCTOBER 26-30, 2015
IPC CORPORATE UNIVERSITY, BOGOR-CIAWI, INDONESIA

Aimed at (future) decision makers and their advisors in governments, port and harbour authorities, off-shore companies and other organisations that have to execute dredging projects, the International Seminar on Dredging and Reclamation has been organised by the International Association of Dredging Companies (IADC) in various locations since 1993.

Often presented in co-operation with local technical universities, the IADC Seminar has a week-long Seminar especially developed for professionals in dredging-related industries. In the past this intensive course has been successfully presented in The Netherlands, Singapore, Dubai, Argentina, Abu Dhabi, Bahrain and Brazil. This seminar was inspired by the dredging works going on in the region in combination with a request from IPC Corporate University. IPC Corporate University focusses on certifications for the Maritime – Ports – Logistics branches.

As is appropriate to a dynamic industry, the Seminar programme is continually updated. In addition to basic dredging methods, new equipment and state-of-the-art techniques are explained. The Seminars reflect IADC’s commitment to education, to encouraging young people to enter the field of dredging, and to improving knowledge about dredging throughout the world.

Highlights of the programme
To optimise the chances of the successful completion of a project, contracting parties should, fully understand the requirements of a dredging project. This five-day course strives to provide an understanding through lectures by experts in the field and workshops, partly conducted on-site in order to give the “students” hands-on experience. Subjects include:
- overview of the dredging market and the development of new ports and maintenance of existing ports;
- project phasing (identification, investigation, feasibility studies, design, construction, and maintenance);
- descriptions of types of dredging equipment and boundary conditions for their use;
- state-of-the-art dredging and reclamation techniques including environmental measures;
- site and soil investigations, designing and estimating from the contractor’s view;
- costing of projects and types of contracts such as charter, unit rates, lump sum and risk-sharing agreements;
- design and measurement of dredging and reclamation works; and
- Early Contractor Involvement.

An important feature of the Seminars is a trip to visit a dredging project being executed in the given geographical area. This gives the participants the opportunity to see dredging equipment in action and to gain a better feeling of the extent of a dredging operation.

Each participant receives a set of comprehensive proceedings with an extensive reference list of relevant literature and, at the end of the week, a Certificate of Achievement in recognition of the completion of the coursework. The Seminar starts Monday, October 26 at 8:45 hrs and ends Friday, October 30 at 17:30 hrs. Please note that full attendance is required for obtaining the Certificate of Achievement.

Costs
The fee for the week-long seminar is 37.5 million Indonesian rupiah (€ 2,795), exclusive VAT where applicable. Accommodation at the university is included from Monday, October 26 to Friday, October 30 (check-out). Breakfast, lunch and dinner are included as well.

For more information on the IPC Corporate University in Bogor-Ciawi, Indonesia see http://www.ipc-corporateuniversity.com/

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EUROPEAN DREDGING SUMMIT
OCTOBER 6-8, 2015
ANTWERP, BELGIUM

ACI’s European Dredging Summit 2015 will discuss essential dredging strategies and environmental monitoring for project approval. The meeting will provide a global analysis of dredging projects, environmental regulations and recommendations for dredging activity including equipment and contractor selection. Participants will learn how to solve the major problems when developing a successful dredging project, discover global opportunities of future project locations and their financial value as well as network with industry most experienced individuals. Exclusive APEC-Antwerp/Flanders Port Training Center, DEME Headquarters and Antwerp City Hall Site Visit will take place on Tuesday, October 6. There is no extra charge to attend the site visit, but spaces are limited and allocated on a first come first served basis.

For further information or to register your attendance contact:
Mado Lampropoulou
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PIANC USA/COPRI/ASCE DREDGING 2015
OCTOBER 19-22, 2015
HYATT REGENCY, SAVANNAH, GEORGIA

PIANC USA/COPRI/ASCE Dredging 2015 Conference with the theme “Moving and Managing Sediments” will take place on the riverfront of Savannah’s Downtown Historic District. The format will include plenary sessions, concurrent technical sessions, short courses, tours and a large industry exhibit hall. More than 140 track presentations covering the latest developments and innovations regarding: Savannah Harbor’s Expansion; Confined Disposal Facilities; Climate change impacts on dredging; Regional sediment processing facilities; Case studies outside North America; New port and channel dredging in developing countries; Monitoring for quality of life parameters; Engineering with Nature; Innovations in equipment; and more.

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CEDA DREDGING DAYS
NOVEMBER 5-6 2015
AHOY ROTTERDAM, THE NETHERLANDS

The full programme for the forthcoming CEDA Dredging Days 2015 “Innovative dredging solutions for ports” is now available. The conference and exhibition will be held November 5-6, 2015 in conjunction with Europort 2015 at Ahoy Rotterdam, the Netherlands. An optional technical visit will be organised to one of the 30 locations of the Dutch Water Programme, “Room for the River” on the afternoon of November 4th.

CEDA Dredging Days is widely considered as an invaluable forum for leading researchers and industry experts to discuss and share dredging challenges, solutions and experiences. This year’s conference will feature 25 peer reviewed technical papers by experts from a range of countries. Further highlights of the programme include:
- The keynote address, ‘Implementation of sustainable design solutions in port development’ will be given by Tiedo Vellinga, Director Environmental Monitoring Maasvlakte 2 - Port of Rotterdam.
- An expert panel, chaired by P Laboyrie, Witteveen+Bos, the Netherlands and Chairman of CEDA Environment Commission, will discuss the question “When is your project sustainable?” in an interactive session with the audience.
- A session of Young CEDA Pitch Talks chaired by A de Heer, Witteveen+Bos, the Netherlands and Chairman of Young CEDA.
- A Student Programme under which CEDA offers some 50 free registrations to graduate and post-graduate students who have shown great affinity with dredging technology within their studies.
- The IADC Young Author Award will be presented to an author under the age of 35 for an outstanding contribution to the literature.

For further information contact:
• Email: info@westerndredging.org
https://www.westerndredging.org/index.php/events/wodcon-xxi

World Dredging Congresses (WODCONs) are organised once every three years by WODA, the World Organization of Dredging Associations. First organised in 1967 in New York and held throughout the world since, this series of congresses has become the most important event for dredging professionals worldwide. WODCON XXI with the theme “Innovation in Dredging” will showcase some 120 technical papers over three days covering all aspects of dredging and maritime construction.

Interested authors are invited to submit one page abstracts (less than 400 words). The abstracts must contain a descriptive title, author(s) contact information (name, company, address, phone, email).

Deadline for abstracts is September 15, 2015. Abstracts presenting both practical applications as well as applied research are encouraged. Abstracts are to be emailed to the chair of the respective regions (CEDA, EADA or WEDA).

For further information contact:
• Email: info@westerndredging.org
https://www.westerndredging.org/index.php/events/wodcon-xxi

PIANC-COPEDEC IX CONFERENCE
OCTOBER 16-21, 2015
RIO DE JANEIRO, BRAZIL

The overall theme for the PIANC-COPEDEC IX Conference is “Enhancing Waterborne Transport and Coastal Development – The challenge of reaching integrated solutions”. The subjects to be covered on proposals include: Port Engineering, Port Planning and Management, Port, harbour and marina planning and layout, Inland Navigation, Short Sea Shipping and Coastal Navigation, Coastal Engineering, Coastal Zone and Coastal Risk Management, Port and Coastal Environmental Issues and Climate Change and Port and Waterborne Transport Logistics and Multi Modal Transport.

Abstracts must be submitted by October 31, 2015 and can only be submitted as a PDF and must be submitted as 2 pages.

For more information about the conference and submissions:
MEMBERSHIP LIST IADC 2015
Through their regional branches or through representatives, members of IADC operate directly at all locations worldwide

AFRICA

BKI Egypt for Marine Contracting Works S.A.E., Cairo, Egypt
Dredging and Reclamation Jan De Nul Ltd., Lagos, Nigeria
Dredging International Services Nigeria Ltd., ikoyi Lagos, Nigeria
Nigerian Westminster Dredging and Marine Ltd., Lagos, Nigeria
Van Oord Dredging and Marine Contractors B.V., Representation office, Luanda, Angola
Van Oord Nigeria Ltd., Victoria Island, Nigeria

ASIA

Beijing Boskalis Dredging Technology Co. Ltd., Beijing, PR China
Boskalis International (S) Pte. Ltd., Singapore
Boskalis Smit India LLP, Mumbai, India
Dredging International Asia Pacific (Pte) Ltd., Singapore
Hyundai Engineering & Construction Co. Ltd., Seoul, Korea
International Seaport Dredging Private Ltd., New Delhi, India
Jan De Nul Dredging India Pvt. Ltd., India
Jan De Nul Singapore Pte. Ltd., Singapore
P.T. Boskalis International Indonesia, Jakarta, Indonesia
Penta-Ocean Construction Co. Ltd., Tokyo, Japan
PT Van Oord Indonesia, Jakarta, Indonesia
Toa Corporation, Tokyo, Japan
Van Oord (Malaysia) Sdn Bhd, Selangor, Malaysia
Van Oord (Shanghai) Dredging Co. Ltd., Shanghai, PR China
Van Oord Dredging and Marine Contractors B.V., Baku, Azerbaijan
Van Oord Dredging and Marine Contractors B.V., Representation office, Hanoi, Vietnam
Van Oord Dredging and Marine Contractors B.V., Branch office, Hong Kong, PR China
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Van Oord India Pvt Ltd., Mumbai, India
Van Oor Thai Ltd., Bangkok, Thailand
Zinkcon Marine Singapore Pte. Ltd., Singapore

AUSTRALIA + NEW ZEALAND

Boskalis Australia Pty. Ltd., Sydney, Australia
Dredging International (Australia) Pty. Ltd., Brisbane, QLD, Australia
Jan De Nul Australia Ltd., Australia
NZ Dredging & General Works Ltd., Maunganui, New Zealand
Van Oord Australia Pty Ltd., Brisbane, QLD, Australia
WA Shell Sands Pty Ltd., Perth, Australia

EUROPE

Atlantique Dragee Sarl, St. Germain en Laye, France
Baggermaatschappij Boskalis B.V., Papendrecht, Netherlands
Baggerwerken Decloedt & Zoon NV, Oostende, Belgium
Ballast Ham Dredging, St. Petersburg, Russia
Baltic Marine Contractors SIA, Riga, Latvia
BKW Dredging & Contracting Ltd., Cyprus
Boskalis International B.V., Papendrecht, Netherlands
Boskalis Italia Srl., Rome, Italy
Boskalis Nederland B.V., Rotterdam, Netherlands
Boskalis Offshore Subsea Contracting B.V., Papendrecht, Netherlands
Boskalis Sweden AB, Gothenburg, Sweden
Boskalis Westminster Ltd., Fareham, UK
Boskalis Westminster Middle East Ltd., Limassol, Cyprus
Boskalis Westminster Shipping BV, Papendrecht, Netherlands
BW Marine (Cyprus) Ltd., Limassol, Cyprus
DEM Building Materials NV (DBM), Zwillenicht, Belgium
Dragapor Dragagens de Portugal S.A., Alcochete, Portugal
Draavo SA, Italia, Amelila (TR), Italy
Draavo SA, Lisbon, Portugal
Draavo SA, Madrid, Spain
Dredging and Contracting Rotterdam b.v., Bergen op Zoom, Netherlands
Dredging and Maritime Management S.A., Capellen, Luxembourg
Dredging International (Luxembourg) SA, Luxembourg, Luxembourg
Dredging International (UK) Ltd., East Grinstead, UK
Dredging International N.V., Zwillenicht, Belgium
Heinrich Hirdes G.m.b.H., Hamburg, Germany
Irish Dredging Company Ltd., Cork, Ireland
Jan De Nul (UK) Ltd., Ascot, UK
Jan De Nul n.v., Hofstade/Aalst, Belgium
Jan De Nul Group (Sofrida S.A.), Capellen, Luxembourg
Mijster Zand- en Grinhandel bv, Gorinchem, Netherlands
Nordees Nssbagger-und Tiefbau GmbH, Bremen, Germany
Paans Van Oord B.V., Gorinchem, Netherlands
Rock Fall Company Ltd., Aberdeen, UK
Rohde Nielsen, Copenhagen, Denmark
Sociedade Española de Dragados S.A., Madrid, Spain
Società Italiana Dragaggi SpA ‘SIDRA’, Rome, Italy
Sociedad de Dragage International ‘SXI’, Lambersart, France
Sodraoco International S.A.S., Armentières, France
Sodranord SARL, Le Blanc-Mesnil Cédex, France
Terramare Esti OU, Tallinn, Estonia
Terramare Oy, Helsinki, Finland
Tideway B.V., Breda, Netherlands
TOA (LUX) S.A., Luxembourg, Luxembourg
Van Oord (Gibraltar) Ltd., Gibraltar
Van Oord ACZ Marine Contractors bv, Rotterdam, Netherlands
Van Oord Belgie BVBA, Zee, Belgium
Van Oord Deutschland GmbH, Bremen, Germany
Van Oord Ireland Ltd., Dublin, Ireland
Van Oord Middle East Ltd., Nicosia, Cyprus
Van Oord Nederland bv, Gorinchem, Netherlands
Van Oor nv, Rotterdam, Netherlands
Van Oord Norway AS, Oslo, Norway
Van Oord Offshore bv, Gorinchem, Netherlands
Van Oor UK Ltd., Newbury, UK

MIDDLE EAST

Boskalis Westminster (Oman) LLC, Muscat, Oman
Boskalis Westminster Al Rashaid Co. Ltd. , Al Khobar, Saudi Arabia
Boskalis Westminster Middle East Ltd., Abu Dhabi, UAE
Boskalis Westminster Middle East Ltd., Manama, Bahrain
Gulf Cobia (Limited Liability Company), Dubai, UAE
Jan De Nul Dredging Ltd. (Dubai Branch), Dubai, UAE
Middle East Dredging Company (MEDCO), Doha, Qatar
National Marine Dredging Company, Abu Dhabi, UAE
Van Oord Bahrain SPC, Manama, Bahrain
Van Oor Gulf FZE, Dubai, UAE

THE AMERICAS

Boskalis International bv Scurural Argentina, Buenos Aires, Argentina
Boskalis International Uruguay S.A., Montevideo, Uruguay
Boskalis Panama SA, Panama City, Panama
Compagnia Sud Americana de Dragados S.A., Buenos Aires, Argentina
Dragabras Servicos de Dragagem Ltda., Brazil
Dragamex SA de CV, Mexcio City, Mexico
Dravensia C.A., Caracas, Venezuela
Dredging International de Panama SA, Panama
Dredging International Mexico SA de CV, Veracruz, Mexico
Jan De Nul do Brasil Dragagem Ltda., Brazil
Mexicana de Dragados S.A. de C.V., Mexico City, Mexico
Van Oord Canada Ltd., Calgary, Canada
Van Oord Curaçao nv, Willemstad, Curaçao
Van Oord de Mexico, S.A. de C.V., Mexico City, Mexico
Van Oord Dragagens do Brasil Ltd., Rio de Janeiro, Brazil
Van Oord Marine Contractors Canada Ltd., Ontario, Canada
Van Oord Offshore (USA) LLC, Houston, Texas, USA
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