(Click on text to navigate to a specific page or element.)

Table of Contents

Resources and web pages taken from IIHR – Hydroscience & Engineering http://international.uiowa.edu/

you're going somewhere

Egypt

International Perspectives in Water Science & Management

Dec. 26, 2008–Jan. 11, 2009

Application Procedure and Deadline

Completed applications must reach The University of Iowa's Office for Study Abroad by September 15, 2008. The application includes the application form, available from OFSA (http://international.uiowa.edu/study-abroad/), the most current transcript of grades, a letter of recommendation and a non-refundable application fee of $35. Early application is encouraged, as the number of participants is limited and applications will be reviewed as they are received.

Prospective applicants should make an appointment with Study Abroad Adviser Autumn Tallman Picazo. Students should also discuss their plans with their academic adviser and other appropriate faculty.

For more information, please contact:

Office for Study Abroad

1111 University Capitol Centre
The University of Iowa
Iowa City, IA 52242
319-335-0353
study-abroad@uiowa.edu

The University of Iowa
INTERNATIONAL PROGRAMS

egypt

International Perspectives in Water Science & Management Dec 26, 2008–Jan 11, 2009

Course Overview

International Perspectives in Water Science & Management (IPWSM) is a study abroad program organized each year in a country or a world region for an intensive and in-depth exposure to historical, cultural, social, economic, ethical, and environmental issues impacting water resources projects to prepare students for careers in a global marketplace. Ongoing and future water resource development projects are subject to worldwide scrutiny, and it is proper that today's student, and tomorrow's water professional have first-hand knowledge of the realities and complexities of issues that extend well beyond hydraulics, hydrology and related engineering disciplines. Since 1998, IPWSM has focused on particular water resources projects in selected world regions, including the Narmada Valley in India, the island nations of Taiwan & Japan, the Three-Gorges Dam in China, the lower Danube River basin in Hungary, Poland and Romania, the Itaipu Dam–the largest in the world–on the border of Brazil and Paraguay, and the Southeast Anatolia Project in Turkey. Since 2005, the course has been placed under the International Association of Hydraulic Engineering and Research's (IAHR) Engineering Graduate School Environment Water (EGW) auspices.

Academic Program

Students register for 165:841 and receive departmental credit for 053:185. The course starts with preparatory lectures presented by experts on the history, culture, and water resources projects in Egypt. Lectures will be held on The University of Iowa campus during October–December 2008. The course finishes with post-visit written reports by participants. During the visit abroad, participants will interact with local students, faculty, and experts in jointly organized workshops. The workshops will emphasize the planning, socio-economic and environmental impacts, rehabilitation programs and problems, legal, cultural and institutional aspects of water resources projects. Participants will also visit technical, historical, and cultural sites.

Specific Activities Tentatively Planned

The short course is organized by IIHR—Hydroscience & Engineering (IIHR) in cooperation with Cairo University, Egypt. Activities are planned to encourage interaction of course participants with local university students. Workshops and lectures will be held at government agencies with participants from academia and industry. The technical focus will include field visits to major hydraulic structures on the Nile River, Suez Canal, including large-scale flood prevention and mitigation projects and hydro-power plants; irrigation systems in the Nile River Delta; and water treatment plants, maritime ports. In addition, cultural and historical tours of various sites are planned in Cairo, Giza, Luxor, and Aswan.

Eligibility

The multidisciplinary course is directed to seniors and graduate students who wish to become engineers, economists, planners, legal and management specialists, and environmental, social and political scientists. It is also suitable for students with an international studies major, professionals and young faculty members working in water-related fields.

Academic Recognition

Each participant can earn 0–3 semester hours of credit (0–3 in the ECTS system depending on agreement with the instructors regarding assignments and methods of evaluating student's work.

Course Instructors

Dr. Marian Muste, *IIHR*
Dr. Tarek Salaheldin, *Cairo University, Egypt*
Dr. M. Elhakeem, *IIHR*

Cost

The estimated cost for the short course will be posted to the program webpage and will include fees, lodging, meals and travel within Egypt, and all educational and administrative costs. Participants are expected to obtain the appropriate travel visa and pay for their travel to and from Egypt.

Financial Aid & Scholarships

In general, financial aid received to attend the University of Iowa may be applied toward the cost of studying abroad. Aid eligibility is adjusted to reflect the total cost of participating in the program. In addition, UI students are encouraged to apply for need- and merit-based scholarships awarded by the Office for Study Abroad. Complete information is available at: http://international.uiowa.edu/study-abroad/funding/ Additional funding may be available from IIHR. Contact Dr. Marian Muste for details: marian-muste@uiowa.edu




International Perspectives in Water Resources Management is a study abroad program initiated in 1997 by IIHR – Hydroscience & Engineering that offers intensive and in-depth exposure to students about issues impacting water resources worldwide. Each year, the program focuses on a different world region, preparing students for careers in a global marketplace. The course in Egypt was organized by IIHR in cooperation with Cairo University, Helwan University, the Egyptian Ministry of Water Resources & Irrigation, the Egyptian National Water Research Center, and Stanley Consultants.

Activities

Activity 1	
Meeting (10/21/08)	
	Course history
	Course Description
	Course logistics
Activity 2	
Meeting (11/11/08)	
	"Travel in Egypt: Being a Responsible Guest" - Hope Fitzgerald, Lecturer, Department of French & Italian, Univeristy of Iowa
	Registration Information - Autumn Tallman, Office for Study Abroad
	Course Itinerary
Activity 3	
Orientation Meeting (12/06/08)	
	"Pre-departure Orientation for UI Students Traveling Abroad" presented by Office for Study Abroad
Activity 4	
Meeting (12/12/08)	
	Administrative updates
	NSF Workshop information
	Practical travel tips
	Project teams and topics selection
	Preperation of reference
Activity 5	
Course Tour (12/26/08 - 01/11/09)	
Activity 6	
Project Development (01/12/09 - 03/15/09)	

Course Tour

Illustrated Journey

Day:	Date:
1	Dec 28
2	Dec 29
3	Dec 30
4	Dec 31
5	Jan 1
6	Jan 2
7	Jan 3
8	Jan 4
9 & 10	Jan 5 & 6
11	Jan 7
12	Jan 8
13	Jan 9
14	Jan 10

Brief samples of the group in action


New Year's Feast


Dinner Cruise


Camel Rides

Dec 28	Dec 29	Dec 30	Dec 31	Jan 1	Jan 2	Jan 3
Jan 4	Jan 5	Jan 6	Jan 7	Jan 8	Jan 9	Jan 10

December 28th, 2008

On the first full day with all of the group members, the students were introduced to the guides from Dana Tours, Ms. Lou and Maged, who would most often be seen carrying an umbrella to lead the way through crowded historical sites. In the early afternoon the students fought off jetlag and boarded the bus for a visit to Coptic Cairo. The area encompasses a number of structures that were built by Coptic Christians throughout many centuries. Here the group was given a brief summary of the unstable history of the Christian and Jewish religions in Egypt. The sites visited included the Roman fortress, the Saint Virgin Mary's Coptic Orthodox Church (also known as the Hanging Church), the Church of St. George, and the Ben Ezra Synagogue. Following the visit to the Coptic area, the group visited the Al-Azhar Mosque in El Hussein Square, which is home to one of the oldest educational institutions in the world. Upon entering the mosque, everyone removed their shoes and the ladies covered their hair as is customary in the Muslim religion. There was also a quick visit to the Sabil of Muhammad Ali Pasha where people obtained drinking water in the 1800s. After returning to the hotel, a few students with dwindling hopes of tracking down lost luggage before departing for southern Egypt went to nearby shops to replace some necessities. The day concluded with dinner on the Nile River aboard the Fish Boat Abou Zeid restaurant. This full first day gave the students a glimpse of the fast paced schedule that lay ahead.


LEFT: James at the Church of St. George. CENTER: Al-Azhar Mosque. RIGHT: Students at the Hanging Church.

LEFT: Students at Al-Azhar. RIGHT: Dinner at the Fish Boat Abou Zeid restaurant.

LEFT: Traveling through a market. CENTER: Al-Azhar Mosque. RIGHT: Maged with the iconic umbrella.

COPTIC CAIRO

Coptic Cairo sits in an area of a Roman fortress originally developed in the 2nd century AD as a "Babylon-in-Egypt". One of the two towers has been carefully excavated from layers of rubble and debris that have built up over hundreds of years. The Monastery and Church of St. George sits on the foundation of the other tower. Inside the structure is a shrine to the church's namesake, a Palestinian soldier in the Roman army who was imprisoned, tortured, and later executed in 303 AD for practicing Christianity. The nearby Coptic museum and Hanging Church show the planning that went into the construction of these buildings. The church's arched roof represents an inverted form of Noah's Ark, and the thirteen pillars supporting it stand for Jesus and the twelve disciples. Intricate wood carvings cover the interior walls, while mosaics surround the walls of the garden outside the church. A short walk away between cobbled walls is the Ben Ezra Synagogue. Originally built as a church in the 4th century, it was converted to a synagogue in the 9th century. Rabbi Ben Ezra restored the synagogue in the 12th century, and it now bears his name. Near this site, there are historical accounts of baby Moses being found in the Nile River and the Holy family seeking shelter here for a short time after Jesus' birth.

December 29th, 2008

The course participants flew from Cairo to Luxor in the afternoon. The flight gave a bird's eye view of the Nile River valley splitting through the vast African desert. Following a scenic drive through the agricultural areas surrounding Luxor, the group checked in on board the Queen Isis which would be home for the river cruising portion of the trip. After tea and snacks, everyone headed to the bus for the quick drive to the group's first ancient site in southern Egypt. As the sun set, the group arrived just and was given a brief tour of the Luxor Temple. The participants then had time to explore the lit up complex and examine the statues, pillars, and intricately carved stones. The boat remained docked in Luxor overnight.

LEFT: Luxor Temple at night. RIGHT: Matt with some locals.

LEFT: Side view of Luxor Temple. RIGHT: Statues of Ramses II at Luxor Temple entrance.

LUXOR TEMPLE AND AVENUE OF THE SPHINXES

The Luxor Temple was built largely during the reign of Amenhotep III (1380–1352 BC) and the reign of Ramses II (1279–1213 BC). An obelisk and two seated statues of Ramses II flank the entrance to the temple. Only one of the two original granite obelisks remains here. The twin was removed by French archaeologists; it now sits on the Place de la Concorde in Paris. The entrance proceeds into a series of courtyards which were used during the Festival of the Opet. Closed bud lotus flowers and open papyrus stems adorn the top of the columns surrounding the courts. This site was partially buried under sand and rubble for hundreds of years during which time a mosque was built extending into and over one of the courts. Carvings showing the pharaohs and gods carrying the key of life are throughout the temple. Highlights of the many sunken reliefs in this temple are Ramses II's many sons and military victories and the godly conception of Amenhotep III; fertility was particularly important to Egyptians during this time. Beyond the temple is an impressive pathway of sphinxes. Future excavations may reveal that the Avenue of Sphinxes spans the two miles between the Luxor Temple and the Karnak Temple.

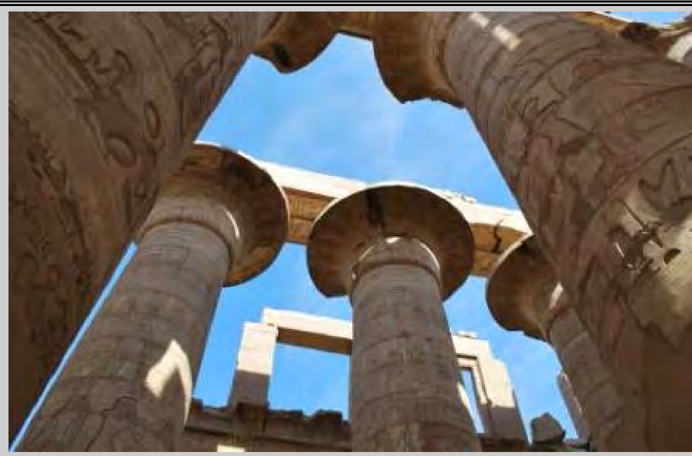
December 30th, 2008

While driving by the fields, the group had the chance to see the irrigation canals branching out from the Nile that enable agricultural production on the West Bank. The road was quickly engulfed by desert terrain as we neared the winding road that follows the ancient burial procession into the Valley of the Kings. The visitor's center at the entrance has an intricate three-dimensional display showing the locations of the tombs. The group visited three tombs—the Tomb of Ramses VII, the Tomb of Seti II, and the Tomb of Tausert/Setnakht. The excavation of a newly discovered tomb was also seen. After visiting the Valley of the Kings, the bus stopped at an alabaster factory where we watched a demonstration of the painstaking process of hand-carving alabaster vases. Then the group visited the Temple of Siti I, also known as Hatshepsut's Temple. The presence of the three-tiered structure stretching across base of the desert hills is as impressive as the temple's elaborate reliefs and paintings on its stones. The last site the group visited on the West Bank of Luxor was the Colossi of Memnon, where two enormous stone statues are all that is left from what is thought to be one of the largest temples in Egypt. After crossing back to the east bank of the Nile, the group visited the Karnak Temple, a massive labyrinth of columns and pylons. The complex was constructed throughout many dynasties, and we learned that is the largest temple surrounded by enclosure wall in the world.
In the late afternoon, we were formally introduced to our Egyptian hosts Dr. Tarek Salaheldin and Dr. Rasha Elkholy, who are professors at Cairo's National Water Research Center and Cairo University, respectively. The students had a great time getting to know the professors and their families. The group was also joined by Ms. Lou's daughter and niece, who were visiting from Montenegro. After a busy day visiting historical sites, the group enjoyed a boat party hosted by the crew with several of the other passengers. Many of the students dressed up in Egyptian costumes and took part in the festivities, which included some comical games.


LEFT & RIGHT: Students display the carvings at Hapshepsut's Temple.


LEFT: Students at the Valley of the Kings. RIGHT: Tourists dwarfed at Karnak.


LEFT: Old friends enjoying some free time at Valley of the Kings. RIGHT: Mike poses at Hatshepsut's Temple.



LEFT: Amazing view at Karnak.



LEFT: Mike shows off some fashion. CENTER: Jess dances at the boat party. RIGHT: LlynnAnn and Jess relax on the boat.

LEFT: Valley of the Kings from a distance. RIGHT: Students circle a carving at Karnak.

VALLEY OF THE KINGS

A tram at the Valley of the Kings takes sightseers between the visitor’s entrance and the tombs. 63 tombs have been discovered in the Valley of the Kings. Most of the kings of Egypt were buried from here 1550-1069 BC. The tombs were positioned in Theban hills of the West Bank for protection, however nearly all of the tombs were robbed by thieves over thousands of years. The famous tomb of Tutankhamun is the only tomb to be discovered untouched, but there are currently excavations of two possible tombs. Most of the tombs are empty except for some that still house empty sarcophagi. The elaborate reliefs and paintings are quickly being deteriorated by the high humidity due to large numbers of tourists, so only some of the tombs are open to visitors.

HATSHEPSUT'S TEMPLE

The Temple of Siti I, or Hatshepsut’s Temple, is a stunning structure located on the West Bank near Luxor. It was built for Queen Hatshepsut who ruled Egypt from 1479 to 1458 BC. A long ramp leads to the second terrace of the three-level temple. Though a number of reliefs were defaced after her death by her stepson and successor, Tuthmosis III, there are many colorful carvings and drawings that remain or have been restored.

KARNAK

Karnak is a massive complex built for the Theban gods covering nearly 250 acres. Its four precincts were built over 1300 years. The greatest precinct is that of Amun, which is dedicated to the great Temple of Amun-Ra. In the Great Hypostyle Hall, two rows of six columns that once held a roof tower 84 feet above the floor; more than 60 42-foot tall columns surround them on each side. Enormous granite obelisks and stone pylons are among the other structures at Karnak. Floods and earthquakes have weathered some of its’ details, but Karnak’s vast size makes it the most visited site in Egypt, second only to the Great Pyramid.

December 31st, 2008

The boat docked in Edfu where the participants split up into groups of four for exhilarating horse-drawn carriage rides through the streets to the Edfu Temple. Although quite crowded inside, the group had the opportunity to see some of the most well-preserved hieroglyphics of any temple. While cruising between the ancient historical sites, many of the students (and even Marian!) basked in the warm afternoon sun on the top deck of the boat. When the boat arrived in Kom Ombo, the group enjoyed an enchanting moonlight visit to the Kom Ombo Temple. The unique temple was built for two gods rather than one and is symmetrical. The site has a “Nilometer”, otherwise known as a groundwater observation well which was once used to determine taxes. Two of the hundreds of mummified crocodiles found at the site were on display in the crypt. After the visit to the Kom Ombo Temple, the crew treated us with an elaborate feast followed by dancing to celebrate the New Year.

LEFT: LlynnAnn and Kara at the Edfu Temple. RIGHT: Group photo at Edfu.

LEFT: Ladies at the New Year celebration. RIGHT: New Year's feast.

LEFT: Dustin dons local attire. RIGHT: Jeremy commandeers a carriage.

LEFT: Kom Umbo at night. RIGHT: The Nilometer.

LEFT: Students gather at Kom Umbo. RIGHT: Another group photo.

LEFT: Marian enjoyes some well-earned relaxation on the boat. RIGHT: Mike befriends a shopkeeper.

EDFU TEMPLE

The Edfu Temple is the second largest temple in Egypt. It was built for the falcon god, Horus. The entrance has a 120 foot (36 meter) pylon with huge reliefs depicting the prowess of Horus and Ptolemy XII, who reigned when the temple was completed in 57 BC. This is most well-preserved temple in Egypt because it was built above the floodplain and was completely buried in sand for hundreds of years. Excavation began only in the mid-1800s. Inside the temple is the Court of Offerings which is surrounded by 32 columns. Two hypostyle halls then lead into a series of chambers, each one darker the last, and ultimately into the Sanctuary of Horus.

Dec 28	Dec 29	Dec 30	Dec 31	Jan 1	Jan 2	Jan 3
Jan 4	Jan 5	Jan 6	Jan 7	Jan 8	Jan 9	Jan 10

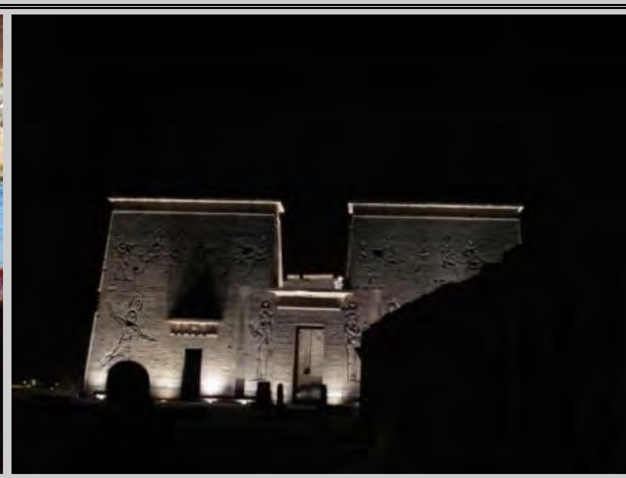
January 1st, 2009

The first visit of the day was to the Unfinished Obelisk where a massive cracked obelisk still lies abandoned in a huge granite quarry still partially connected to the stone. Had the obelisk been finished, it would have stood as the largest single stone used in any of Egypt's ancient structures. Following the Unfinished Obelisk, the group visited Egypt's major hydraulic structure, the Aswan High Dam. Dr. Tarek gave a detailed description of the construction and specifications of the dam. He also discussed environmental issues that have risen since the Nile River was first dammed. Unfortunately, we were not able to tour inside the dam, but detailed cross-sectional views showed the observation tunnel that runs through the center of the enormous earthen dam. Back at the boat, the group members got out their lifejackets in preparation for a sailing on the Nile. The group was awarded an enchanting felucca ride, sailing the Nile's late afternoon winds as the sun faded behind the adjacent sandstone hills. In the evening, some of the group members explored the shops in Aswan searching for Egyptian treats and souvenirs before the group left for the "Light and Sound Show" at a temple situated on a cliff above the Nile.

LEFT: Marian rests at the Unfinished Obelisk. RIGHT: Windy day at the Aswan High Dam.


LEFT: Group photo at the Aswan Dam. RIGHT: Ladies at the Unfinished Obelisk.


LEFT: The group sails on the Nile. RIGHT: Mike and Jess sit on the bow.

LEFT: Most of the group relax on the sailboat while Paul and Jesse tempt fate. RIGHT: Light and Sound show!

ASWAN HIGH DAM

The Aswan Dam was built to control the Nile River's summer floods and generate hydroelectric power. Despite being the largest dam in the world when it was completed in 1902, it was too low and had to be raised twice. In 1946, the Nile River nearly overtopped the dam, so a new dam was built rather than raising the dam a third time. Construction of Aswan High Dam began in 1958 about 4 miles (6 kilometers) upstream from the old dam. The 2.4 mile (3,830 meter) long dam was completed in 1960 and has a hydroelectric capacity of 2.1 gigawatts. Lake Nasser, the reservoir upstream from the dam, stretches 340 miles (550 kilometers), even into Sudan. The 130 million acre-feet (157 cubic kilometer) reservoir took thirteen years to fill to capacity. The dams were built to allow for more of the Nile River Valley to be safely irrigated, though the farmland no longer receives the fertile sediment that used to be carried by the floods. The reservoir displaced many Nubian tribes and flooded some archaeological sites, but a number and devastating floods and droughts have been prevented.

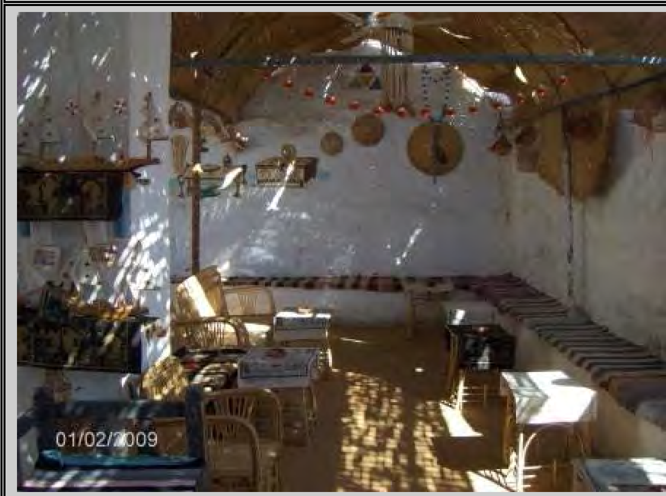
January 2nd, 2009

After enjoying another boat ride, the group stopped at a Nubian village on the banks of the Nile downstream from the Aswan Dam. Students had the chance to hold an eerily calm baby crocodile, but thankfully everyone escaped with all of their fingers intact. A sand art demonstration and traditional Nubian dancing and singing followed hibiscus and mint tea. Some students also had henna, a plant-derived paste commonly used for body art, painted in Nubian patterns on their wrists or arms. The visit was finished by exploring the shops around the village. The group spent one more afternoon relaxing on the Queen Isis before packing up and departing the boat for the last time. The group boarded a sleeper train at the Aswan train station and headed north to Cairo. Though the train was not as conducive to sleeping as the other accommodations, the group members had the chance to experience a common method of travel between northern and southern Egypt.

LEFT: Group members on the roof of the boat. RIGHT: Kara holds an infant crocodile.

LEFT: The group enjoys some hibiscus tea. RIGHT: Nubian resident entertains us with music.

LEFT: Habib holds the crocodile. RIGHT: More music from the locals.



LEFT: Typical Nubian dwelling. RIGHT: Marian and a few of the ladies bargain with a shopkeeper.

January 3rd, 2009

After arriving back in Cairo, the group checked into the Intercontinental Pyramids Park Hotel in Giza. An authentic Egyptian lunch included hummus, salad, kofta, and baklava. The group then took a long bus ride through the crowded downtown streets in Cairo. The students were greeted at the Nile City Towers by Jim Kemper of CSG Engineering, whose parent company Stanley Consultants, Inc. was founded in nearby Muscatine, Iowa. (C. Maxwell Stanley's name also adorns the IIHR Hydraulics Laboratory on the University of Iowa campus.) Mr. Kemper described his many experiences working internationally as an engineer. He also discussed the benefits and options that students should consider for international careers. That evening the group split up and walked around in downtown Cairo. One group enjoyed tea in the gardens at the Marriot Hotel, while the other stopped at a hookah bar. The day finished off with a delicious buffet of Egyptian cuisine.

CENTER: Students visit the CSG Engineering office to meet with Jim Kemper

January 4th, 2009

The professors from the United States joined the group on the 4th. This marked the first year that a professor from another university participated in an IIHR international perspectives course. In the morning, the group traveled from Cairo to Alexandria by bus along the "desert highway". The first destination was the Catacombs of Kom es-Shoqafa which is an impressive network of tombs carved from the bedrock. The group also visited Pompey's Pillar—one Alexandria's few ancient monuments to survive the numerous earthquakes throughout the centuries. After touring Pompey's Pillar, the group strolled along the coast of the Mediterranean Sea near Qaitbay Castle where some of the remains of the Lighthouse of Alexandria were recently discovered. Mohamed, IIHR student and Egyptian host, graciously treated everyone to ice cream before going to the Bibliotheca Alexandrina, an emulation of the ancient library in Alexandria. The architecture and design of the new building was stunning. Students toured the library and its exhibits which included rare manuscripts, maps, and antiquities. The participants indulged in a traditional Mediterranean lunch at the Fish Market Restaurant with a beautiful view of the Mediterranean Sea. Pitas and a variety of dips were served as appetizers, and the grey mullet and calamari were the fresh catch of the day. Before the drive back to Cairo, the group drove through the Al-Montazah gardens. Everyone had a chance to walk around the breakwater near the bay where the Farouk Bridge and Al-Montazah Palace stand.

LEFT: Larry, Mike and Carmen on the Mediterranean coast. RIGHT: LlynAnn and Kara in the Pompey's Pillar

LEFT: Students relax at Pompey's Pillar. RIGHT: Group photo at Pompey's Pillar.


LEFT: James and Kara on the Mediterranean Coast. RIGHT: Mike and Jess at Pompey's Pillar.

LEFT: Larry and Mike on the coast. RIGHT: LlynnAnn on the coast.

CATACOMBS OF KOM ES-SHOQAFA AND POMPEY'S PILLAR

The catacombs of Kom es-Shoqafa were discovered in 1900 when supposedly a donkey fell through the ground into the spiral staircase that descends into the ground. The complex was originally built in the 2nd century, but it was expanded for over 300 years, and it became considered a medieval wonder of the world. Roman, Greek, and Pharaonic elements decorate the subterranean hallways. At the base of the staircase is a large banquet chamber where mourners gathered to grieve following the funeral. There are three levels carved from the bedrock and tombs are as deep as 110 feet, though the lowest tier is now below the water table.

Sitting a short distance from the catacombs is a single 100 ft granite column named Pompey's Pillar after Cleopatra's brother, though is was actually built for emperor Diocletian in 291 AD. The pillar is surrounded by the ruins of the ancient settlement where the Temple of Serapeum stood. Students explored the excavated hallways of the 'daughter library' of the Library of Alexandria which contained extra texts and overflow from the historical library. Nearly everything but the pillar was destroyed in 391 AD during the early Christian antipagan movement. Excavations have revealed a nilometer and a few sphinxes, though.

BIBLIOTHECA ALEXANDRIA

The contemporary architecture and design of the enormous seven-level structure ranks the Bibliotheca Alexandrina as one of the top libraries in the world, even without the eight million book capacity. The library was finished in 2002 and intended to be a contemporary replacement for the Library of Alexandria, which was a major center of learning during ancient times. The large reading room's disc-shaped glass roof shines in the Mediterranean coast sun, and the exterior walls are decorated with symbols from every known alphabet. Similar to so many of Egypt's ancient temples, the roof is supported by many open-papyrus shaped stone columns. In addition to countless texts, the library houses an extensive collection of drawings, maps, photos, and manuscripts from Egypt, the Mediterranean, and the Middle East dating back hundreds of years. There is also a series showing in the evolution of the printing press that culminates with a machine capable of reproducing entire books with the push of a button.

January 5th and 6th, 2009

On January 5th and 6th, the group members returned to Cairo to participate in a two day workshop titled “Broadening the Role of Cyberinfrastructure in Water Resources Management: Coping with the Challenges of Large River Basins”. The workshop was sponsored by a grant from the National Science Foundation and was jointly organized by Dr. Marian Muste and Dr. Mohamed Elhakeem of IIHR-Hydroscience & Engineering, Dr. Rasha Elkholy of the National Water Research Center in Cairo, and Dr. Tarek Salaheldin of Cairo University. The workshop took place at the National Water Research Center located along the banks of the Nile. Course participants were awarded with presentations by distinguished Egyptian and American professors and researchers followed by lively group discussions. During a break from the presentations, we toured the large scale models used in research and the advanced research laboratories at the NWRC. After the workshop on January 5th, the women workshop participants gathered for the Women Scientists’ Meeting to discuss their perspectives about the role of women in science and engineering in Egypt and the United States. Following the workshop on January 6th, the professors met for a networking reception. Later in the evening, the workshop participants met aboard a Nile cruise boat for dinner. The entertainers on the boat included a belly dancer and an incredible spinning performer. After dinner some of the guys comically served as captains of the boat.

LEFT: The NSF workshop begins. RIGHT: Intriguing presentation by Professor Sameh Abdel-Gawad.

LEFT: Group discussion. RIGHT: Professors compare presentations.

LEFT: Tour of scale hydraulic model. RIGHT: Students admire NWRC model.

LEFT: Group photo at the conference. RIGHT: Marian enjoys lunch with some of the students.

LEFT: Mike and James steer the boat. No injuries were reported. RIGHT: Craig Just tries his hand at the wheel.

January 7th, 2009

The morning following the workshop, the group departed for the nearby Giza Necropolis. Standing at the base of the Great Pyramid, the group was dwarfed by the incredible size and amazed by the precision of the ancient structure. A number of students and professors made the grueling climb through the winding passage that leads to the King's chamber. Before touring the Great Sphinx of Giza, the group had a chance to ride camels on the edge of the desert with the famous panorama of the pyramids in the backdrop. The group went to perfume and papyrus shops afterwards to see modern fabrications of ancient Egyptian productions. After leaving the necropolis, the group visited the Egyptian Museum in Cairo which holds numerous invaluable antiquities that have been discovered in the tombs and temples throughout Egypt, including the full collection of artifacts discovered untouched in King Tutankhamun's tomb.
In the evening, everyone shopped in the streets of the Khan el-Khalili bazaar, a popular destination for tourists to buy souvenirs. The group also visited the Al Hussein Mosque which is adjacent to the bazaar.



LEFT: James and Jessica. CENTER: Old friends with their new mentor. RIGHT: Matt puts things in perspective.


LEFT: Group Photo. The pyramids forgot to smile. RIGHT: Keri gets ready for the camel ride.

LEFT: LlynnAnn and Kara lead the caravan. RIGHT: Craig deftly poses for a photo while taking one of his own.

LEFT: Travis and Jesse are very excited about the pyramids. RIGHT: Jesse gets fresh with the Sphinx.

LEFT: Mike and Larry relax. RIGHT: Pyramids and squares.


LEFT: Marian and Miki pose with a new friend. RIGHT: Keri and Jess enjoy some grilled corn on the cob.


LEFT: Marian relaxes with some shisha. RIGHT: James carefully selects a perfume.


LEFT: Everyone relaxes at the perfume shop. RIGHT: Khan el-Khalili bazaar.

GIZA NECROPOLIS

The Great Pyramid of Khufu (Cheops) is the largest pyramid at the Giza Necropolis, and it is the only structure from the seven wonders of the ancient world that still stands today. Its square base is 756 ft wide, and it stands about 480 feet tall. The pathway to the king's chamber near the center of the pyramid is hundreds of feet long. On the south side of the Great Pyramid sits the Solar Barque Museum, which houses the barques, or boats, thought to have been used to transport the pharaoh's mummy on the Nile River. East of Pyramid of Khafre, or the middle pyramid, sits the Great Sphinx of Giza. The monolith structure was carved from bedrock in the shape of a lion with a human head. It is 241 feet long by 20 feet wide and 65 feet tall.

Dec 28	Dec 29	Dec 30	Dec 31	Jan 1	Jan 2	Jan 3
Jan 4	Jan 5	Jan 6	Jan 7	Jan 8	Jan 9	Jan 10

January 8th, 2009

The group had the opportunity to visit Cairo University on the 8th. Professors from the Irrigation and Hydraulics Engineering department gave presentations about their research projects, and a tour of the department's research facilities was given. During the tour, American and Egyptian researchers had a chance to compare some of their views on the research equipment, and the students saw fluid mechanics labs similar to those at the University of Iowa. Afterwards, the Iowa students were introduced to the Cairo University students. In addition to the students discussing graduate studies at their respective schools, Mike and Jess gave a short presentation about college life at the University of Iowa. All of the students were very enthusiastic to discuss their university experiences and their research. After leaving Cairo University, the students and professors enjoyed a leisurely lunch at the picturesque Hilltop Restaurant with views of the Citadel, the City of the Dead, and historic areas of Cairo. Adjacent to the restaurant was Al Azhar Park. After dessert everyone took a few hours to explore the park's gardens, water channels, and fountains.

LEFT: Students at Cairo University. RIGHT: Professors pose for a group photo.

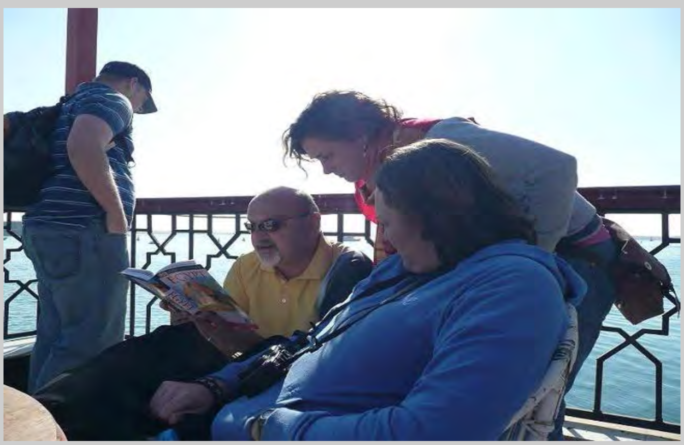

LEFT: Students and Professors from both Universities. RIGHT: Jess, Kara and James at the Hilltop Restaurant.


LEFT: James, Kara and Jess relax in the Al Azhar park. RIGHT: Tasty desert at the Hilltop Restaurant.


LEFT: Students tour the University of Cairo labs. RIGHT: Students at the hydraulics lab at Cairo University.

January 9th, 2009

The day started with a drive to Port Suez to see the Suez Canal. The canal enables ships to travel from the Indian Ocean to the Middle East and Europe by connecting the Mediterranean and Red Seas. After a quick ride down the seaside highway the group stopped at resort situated on a sandy beach of the Red Sea. A relaxing day of free time on the beach was perfect as the fast-paced trip neared its conclusion. Besides lounging on the beach, the students looked for seashells in the sand, played soccer and volleyball, and danced around the pool.




LEFT: Marian reads about the Suez Canal while students look on. RIGHT: The group relaxes for tea.


LEFT: Beach volleyball on the Red Sea coast. RIGHT: LlynnAnn, Mike and Jess at the Red Sea.

LEFT: The IIHR group makes its mark on the beach. RIGHT: More sand volleyball.


LEFT: Jesse and Mike display the diversity of size amongst the IIHR students. RIGHT: Dustin relaxes near the Suez Canal.

SUEZ CANAL

After a number of failed attempts over hundreds of years, including a miscalculation by Napoleon's engineers, construction on the modern day Suez Canal began in 1859. It lasted ten years, and the canal was officially declared open in 1869. The canal connecting the Mediterranean and Red Seas is 101 miles long and 38 feet deep. It was operated under French and British control until 1956 when Egyptian President Nasser took control of the waterway by military force. The annual shipping tolls for a typical year are $3.2 billion, a significant percentage of Egypt's external revenue. An average of 55 ships pass through the canal each day, totaling nearly 20,000 ships per year.

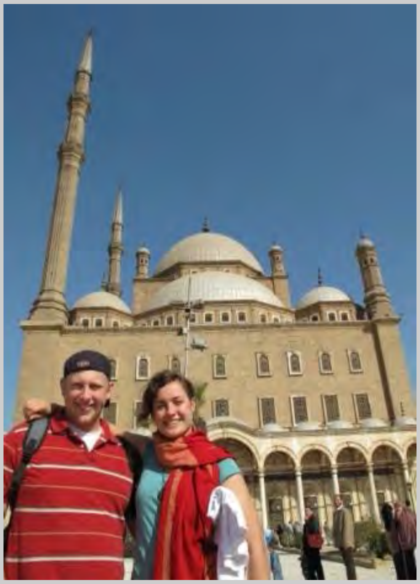
Dec 28	Dec 29	Dec 30	Dec 31	Jan 1	Jan 2	Jan 3
Jan 4	Jan 5	Jan 6	Jan 7	Jan 8	Jan 9	Jan 10

January 10th, 2009

After a quick jaunt to an Egyptian cotton shop, the group headed to the Citadel and Muhammad Ali Mosque. The group finally had time to visit the promontory fort and mosque after seeing this site many times while traveling around Cairo. Outside the mosque, the group members were awarded a panoramic view of the city. The sky was unusually clear of smog, so many of the Cairo sites that we had toured could be identified in the skyline including the distant pyramids at Giza. In the afternoon, the group also toured the Mosque and Madrasa of Sultan Hassan which has an impressive open air courtyard surrounded on four sides by vaulted halls with intricately carved interlocking stones. Adjacent to the 14th century mosque, is the Al-Rafai Mosque. Many tombs are located inside the mosque, including those of last shah of Iran and King Farouk, the last king of Egypt.


LEFT: Muhammad Ali Mosque. RIGHT: Students relax while Maged gives a history lesson.


LEFT: Group photo overlooking Cairo. RIGHT: The final group photo!

LEFT: James and Jess at the Citadel. RIGHT: Intricate stone work. RIGHT: Students pass under high arches.

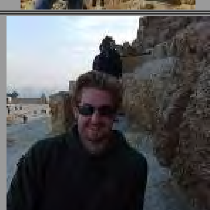
CITADEL OF SALAH AL-DIN

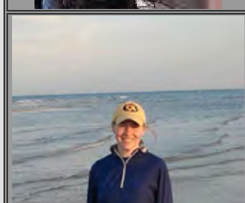
The Citadel of Salah al-Din was originally built in 1176 as protection during the Crusades. Over hundreds of years the site has been controlled by the Mamluks, the Ottomans, the French, and the British. The Muhammad Ali Pasha Mosque is the highlight of the site. The first floor of the mosque is encased in alabaster, for which it is sometimes called the Alabaster Mosque. The clock in the mosque's courtyard was given by King Louis-Philippe of France as a gift for the second obelisk from the Luxor Temple. While touring inside, the adhan, or call to prayer, was given.

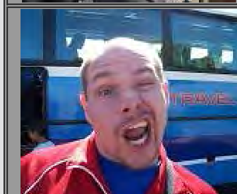
University of Iowa and University of Minnesota Staff Participants

			
Craig Just	**Keri Hornbuckle**	**Larry Weber**	**Mohammed Elhakeem**
			
Marian Muste	**Miki Hondzo**	**Thanos Papanicolaou**	

University of Iowa Student Participants

	Name and status	Pre-trip comments:	Favorite moment:
	**Carmen Langel** *IIHR Program Associate and Graduate Student seeking MBA*	I want to get to know some great people (group participants and people in our host country) and learn more about Egypt's unique water resources challenges. I am most excited about seeing a part of the world that I haven't visited before.	My favorite moment was standing on the deck of our boat, watching the other cruise ships, the fishermen and the Nile River shoreline.
	**Dustin Tardiff** *Undergraduate student seeking B.S. in Mechanical Engineering*	I want to see some good sights, learn a good deal and gain a new cultural perspective. I am most excited about seeing the Giza Pyramids.	My favorite moment was standing in the Red Sea with waves up to my waist.
	**James Johansen** *Graduate student seeking M.S. in Civil & Environmental Engineering*	I am excited about experiencing a new culture. I hope to learn more about the Nile River basin.	My favorite moment seeing the pyramids.
	Jeremy Bril	I want to learn about a different culture and to explore a different part of the world. I have never been out of the country before and I am	My favorite moment was relaxing on the beach of the

	*Graduate student seeking M.S. in Civil & Environmental Engineering (Emphasis: Water Quality)*	very excited. I am most excited about seeing all the historical sites and learning the similarities and differences between research projects on the Mississippi and Nile Rivers.	Red Sea.
	**Jessica Kilgore** *Undergraduate student seeking B.S. in Civil & Environmental Engineering*	I am excited to see the great Egyptian monuments like the temples and the pyramids that I've seen so many times since I was a little girl in books and movies. I am also excited to get to experience a culture that is so different from ours here in the US.	My favorite moment was riding camels in the shadow of the pyramids, something I was counting down to the entire trip until it actually happened.
	**Jess Smith** *Undergraduate student seeking B.S. in Civil & Environmental Engineering*	I want to gain a broader understanding of what is considered in the concept of designing water infrastructure. I am most excited about experiencing a new culture while getting to know classmates and touring water facilities.	My favorite moment was hearing our tour guide yell "Dana!" to get our attention.
	**Jesse Piotrowski** *Graduate student seeking M.S. in Civil & Environmental Engineering (Emphasis: River Hydraulics)*	I want to gain a better understanding of how international collaboration is conducted. I am most excited about seeing the Aswan Dam and traveling on the Nile River.	My favorite moment was nearly having a heart attack in Cairo traffic. It's a sight to behold!
	**Kara Prior** *Undergraduate student seeking B.S. in International Studies and Environmental Science*	I want to gain a general understanding of Egyptian water management and culture. I am most excited about being on the Nile River.	My favorite moment was holding a baby crocodile.
	**LlynnAnn Luellen** *Graduate student seeking M.S. in Civil & Environmental Engineering*	I want to learn about Egypt's large water resources projects and their environmental impacts. I am most excited about being immersed in a new, different culture from my own. I hope I get a chance to ride a camel.	My favorite moment was the sunset felucca ride on the Nile.
	**Mohamed Habib** *Graduate student seeking PhD in Civil & Environmental Engineering (Emphasis: Water Resources & Hydrology)*	I want to experience an international perspective for water resources in Egypt through the people of the IIHR (because I am familiar with water resources issues in Egypt). I am most excited about welcoming the participants to my home country. Also, experiencing my country in the eyes of other people and comparing it to my personal experience away from home.	I enjoyed helping out whenever I could.
	**Matt Zager** *Young professional and Graduate student seeking M.S. in Civil & Environmental Engineering (Emphasis: Water Resources)*	I want to learn about water resource management practices in a different country and experience a different culture. I am most excited about learning about the history of Egypt.	My favorite moment was lying on the grass, basking in the sun near Al-Alzar Park, overlooking the whole city of Cairo while listening to the chants of the minarets.
	Michael Schubert *Graduate student seeking*	I want to gain a broader perspective of the importance of river management. I am most excited about spending time on the Nile River.	My favorite moment was walking out of the great pyramid and getting a breath of fresh air.

	*M.S. in Civil & Environmental Engineering (Emphasis: Hydrology and Hydraulics)*		
	**Michael Shaefer** *Graduate student seeking M.S. in Civil & Environmental Engineering*	I want to gain international engineering experience, an appreciation for social and cultural constraints and criteria in engineering design projects. I am most excited about the Nile cruise.	My favorite moment was spending a day on the Red Sea beach.
	**Paul Eastling** *Graduate student seeking M.S. in Civil & Environmental Engineering*	I want to gain a grasp on water resource issues on the Nile and learn about Egyptian culture. I am most excited the Nile cruise. I have never been on a boat for more than a day.	I really enjoyed the food!
	**Travis Anderson** *Graduate student seeking M.S. in Civil & Environmental Engineering*	I want to learn about Egyptian culture, how an international engineering firm operates (Stanley Consultants) and how water resource management in Egypt differs from U.S. management. I am most excited the Nile cruise. It should be a fun way to both relax with friends and learn firsthand about the Nile and the surrounding culture.	My favorite moment was riding camels near the pyramids.

Projects

Team 1

Course Website

- Jesse Piotrowski
- LlynnAnn Luellen
- Jessica Kilgore

Team 2

Historical Comparison of Flood Management Practices between the Upper Mississippi and Nile River Basins

- Jeremy Bril
- Paul Eastling
- Travis Anderson

Team 3

A Comparison in Water Resources Engineering Challenges: River Management Practices on the Mississippi and Nile Rivers.

- Michael Schubert
- Mohamed Habib
- Matthew Zager

Team 4

International Perspectives in Water Science & Management: Evaluation of a Short-Term International Engineering Course

- Carmel Langel
- Dustin Tardiff
- Jessica Smith
- Michael Schaefer

Team 5

International Research and Education: Workshop Summary and Interpretation

- James Johansen
- Kara Prior

Historical Comparison of Flood Management Practices between the Upper Mississippi and Nile River Basins

Written By:

Travis Anderson, Jeremy Bril, and Paul Eastling

March 6th, 2009

International Perspectives in Water Resources Management
IIHR-Hydroscience & Engineering
University of Iowa, College of Engineering

TABLE OF CONTENTS

1. INTRODUCTION

The Upper Mississippi River Basin and the Nile River Basin have significantly impacted the development of civilization relying on the rivers' resources. Specifically, establishing methods for the successful management of flood events occurring in each basin has been especially important. Throughout history, flood management practices used on each river were often as different as the cultures inhabiting their banks. To develop a better understanding of how past flood management practices have influenced current practices, an analysis was completed comparing historical practices of each river. For the Nile River Basin, historical practices were defined as management methods used prior to the construction of the first Aswan Dam (1902). For the Mississippi River, historical flood management was defined as practices utilized prior to The Great Depression (1929).

2. THE NILE RIVER BASIN

2.1. Geographical Background

Stretching more than 6,650 km, the Nile River is the longest river in the world (Parsons, 2003). The river is composed of two major tributaries, the Blue Nile and the White Nile, which converge near the capital of Sudan (Khartoum) to form the Nile Proper (see Figure 1).

Figure 1: Two major branches of the Nile River include the Blue River (in blue) and the White River (in white) and come together to form the Nile Proper (in red) (image adapted from World Fact Book)

The Nile is fed by several sources throughout northeastern Africa. To the south of Khartoum, the White Nile forms from the tributaries of several tropical lakes. Originating in Lake Victoria (3720 feet), the White Nile also flows through Lake Albert (2030 feet) in western Uganda and Lake No in southern Sudan. From there, the river flows quietly through the grassy plans of central Sudan to Khartoum (Smith, 1998). The Blue Nile originates in the high mountains of Ethiopia (13,000+ feet) along with the Atbara River, which flows into the Nile about 150 miles north of Khartoum. Both the Blue Nile and Atbara carry rocky debris from the mountains which eventually forms the fine stone dust that comprises the black mud of the Nile (Smith, 1998).

Once the Blue Nile and White Nile combine to form the Nile Proper (commonly referred to as just the Nile River), the river flows more than 950 miles through the sandstone of Sudan's plateau landscape. In several places along the Nile, the flow of water failed to erode more resilient rock. As water forced its way through the harder rock many areas of great rapids, called cataracts, were formed (see Figure 2). In total, ten cataracts exist along the Nile River. The cataract that is furthest downstream forms the natural southern boundary of Egypt and is nearly seven miles long (Smith, 1998).

Figure 2: One of ten cataracts that exist along the Nile River (photo taken by W.F. Hume)

2.2. Ancient Civilizations and the Nile

Looking back at history, the primary use of the Nile River has been for agriculture and farming. Approximately 6,000-7,000 years ago, farming villages around the Nile became urban centers. This development occurred due to the ancient people's increased abilities to control the flow of the Nile River. The first successful efforts for controlling water were driven by needs for agriculture (primarily irrigation) and were implemented in Mesopotamia and Egypt (Mays, 2008). The people of ancient times congregated to the steep banks of the Nile even though the river flooded annually and contained marshlands that constantly changed location. These civilizations not only depended on the Nile for the irrigation needed for their crops, but also for the rich topsoil that was deposited by the annual floods (Martinson, 1998). The annual cycle of flooding and depositing fresh silt provided a new layer of topsoil every year. As the flood waters began to recede, farmers would plant their crops in the mud that was rich in organic nutrients and nitrogen (Gadalla, 2004).

2.3. Historic Flood Management Practices

Being one of the most predictable rivers in the world, the flooding of the Nile was rarely sudden or unexpected (Mays, 2008). Caused by the intense rainy season in Ethiopia, the flooding began in April in southern Sudan. The floods did not reach southern Egypt until July and Cairo was not flooded until October. The peak flood stage occurred in mid-September and gradually decreased until water levels fell quickly in November and December (Think Quest Team, 1998).

Since civilizations did not have to worry about abrupt flooding events, the most prevalent type of flood management was artificial basin irrigation. This method was established in Egypt by the first Dynasty (ca. 3100 BC) and consisted of deliberate flooding and draining using sluice gates (see Figure 3) in addition to longitudinal and transverse dikes (Mays, 2008).

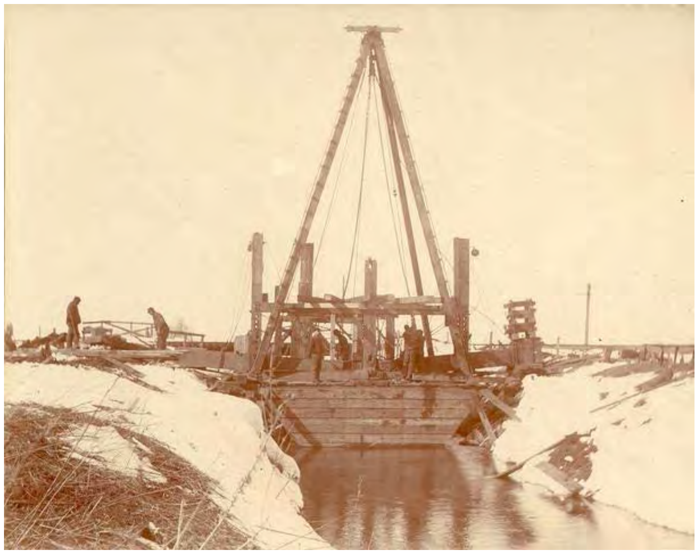


Figure 3: Example of sluice gate

Artificial basin irrigation was a technique that used intentional flooding and draining through a network of earthen banks. Some of the banks were constructed parallel to the river and some were constructed perpendicular. The series of banks created basins of various sizes where the diverted floodwaters were held. Water that was brought into the basins was allowed to saturate the soil and any excess water was drained away from the basin via a down-gradient basin or canal. Once the basins were drained of standing water and the soils were saturated, crops were then planted.

Feeder canals were used to supply the basins with water. The bed level of these feeder canals was halfway between the low Nile level and ground level (Mays, 2008). Constructing the feeder canals in this manner allowed for a natural downstream slope that was less than the slope of the Nile. To separate the basins, dikes were built along with controls (masonry regulators) to control water flows into the basins. The basins remained very level due to the presence of the water laden alluvium that deposited throughout the basins (Mays, 2008). If the flow of the Nile was lower than usual, the basins would be drained into the next downstream basin instead of back to the Nile in order to store the water.

In addition to artificial basin irrigation, the Egyptians were also known to have built the first large-scale dam called the Sadd-el-Kafara dam in 2650 BC (Mays, 2008). The dam was the first attempt at storing water on a large scale. Standing 14 meters in height and having a 113 meter crest length, the dam contained a 0.5 million meter cubed storage capacity (Mays, 2008). Water storage was very important to ancient civilizations as studies have shown that significant droughts often occurred throughout the Nile River Valley (Hassan, 1997). Table 1 shows the variation in flood magnitude over time. The construction of dams such as the Sadd-el-Kafara also increased the possibility for trading to occur among different groups of people. In an area above the Third Cataract (near modern-day Semna), a dam was built that raised the level of the Nile for hundreds of miles to the south (Gadalla, 2004). The higher water levels allowed for trading expeditions to navigate much farther into the interior of Africa. On the rocks below the former channel fortresses of Semna East and Semna West, 25 inscriptions were found. The inscriptions were believed to represent the water level of Nile floods recorded during the time of the Middle Kingdom. Each inscription found indicates a water level of about 25 feet higher than the maximum water levels of today (Gadalla, 2004).

Table 1: Episodes of Nile flood level fluctuations (adapted from Hassan, 1997)

Years AD	Nile Floods
Before 650-930	Generally low (with minor highs)
931-1070	Major low
1071-1180	Major high
1181-1350	Major low
1351-1470	Major high
1470-1500	Minor low
1500-1700	Incomplete record
1725-1800	Minor high
1800-1830	Minor low
1830-1885	Minor high
1885-1898	High

Another flood management practice was the creation of a major waterway diversion project (Gadalla, 2004). Completed around 2000 BC, the project dealt with an area known as the Fayoum Oasis in an area located near modern-day Fayoum. Within the Fayoum Oasis is Lake Qarun, a lake that was originally used as a catchment of waters overflowing from the Nile. The lake filled nearly the entire region of the Oasis and when it was filled with overflow waters from the Nile, millions of gallons of water were wasted at the deserts around the Fayoum region (Gadalla, 2004). This overflow wasted water carried the valuable fertile Nile silt that had collected on the lakebed and deposited it across the desert. To decrease the amount of water that was wasted, the flow of water into the lake was reduced by diverting the water to areas where it could be used. This was done by building up the banks of the river and using a series of waterwheels to raise the water to the banks along this stretch of the Nile. The diversion project resulted in about 80% of the original lake area being reclaimed so the rich soil could be cultivated (Gadalla, 2004). Keeping the water within the banks of the Nile also increased water supply to downstream areas which increased the amount of arable lands available.

To assist in better management of flood events, the Ancient Egyptians also created Nilometers. Nilometers were devices used for measuring the gradual rise and fall of the Nile. The Nilometers were located all throughout Egypt and were used to record and report water surface fluctuations which were all tied to a single common datum (Gadalla, 2004). Using the measured water levels allowed knowledgeable officials to regulate the flow amounts and flow duration through use of the sluice gates.

2.4. Impacts of Flood Management Practices

While the flood management practices have benefited ancient civilizations in many ways, there have been some significant impacts on the Nile River Valley ecosystem. In pre-historic times, the banks of the Nile River were covered by primeval forests containing vast swamps of rushes, papyrus, and weeds. However, years of human intervention turned the Nile banks into constant green fields of crops resembling a rich, well-cultivated European plain (Smith, 1998).

Also, a study completed in 2003 used strontium isotopic and petrologic information to show that paleoclimatic and Nile baseflow conditions changed considerably from 4200 to 4000 BC (Stanley et al., 2003). Using sediment cores obtained from the Nile delta of Egypt, the researchers determined that a higher proportion of White Nile sediment was transported during the annual floods of ca. 6100 BC than those of 4200 BC. The decreased amount of White Nile sediment correlated with an increase in the amount of suspended sediment from the Blue Nile for this time period. The increase in suspended sediment was concluded to be caused by the decrease in vegetative cover along the Nile and the increase in erosion rate. This was also accompanied with a marked decline in rainfall. Researchers believe that the data obtained from this study indicates major changes in annual flooding and baseflow of the Nile which, along with short-term paleoclimatic events, could have been part of what led to the collapse of the Old Kingdom (Stanley et al., 2003).

In addition to the negative impacts of historic flood management practices, there have also been some positive impacts. For example, some scholars argue that the first written language was developed based on the need to keep records of rainfall levels and harvests (Phippen, 1998). Also, the artificial irrigation basins allowed for the increased deposition of Nile mud. Sun-dried Nile mud bricks were very important raw materials for building the dwellings of the nobility and royal palaces (Klemm & Klemm, 2001). Unfortunately, Nile mud bricks did not resist weathering forces very well so many of the villages, private buildings, and noble buildings that once existed in ancient civilizations have been lost. The temples and sacral monuments were not made out of the Nile mud bricks and therefore lasted much longer. However, the materials required to build these structures had to often be transported up to 100 km or more (Klemm & Klemm, 2001). The man-made channels built for irrigation often served as ideal shipping routes for the transport of these heavy stones.

3. THE MISSISSIPPI RIVER BASIN

3.1. Geographical Background

The source of the Mississippi River is Lake Itasca in northern Minnesota. From this point the river flows for 2,552 miles to the Gulf of Mexico (McCall, 1990). However, Lake Itasca has not always been the source of the Mississippi River. Only since the end of the ice age, about 10,000 years ago, has the modern headwater been located in its current position. Although the origin of the river has changed in recent geologic time, the Mississippi River is thought to have flowed in the same general course for over 250 million years. The large gorge which the river occupied has been enlarged by the meltwaters of glaciers over millions of years (Fremling, 2005). Although in some ways unchanged for millions of years, the Mississippi River and its floodplain have been drastically altered by humans, especially in during the last 200 years. These alterations have made a substantial impact on the natural flood regime of the Mississippi.

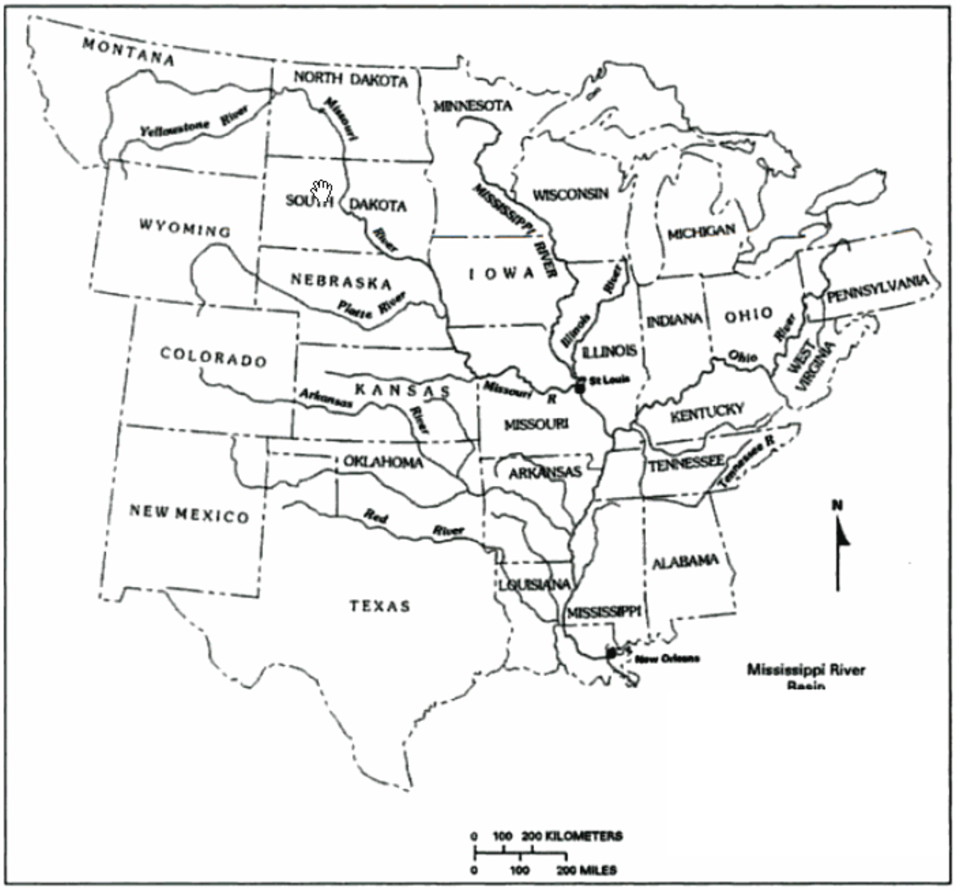


Figure 4: Map of the Mississippi River Basin

3.2. Native American Culture and European Discovery

The first human inhabitants of the Upper Mississippi River arrived approximately 10,000 years ago and primarily hunted large extinct mammals such as mammoths (Fremling, 2005). Agriculture began in the region about 4,000 years ago, and the river became an important mode of transportation for the exchange of goods between Native Americans (Lentz, 2000). During this time native people developed organized transportation routes and traded goods over great distances, usually by water (Fremling, 2005).

Around 700 A.D. Native Americans established the city now known as Cahokia near present day St. Louis. Cahokia was the center of the most sophisticated Native American civilization north of Mexico. Like the Nile River valley, the Mississippi River provided fertilizing floodwaters and an abundant supply of plant and animal resources. Cahokians used the rich floodplains of the Mississippi to develop an extensive agricultural system including corn and squash. With a stable food base, the Cahokians developed highly specialized social, political, and religious organizations. However, the rapid deforestation required to support the city eventually caused erosion and flooding of agricultural fields. By 1350 A.D. Cahokia had been nearly completely abandoned (Fremling, 2005).

Hernando de Soto, a Spanish explorer, was the first white man to discover the Mississippi near present day Tennessee in 1541 (McCall, 1990). The Spanish explorers crossed the Mississippi in search of gold, although hundreds died of disease and Indian attacks in the following year. De Soto died within a year of discovering the Mississippi and Europeans did not return for over 100 years (Fremling, 2005).

3.3. Alteration of the Upper Mississippi by the United States

The lure of fur trading brought Europeans and settlers to the Upper Mississippi in the 17^{th} century. Control of the region passed from the French to the British and eventually to the United States 1783. With the Louisiana Purchase in 1803 the United States gained full control of the Mississippi River basin. Soon American settlers poured in and began settling the land along the Mississippi River (Fremling, 2005).

Steamboats began operating along the Mississippi in 1811, providing transportation for mail, passengers, and cargo along the river. In 1878, Congress authorized the creation and maintenance of channel four-and-one-half-feet deep on the Upper Mississippi River between St. Paul, Minnesota and the mouth of the Ohio River. The project was created to prevent railroads from forming a transportation monopoly and was to be implemented by the U.S. Army Corps of Engineers (Fremling, 2005).

The U.S. Army Corps created this main channel in the river through the construction of wing dams and dredging. This constricted the flow of the river and forced the water to be directed through the designated channel. The resulting swifter current prevented the deposition of sediments in the designated channel. Instead, much of the sediment of accumulated between the channel edge and the shore. In 1907 Congress supplied additional funds to deepen the channel to six feet deep. This was accomplished through the creation of two thousand additional wing dams, additional shore protection, more dredging, and the construction of two new locks. However, in the 1920s river traffic slowed and the Army Corps realized that the six-foot channel depth would not be possible along the entire length of the river with the techniques being used.

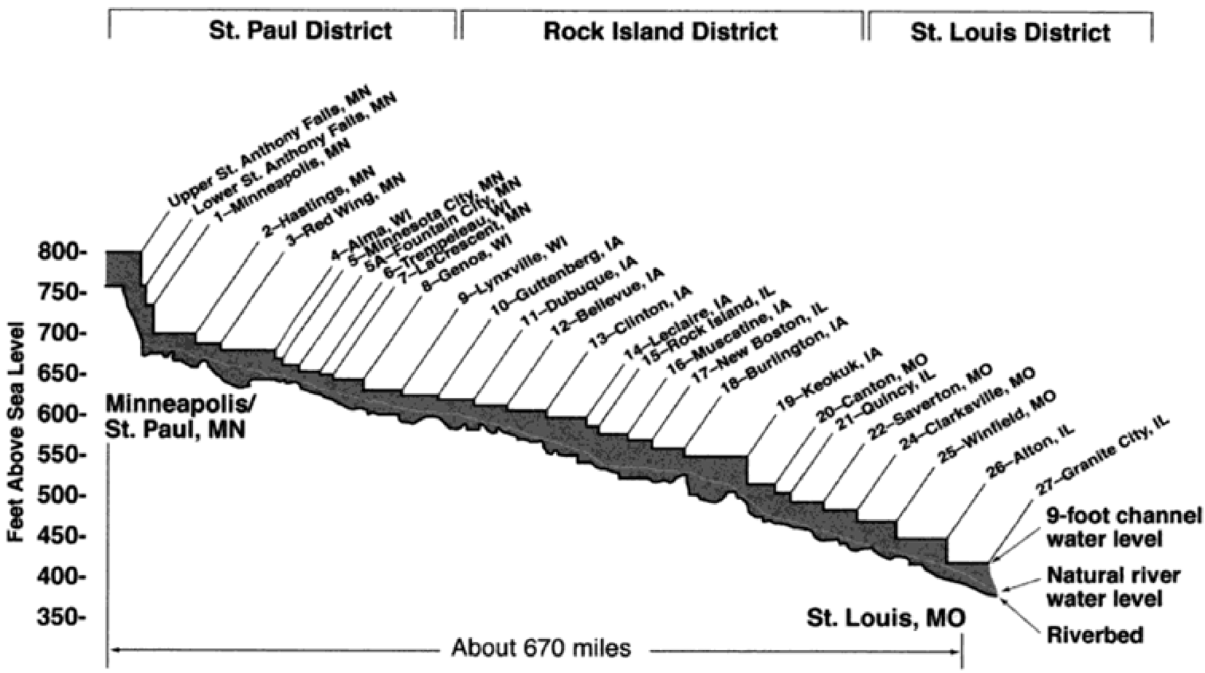
As a result, the six-foot proposal was abandoned in 1927 with the intent of eventually creating a more useful nine-foot channel (Fremling, 2005).

Just as attempts were made to improve navigation on the Mississippi, attempts were also made to improve the floodplain of the river for agriculture. In the 1920s farmers who owned land in the Mississippi River floodplain began proposing draining their land and constructing dikes to protect farmland from high water. Soon thousands of acres within the Mississippi floodplain was drained for agricultural development and then protected through the construction of levees (Fremling, 2005).

The increasing population of the Upper Midwest in the 1920s increased the demand for coal and the need to ship surplus grain south. For steel barges to carry these cargoes north of St. Louis, a nine-foot channel was required. In 1930 a bill was passed authorizing the creation of a nine-foot navigation channel to accommodate multiple-barge tows. The project required the construction of a system of locks and dams supplemented by dredging. The Nine-Foot Channel Project received minimal funding until 1933, during the Great Depression, when the project was used to supply unemployed workers with jobs. The result was one of the largest public works projects in the history of the United States (Fremling, 2005).

3.4. Impacts of the United Stated River Alterations

The system of locks and dams required by the Nine-Foot Channel Project completely altered the Mississippi River north of St. Louis and had unintended consequences on future flooding. The previous channelization projects only required wing dams and did not completely change the flow of the river. In contrast, the new project would be the end of the free-flowing river through the creation of pools between the locks and dams. The engineering design of the dams for the project had to take into account flooding which occurred on the Upper Mississippi River. Movable gates had to be constructed so that they could be raised completely out of the water during floods (Fremling, 2005). A diagram showing the 29 locks and dams along the Upper Mississippi River is provided in Figure 5.



A "Stairway of Water" makes commercial navigation possible between Minneapolis and St. Louis (U.S. Army Corps of Engineers, St. Paul District).

Figure 5: Locks and Dams of the Upper Mississippi River

There were many critics of the proposed projects over concerns of pollution and biological impacts (Fremling, 2005). The resulting pools created by the dams flooded the floodplain areas along the river. These areas provided excellent marsh habitat and are extremely productive ecosystems. Nearly all of the land in the bottomlands of the Mississippi was purchased by the government to form National Wildlife Refuges (Fremling, 2005).

Flooding is a natural process along the Mississippi River. Every spring snow melt and rain causes water to rise and flood the river. This natural phenomenon is actually beneficial to river ecosystems, which have adapted to flooding over thousands of years. However, natural flooding has been altered dramatically by human alteration of the floodplain through farming, the drainage of wetlands, and construction. Also, growing cities in the Upper Mississippi watershed has decreased the runoff storage capacity, raising flood crests (Fremling, 2005).

Flood stages have increased between Illinois and St. Louis mainly due to the construction of wing dams and the loss of floodplain capacity due to levees and development. Because the Army Corps of Engineers has forced the natural flow of the river into a narrower channel, the water rises higher within levees and cannot spread out into the flood plain. The accelerated river velocity and transfers upstream flooding problems further downstream. In effect, the creation of levees has worsened flooding catastrophes. Cities protected by levees upstream increase the flood height causing levees in other cities to fail. Furthermore, the creation of levees has allowed development within the floodplain of the Mississippi, so that when levees do fail during extreme floods the cost of the damage is enormous (Fremling, 2005).

The Nine-Foot Channel Project dams created during the 1930s have caused sediment to accumulate which naturally would have been carried downstream, eventually to the Gulf of Mexico. The increased sediment along the bed of the Mississippi has raised the elevation of flood crests, creating the need for more abundant and higher levees. Sedimentation is also one of the major causes of habitat degradation in the Upper Mississippi. The result has produced more development in flood plains, resulting in catastrophic economic losses during levee failures (Fremling, 2005).

4. CONCLUSIONS

Flood management practices have had important impacts on both the Nile and Mississippi Rivers. Flooding played a crucial role in the agricultural practices of early civilizations as it provided sufficient nutrients and water supply. Early management practices on the Nile were primarily applied for storage and irrigation while management practices on the Mississippi were aimed at protection and navigation. Table 2 provides a summary of the comparisons between flood management practices for the Nile and Mississippi Rivers.

Table 2: Flood management practices for the Nile and Mississippi Rivers

	Egypt and the Nile	Mississippi River
Ag Irrigation	Artificial Basins	Natural Flooding
Transportation	-	Lock and Dam
Protection	Aswan Dam	Lock and Dam
Storage	First Large-Scale Dam	Dam
	Waterway Diversion	-
Regulation	Nilometer	Lock and Dam

5. WORKS CITED

Fremling, C. R. (2005). *Immortal River: The Upper Mississippi River in Ancient and Modern Times.* Madison: University of Wisconsin Press.

Gadalla, M. (2004). *The Ancient Egyptian Superior Farming Techniques*. Retrieved February 2009, from Rediscover Ancient Egypt with Tehuti Research Foundation: http://www.egypt-tehuti.org/articles/farming.html

Hassan, F. A. (1997). The dynamics of a riverine civilization: a geoarchaeological perspective on the Nile Valley, Egypt. *World Archaeology* , 29, 51-74.

Hume, W. (n.d.). *Ground Images of the Cataract Nile*. Retrieved February 2009, from University of Texas-Dallas Geosciences Department: http://www.utdallas.edu/geosciences/remsens/Nile/Cataract-Hume.html

Illinois State Museum. (n.d.). *A Family Farm Album*. Retrieved February 2009, from Illinois State Museum: http://www.museum.state.il.us/ismdepts/art/collections/sadorus-exhibit/embedded-gallery.php?RollID=402-500&FrameID=441sluicegate

Klemm, D. D., & Klemm, R. (2001). The Building Stones of Ancient Egypt - A gift of its geology. *Journal of African Earth Sciences* , 631-642.

Lentz, D. L. (2000). *Imperfect Balance: Landscape Transformations in the Precolumbian Americas.* New York: Columbia University Press.

Martinson, S. (1998). *Tools and Techniques Along the Nile*. Retrieved February 2009, from Ancient Egypt - Technical: http://carbon.cudenver.edu/stc-link/AE/technical.html

Mays, L. (2008). A Very Brief History of Hydraulic Technology During Antiquity. *Environmental Fluid Mechanics* , 471-484.

McCall, E. (1990). *Biography of a River: The Living Mississippi.* New York: Walker and Company.

Parsons, M. (2003). *The Nile River*. Retrieved February 2009, from Tour Egypt Magazine: http://www.touregypt.net/magazine/mag05012001/magf4a.htm

Phippen, K. (1998). *The Ancient Egyptian People's Dependence on the Nile*. Retrieved February 2009, from Ancient Egypt - Culture: http://carbon.cudenver.edu/stc-link/AE/culture.html

Smith, D. (1998). *Nile River Geography*. Retrieved February 2009, from Ancient Egypt - Geography: http://carbon.cudenver.edu/stc-link/AE/geography.html

Stanley, J. D., Krom, M. D., Cliff, R. A., & Woodward, J. C. (2003). Short contribution: Nile flow failure at the end of the old kingdom, Egypt: strontium isotopic and petrologic evidence. *Geoarchaeology-an International Journal* , 395-402.

Think Quest Team. (1998). *The Nile River*. Retrieved February 2009, from The Living Africa - Back to the Land: http://library.thinkquest.org/16645/the_land/nile_river.shtml

World Factbook. (2009). *Egypt*. Retrieved February 2009, from The World Factbook: https://www.cia.gov/library/publications/the-world-factbook/geos/eg.html

INTERNATIONAL PERSPECTIVES IN WATER SCIENCE AND MANAGEMENT

A Comparison in Water Resources Engineering Challenges: River Management Practices on the Mississippi and Nile Rivers

Matthew Zager **Michael Schubert** **Mohamed Habib**

Winter 2008

April 8, 2014

Table of Contents

1 Abstract

Many advances in water resources education has occurred in the last two decades. The IIHR-Hydroscience & Engineering (IIHR) had the lead in introducing International Perspectives courses in water resources management. During these courses, students had the opportunity to explore a water resources issue with emphasis on a famous country or region in water resources management. The most recent course took place in Egypt where the Egyptian people have practiced management on the Nile River since ancient times. Additionally, the course led students on tours of Egypt's famous historical places, introducing the students to the history of the Nile valley and people who lived and still live along the Nile. The keynote activity during the course was a National Science Foundation (NSF) workshop where a renowned group of American and Egyptian scientists and engineers met to discuss the water management and research issues facing both sides. Opportunities of future collaboration were discussed during the workshop.

In this paper, a brief comparison between water resources management along the Mississippi River and the Nile River is discussed. Comparison includes overall river management, navigation, flood Control, water supply and irrigation, hydropower, and environmental health issues. A summary of activities of the International Perspectives course is included with picture illustrations.

2 Introduction

Water is an absolute vital resource.Lack of water or misuse of water supply increasingly poses critical challenges for people in the 21st century. Resolution of these challenges requires development of a comprehensive approach to water resources management based on sound science. The importance and acute need for concerted actions to better manage water resources is illustrated by a wide spectrum of local, national, and international initiatives. Achieving the scientific basis for sustainable water resources management entails long-term investment in research and development of relevant technologies. The necessary scientific efforts will improve models and observational infrastructure, which in turn will enhance our capability to predict temporal and spatial variations of the quantity and quality of available water resources, reducing the uncertainties and risks associated with management.

In response to the recent advances in science and engineering research, computing, information and communication technology, the National Science Foundation coined a new term called cyberinfrastructure. This term is defined as coupled use of real-time sensing, data based, high-performance computational platforms, computer models that enable understanding of processes, knowledge management, visualization, interaction, and collaboration in all science and engineering disciplines.

Building cyberinfrastrucuture-based observatories and observatory networks require vast intellectual multi-disciplinary expertise and extensive infrastructure that currently does not exist at a single institution (in the U.S. or abroad). Therefore there is great need for capacity building and collaboration. Heeding the huge potential of the cyberinfrastructure-based integrative research and The University of Iowa’s (UI) extensive water-related investigative expertise and infrastructure, faculty and researchers from IIHR-Hydroscience & Engineering (IIHR) initiated diverse research and education activities involving cyberinfrastructure applied to water-resource and environmental concerns. The National Water Research Center (NWRC) is a relatively new Egyptian governmental institution focused on implementing up-to-date technologies and contemporary techniques as well as modern management concepts. NWRC has quickly become a visible national and international presence in the region partnering in the most active and authoritative initiatives.

IIHR and NWRC, both set within large river basins, partnered for a two-day workshop, *Broadening the Role of Cyberinfrastructure in Water Resources Management; Coping with Challenges of Large River Basins*, conducted at the NWRC building in Cairo, Egypt and sponsored by the National Science Foundation. Given common interests and expertise, the workshop was a unique and timely opportunity to take advantage of the long professional traditions in water resources research and education at IIHR and NWRC in order to begin collaboration in Cyberinfrastructure development. In conjunction with the workshop, IIHR conducted a winter-session course titled “International Perspectives in Water Science and Management.” This course provided students an immersion experience to Egyptian culture and an introduction to the various water resources challenges facing Egypt. This paper presents a brief comparison of river management in both river basins, the events of the course and workshop, and lessons learned from the experience.

3 Major Inferences

Comparison between the Nile River and the Mississippi River is difficult to conduct without considering overall management, navigation, flood control, and environmental, energy, and supply issues. The Mississippi River has a length of 3,763 km, discharges 17,330 m^3/s, drains an area of 335 million km^2, and flows through 10 states with population of 72 million capita. The Nile River has a length of 6,671 km, discharges 2,574 m^3/s, drains an area of 4.76 million km^2, and flows through 10 countries with population of 160 million capita.

3.1 *River Management*

In the United States, water resource management is divided between federal and state institutions. In general, the federal government is responsible for general policy and regulations, with some implementation and enforcement responsibilities. States are responsible for remaining implementation and enforcement measures, and can set stricter regulations than the federal government. To manage issues that cross state boundaries, other organizations such as river basin commissions exist. At the federal level, the U.S. Army Corps of Engineers is considered widely to be the most significant water resources agency, with navigation, flood control, and ecosystem restoration responsibilities as well as others.

Other federal agencies play important roles. These agencies and their respective roles are: Environmental Protection Agency (water quality), U.S. Geological Survey (water quality, quantity, and use), Fish and Wildlife Service (water dependent plants and animals), Natural Resources Conservation Service (agricultural water), National Oceanic and Atmospheric Administration (hydrology, coastal and watershed management), Federal Energy Regulatory Commission (hydropower, environmental quality). State agencies involved in water management are unique to each state. Many states have Departments of Natural Resources that handle water issues, but this is not true for all states. Often, a state level Environmental Protection Agency or Department of Conversation will manage water resources. Many states have more than one agency, similar to the Federal Government.

In Egypt, the primary agency responsible for managing the water resources of the Nile is the Ministry of Water Resources and Irrigation. Specific duties include planning, designing, constructing, and maintaining hydraulic structures as well as irrigation and drainage systems, and monitoring water quality. The agency also develops ways to improve water usage efficiency and water quality. Other ministries have a more secondary but significant role. These ministries include Housing and Public Utilities, Industry, Planning, Agriculture, Environment, Health and Population, Transportation, and Local Development. A National Water Resources Plan (NWRP) was developed in 2005 that evolved from prior water policies. NWRP has some elements of Integrated Water Resource Management, as it describes how Egypt will safeguard its water resources in the future, both with respect to quantity and quality, and how it will use these resources in the best way from a socioeconomic and environmental point of view. Egypt also partners with other countries within the Nile River watershed. An example of this collaboration is the Nile Basin Capacity Building Network for River Engineering, a group of professionals from Nile Rile countries that work to ensure Nile Basin water resources are developed and managed in an equitable, optimal, integrated, and sustainable manner.

3.2 *Navigation*

Historically, navigation was the most important function of river management on the Mississippi River, although government policy now places a similar level of emphasis on the other management areas. Commercial barge traffic accounts for 400,000 jobs and the movement of over 300 million tons of bulk goods annually on the entire Mississippi River, between Minneapolis and New Orleans. To meet federal regulations, a nine foot deep channel is maintained over the majority of the river, with a 45 feet deep channel maintained downstream of Baton Rouge. The methods for maintained the required channel depth differ between the Lower and Upper Mississippi Rivers due to characteristics unique to the reaches. On the Lower Mississippi, the channel is deeper and the required depths can be maintained through dredging and wing dams. On the Upper Mississippi, navigation dams primarily maintain the required depths, although dredging and wing dams are still necessary in places. Locks facilitate passage of navigation traffic through the dams. Constructed in the 1930s and 1940s, the system of lock and dams is paramount to navigation on the Upper Mississippi River. There are 29 lock and dams and 1,300 wing dams on the Upper Mississippi River alone. Additionally, there are navigational lock and dam systems on the Illinois, Ohio, Arkansas, Red, and White Rivers—all major tributaries of the Mississippi. Dredging is completed throughout the river system to remove excess sediment deposition in the navigation channel. Besides commercial barge traffic, recreational and tourist traffic make use of the navigation channels throughout the river system.

On the Nile River, navigation traffic can be divided into a tourist fleet and a commercial cargo fleet. While the statistics are not the most current, an average of 1300 vessels each carried an average load of 600 metric tons, or 859,000 total tons (1989 data). The number of tourist boats is estimated at 300, with a cumulative capacity of 60,000 people per week. The dams and barrages on the Nile can provide water for navigation during low water periods. Locks provide passage through the barrages. The main channel is not dredged or marked over much of its length. These issues can create problems for boat pilots. A navigation development project has been proposed that would map bathymetry and allow the installation of navigation aids.

3.3 *Flood Control*

The primary means of flood control on the Mississippi River are levees. A flood control reservoir and dam would be unreasonably large and unpractical if it were built due to the large volume of water the river carries. Upper and Lower Mississippi River levees are managed differently. On the Upper Mississippi River, many levees are locally owned and maintained by local municipalities or levee districts. These local entities receive Federal support as long as the levees are maintained to federal standards. If standards are not met, the levee is considered private. There is not a unified levee system on the Upper Mississippi River due to political and economic reasons. On the lower Mississippi River, most levees are part of the Mississippi River and Tributaries Project. This levee system is more standardized. All levees are designed to withstand a flood of a specified frequency, with height being primary design criteria. Heights vary on the Upper Mississippi River as a result of the patchwork nature of levee systems. On the lower Mississippi, the frequency levees are built to are more consistent.

Levees are constructed from fill or sand material. In addition, flood walls protect certain areas, especially in urban regions. Flood protection projects are often classified as agricultural or urban. The level of protection for agricultural systems is often less than for urban systems, especially on the Upper Mississippi River. Most levee failures are caused by overtopping. Overtopping produces large scouring forces on the levee from the sudden rush of water from the wet side to the dry side of system. These forces can quickly cause a levee to break, flooding the area behind it. Major overtopping events were witnessed in floods in 1993 and 2008, and also during Hurricane Katrina in Louisiana. Levees are not built higher to prevent overtopping because the construction cost is often greater than the cost of flood damages.

On the Nile, the primary means of flood control are large dams. Aswan Dam in Eqypt is the most notable, but Jebel Aulia, Sennar, Roseires, and Khashm El Girba Dams in Sudan, and Owen Falls in Uganda are also significant. Other dams exist in Ethiopia, but due to dry conditions the dams are more likely to be used for water supply and hydropower. Flood control dams and reservoirs are possible on the Nile River because the volume of water carried is lower than on the Mississippi. The Aswan Dam in particular is designed and operated both to protect existing cities downstream from extreme flood events and to provide water for Egyptian agriculture in drought years.

3.4 *Environmental Health Issues*

Along the Mississippi River, the condition of the environment is better due to a lower population density and better regulatory and funding structure compared to the condition along the Nile River. Rigorous water quality standards are promulgated by Federal Law, with states enforcing laws through Department of Natural Resource agencies or equivalent agencies. While pollution problems are less common compared to other major rivers around the world, degradation in environmental quality still occurs through dredging or sedimentation. One consequence of building locks and dams is the altering of natural ecosystems. Through agencies such as Corps of Engineers and U.S. Fish and Wildlife Service, programs have been created to restore some habitat lost when the dams changed backwater habitat and the natural river hydrograph.

Along the Nile River, the state of the environment is more serious. In Egypt, a water quality monitoring program is in place, but in many areas, especially in the north half of the country, the water is not even considered healthy. Direct dumping into the Nile is obvious in many areas, creating pollution problems. No known programs are in place to encourage healthy ecosystems. Governments have a hard enough time meeting the needs of people. Plans to increase both commercial and tourist boat traffic will exacerbate environmental problems. Potential actions that could mitigate these problems include improving boat standards, banning hazardous materials, and improving the quantity and quality of waste disposal sites along the river.

3.5 *Hydropower*

Hydropower facilities on the Mississippi exist, but contribute only a small fraction to the total power grid. The most significant hydropower facility is at Lock and Dam 19 in Keokuk, Iowa. The generating capability at this site is approximately 130 MW, but can vary slightly. Other smaller hydropower facilities exist in Minnesota in conjunction with some of the locks and dams in that state. Locks and dams in other states can sometimes have small turbines, but the power extracted is quite small and contributes little to power grid. Currently, studies are underway to evaluate the feasibility of installing additional hydropower at Mississippi River locks and dams. Challenges include environmental impacts and the low height of these dams.

Hydropower on the Nile River is more significant and contributes much more to the total amount of power produced in Egypt. In fact, the total hydropower in Egypt represents about 22% of all power produced in the country. All the dams previously mentioned that control flooding also provide hydropower. Dams in Ethiopia, such as Karadobi, are also significant. Barrages, or dams that divert water for irrigation, can also provide hydropower. There are several barrages in Egypt, including the New Esna, Nag Hammadi, Assiut, Delta, Edfina, and Zifta Barrages.

3.6 *Water Supply and Irrigation*

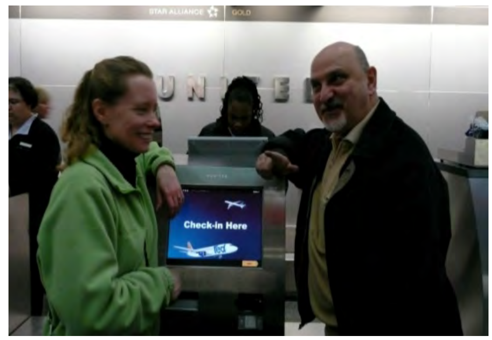
The climate across the Mississippi River basin generally supports adequate rainfall for the population. While drought can occur, it is infrequent and does not reduce discharge enough to be a problematic. The dams on the Upper Mississippi have little storage capacity; what storage there is goes towards maintaining navigable depths. Some of the flood control reservoirs along Mississippi River tributaries could serve as water supply storage reservoirs as well, but that is not their primary purpose. The Mississippi is a source of irrigation for dry periods, although agriculture does not depend on irrigation as much as areas along the Nile River.

The Nile River valley has been famous for irrigation since the time of the Pharaohs. Irrigating adjacent lands enabled ancient Egypt to thrive, and this practice has taken place ever since. The monthly irrigation requirements from Aswan High Dam averaged about 55 billion cubic meters in the 1980s. Barrages along the Nile divert some of its water into canals, which get drawn by irrigation into surrounding arable lands. Since Nile River water levels have become heavily regulated, natural flood cycles that replenish silt and nutrients are not allowed to occur. Salt accumulates as a result, and poor drainage inhibits the recycling of the salt back into the Nile River. Improvements in drainage may help the problem, but additional water is needed to wash the salt away. Despite this challenge, irrigation continues to sustain the rapidly increasing population of the Nile Valley.

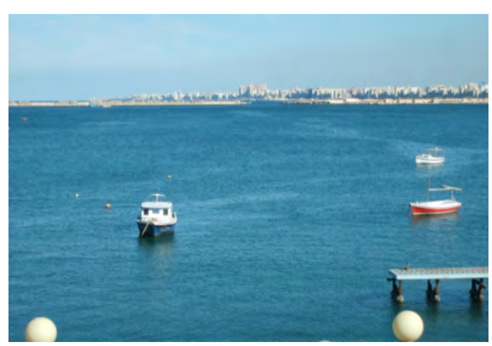
4 Course Events

Participants for the course, International Perspectives in Water Resources Science and Management arrived in Cairo, Egypt on December 27th and for the next 15 days participated in a fast-paced cultural and technical immersion throughout Egypt. The following table details the dates, events, and their significance to the overall course experience.

Table 2: Course Events

Date	**Event**	**Significance**	**Picture**
December 27	Arrival in Cairo	-Introduction to Egyptian transportation system and cuisine	 Carmen Langel and Marian Muste, our fearless leader, at the Airport
December 28	Visit Coptic Cairo and Al-Ahzar Mosque	-Importance of Nile River and Egypt in many religious traditions	 St. Virgin Mary's Church (the Hanging Church) in Coptic Cairo  Al Ahzar Mosque

December 29-31	Nile River excursion from Luxor to Aswan, visits to several ancient sites, viewed irrigation structures	-Importance of Nile to Ancient Egyptians - Modern agriculture's use of Nile River	 Nilometer at Kom Ombo Temple  Irrigation Canal Intake Structure
January 1	Visit to Aswan High Dam	-One of the world's largest dams -Importance of regulating flood waters -Hydroelectric power production on Nile	 Hydroelectric Plant at Aswan High Dam  Class group at Aswan High Dam

January 2	Visit to Nubian Village	-African tribe displaced by Aswan Dam and Lake Nasser	 Enjoying live Nubian music
January 3	Meeting with Stanley Consultants in Cairo	-American Engineering in Egypt and the Middle East	 Visiting Stanley Consultants
January 4	Visit Alexandria	-Egypt's first connection to the Western World -One of the World's oldest port cities -Importance of coastal protection structures to Alexandria's Harbor Region	 Citadel at location of ancient lighthouse  Coastal Protection Structures in Harbor

January 5-6	NSF Workshop*	-Many presentations on current river-management -Collaborative brainstorming for river management and research -Explored challenges of women in Science and Engineering in the US and Egypt -Toured NWRC research labs	 Workshop participants in Roundtable discussion  Touring the NWRC physical modeling facility
January 7	Visit Pyramids, Great Sphinx, Egyptian Museum, Khan el Kahlili bazaar	-Visited important and famous landmarks in Egypt	 At Pyramids Park

* Workshop Activities are discussed in greater detail in the next section

January 8	Visit Cairo University Engineering Dept.	-Toured facilities and laboratories -Learned about ongoing research projects -Interacted with students and faculty in water resources and irrigation engineering department	 Touring Cairo University's Hydraulics Labs  Students from Cairo and Iowa had an opportunity to interact
January 9	Visits to Suez and Sokhna	-Viewed Suez Canal, Red Sea -Visited the red sea shore at Sokhna near Sokhna's Harbor	 Suez Canal at Suez, at the Red Sea
January 9	Visits to various Mosques, Citadel, Al-Ahzar park, and the water conduit "sor magra el eoun"	-Understanding Muslim culture in Egypt -Viewed famous constructed water features in Cairo	 At Salahdin Citadel and Mohammad-Ali Mosque

5 NSF Workshop

The workshop was conducted at the NWRC in Cairo, Egypt. A group of participants from the University of Iowa, University of Minnesota, Cairo University, NWRC, and numerous other Egyptian water-related agencies attended the two-day workshop. Speakers and participants at the workshop explored the similarities and differences in large river management strategies in order to strategize on how to best partner in order to improve Cyberinfrastructure and research related to it. Coffee breaks and roundtable discussions provided workshop participants opportunities to continue discussions from the presentations and build the relationships necessary for a long-lasting, fruitful partnership.

The participants joined two discussion groups under the supervision of professors Mohamed Nasr Allam, Keri Hornbuckle, Alaa Abdin, and Larry Weber. The discussion groups discussed possible collaboration in the fields of large-scale watershed modeling, interdisciplinary work, agriculture, best management practices, transport of sediment and pollutants, and education. Following the workshop, the participating groups all seemed very optimistic with regards to future collaboration in developing Cyberinfrastructure-based research platforms in both countries.

6 Conclusion

International perspectives in water resources and management is a unique course in terms of exploring the water issues facing today's world. It helps students have on-hands training for the water issues discussed in each year's course. Living in an everyday changing world, cyberinfrastructure is needed to facilitate the most efficient use of the research tools and products available within the research community. The conducted comparisons showed many differences between both the Mississippi and the Nile in terms of techniques used to overcome the various problems facing both rivers, even though the problems are similar. Therefore, collaboration between researchers from both sides will help in better management for the water issues of both basins, which was the goal behind the NSF workshop. The shown summary of events, shown previously in section 4, indicates the varieties of experiences that students gained from attending this course.

7 References

http://www.iwtc.info/2001_pdf/05-3.pdf

http://www.ndc.iwr.usace.army.mil/

http://www.iwtc.info/2007_pdf/6-3.pdf

Loucks, Daniel P. and Eelco van Beek, Water Resources Systems Planning and Management, UNESCO.

http://www.unu.edu/unupress/unupbooks/80858e/80858E05.htm

http://www.waterways.org/AmendmentsNWAletter.pdf

http://www.mvp.usace.army.mil/navigation/

communitytechnology.org/nsf ci report

International Perspectives in Water Science & Management:
Evaluation of a Short-Term International Engineering Course

Michael Schaefer, Jessica Smith, Carmen Langel, Dustin Tardiff, and Marian Muste
IIHR-Hydroscience & Engineering, The University of Iowa, Iowa City, IA

In 2007, IIHR-Hydroscience & Engineering celebrated the 10th year of its hallmark study abroad course, International Perspectives in Water Science & Management (IP), for students and young professionals in engineering and science. Each IP course offering focuses on a different country or world region for in-depth exposure to technical, historical, cultural, social, economic, ethical, and environmental issues that impact planning and execution of water-related projects in that region. Most significantly, students are introduced to the realities and complexities of water-related issues in a world in which many water resources transcend political boundaries, requiring collaboration among specialists from multiple countries impacting and depending on a particular watershed. Students are required to attend pre-trip lectures and seminars and to complete an individual or group project. The international component is intense, 2½ to 3 weeks, providing a unique opportunity for engineering students to gain international experience without interrupting their structured curriculums or research. The course consists of behind-the-scenes tours of relevant research laboratories and structures, technical lectures, and an opportunity to meet and interact with top research and water resources managers from the host country/region. Students from the host country interact with IP participants as well.

To date there have been eight course offerings of IP, taking 110 students to seven different countries/regions. IP participants generally rave about their experiences, but until the most recent course offering, only one class was surveyed (post trip) to formally evaluate the students' personal and educational experience. The 15 participants in the eighth offering of IP, which traveled to Egypt December 2008-January 2009, were surveyed prior to their international experience to evaluate their expectations and perceived level of preparedness, and post-trip to evaluate their experience.

International Perspectives Background

IIHR—Hydroscience & Engineering (IIHR), formerly the Iowa Institute of Hydraulic Research, is a world renowned research institute with a distinguished 90-year history in fluid mechanics, water resources, engineering, and hydrology[1]. The institute includes expertise in nearly all areas of hydroscience, with research foci ranging from ship hydrodynamics to fish passage around hydroelectric dams. The common factor linking many of IIHR's research and education areas is complementary expertise in field observational research, laboratory modeling, and computational modeling. Also distinctive to IIHR is its international flair, with faculty and research engineers hailing from 13 countries and its 75 students from 15 different countries (2008-2009 academic year). Thus it is appropriate that IIHR take the lead in offering students a unique international academic experience.

The University of Iowa course "International Perspectives in Water Resources Planning" (henceforth "IP") was created in 1997 as an initiative of IIHR's then director V.C. Patel[1]. It was developed in response to: 1) the increasing need for engineers and scientists to have a global perspective of water resources challenges; 2) the need for engineers and scientists from across the world to work together to develop solutions to our global water resources challenges; and 3) the lack of short-term, affordable international experiences available to engineering students.

Since its inception, IP has taken 110 students on eight different international experiences (India, 1998; Taiwan & Japan, 1999; China, 2000; Eastern Europe, 2001; Argentina & Brazil, 2003; Turkey, 2005; China, 2007; and Egypt, 2008-2009)[2] to introduce them to the realities and complexities of global water and environmental issues. The course seeks to provide in-depth exposure to technical, historical, cultural, social, economic, environmental, and ethical issues and complexities influencing major water resource projects in countries outside of the U.S.[3]. The course participants, structure, and unique itinerary make IP a stand-alone class that goes beyond the technical aspects of engineering, putting water resources engineering within the context of a different culture.

Most IP registrants are graduate students in The University of Iowa (UI) College of Engineering; however, students from other disciplines (generally liberal arts programs), engineering upperclassmen, and young engineering professionals also take IP. In addition, students from eight other domestic universities and colleges and from three international universities have participated in IP[2]. Instructors for the course have also come from outside engineering, included faculty from geology and law[4]. Thus, IP has become a truly international *and* multidisciplinary course, exposing students to new cultures while they interact with a diverse student and faculty group.

The course structure makes each offering unique. Prior to the international experience, students attend a series of seminars and presentations covering the region's culture, history, politics, and other factors relevant to the region. These presentations, which may include speakers from the host country, offer important background and context for the international component.

The international experience includes several specific components during an intense two to three week tour of the host country or region to better understand the complexity of issues that impact planning and execution of water projects in the region. First are visits to a variety of different water resources structures and laboratories. Advance arrangements are made for behind-the-scenes tours of these facilities and to interact with local engineers for discussion of their unique challenges. IIHR's vast network of research partners and alumni are often key to making these arrangements. Second, each tour includes an opportunity for students to meet and interact with engineering students and faculty at one or more universities. This includes formal time together (which includes a presentation about the UI by course participants) and unstructured time interacting with each other.

Each IP participant is also required to complete a group project. These projects vary depending on student interests, but generally include: development of a post-trip web site, presentation materials to deliver in the host country, and research papers focusing on relevant water resources issues of concern to the world region of the course.

IP Egypt, 2008-2009

From December 29, 2008 through January 11, 2009, IP took 15 University of Iowa students to Egypt for the first course offering in an African nation. There were several elements unique about this course offering. First and foremost was the participation of IP students in an international NSF-funded workshop ("Broadening the Role of Cyberinfrastructure in Water Resources Management: Coping with the Challenges of Large River Basins") in Cairo. Second was the co-offering and co-sponsorship of IP through the UI's Office for Study Abroad. Prior course offerings were organized without the benefit of this office's financial, recruiting, and organizational support. Finally, IP Egypt included a comprehensive pre-trip and post-trip survey of student participants. Data collected from participants concerning various aspects of the course is used in this report to provide a systematic means to evaluate the course and a framework for creating and evaluating courses similar to IP.

Figure 1 outlines the course itinerary in Egypt. The agenda encompassed a multifaceted itinerary exposing students to engineering hallmarks such as Aswan Dam on the Nile River, the Suez Canal, and the Red Sea Port. Professional engineers who are also professors of Civil Engineering at the University of Cairo accompanied the group. They served as hosts and as an invaluable resource, especially for interpretation of engineering structures and for discussions of Egypt's greatest water challenges. The trip duration and modest group size resulted in students developing close student-mentor relationships with the Egyptian professors and greatly enhancing their overall experience.

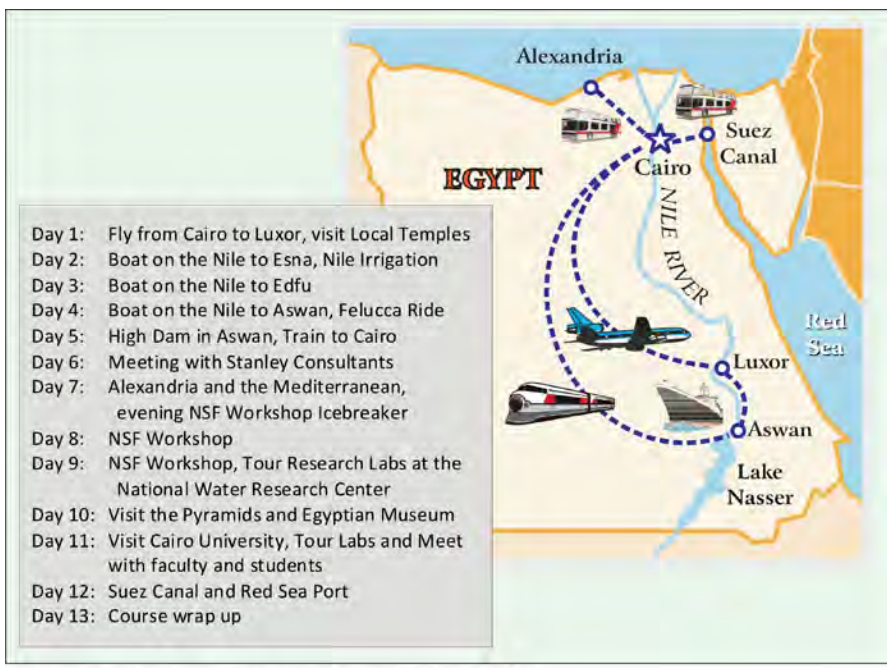


Figure 1. Itinerary for IP Egypt 2008-2009.

The NSF workshop was an opportunity to learn about different research projects in Egypt, visit laboratories, and meet with other engineers and students. The majority of the workshop was devoted to presentations by engineers from Egypt and the U.S. and the resulting discussions. Professors from the University of Cairo and engineers from Egypt's major water resources laboratories presented on a wide range of projects concerning different aspects of the Nile River Basin; American engineers presented on parallel topics related to the Mississippi River. Of particular interest was comparing management challenges related to the Mississippi River, which is contained entirely in the U.S., to management of the Nile River as a water resource that flows through and is used by nine other African nations before entering Egypt. In addition, the Nile River supports the water needs of virtually the entire Egyptian population. Thus, research projects in Egypt tend to focus on collaborations and water conservation, whereas research in the U.S. varies from contamination issues to the impact of climate change on freshwater mussels. These different research emphases further illustrated the vastly different water resources challenges facing the U.S. and Egypt.

The NSF workshop included a guided tour of Egypt's research labs. Many differences and similarities were evident as compared to laboratories at the UI. Differences included the instruments used, procedures, and models; similarities were evident in the methods, practices, and laboratory precautions. The laboratories were clean and in active use by Egyptian scientists. Facility and instrumentation differences were primarily due to resources available and proximity to research supplies. Similar to IIHR physical models, the Egyptian models were related to hydraulic structures (e.g., intakes, ports) and solved problems focusing on sediment transport, water conveyance, and thermal dissipation in rivers and coastal areas.

The final portion of the workshop was spent visiting with students. This was a valuable experience for students from both countries and mentioned as a highlight moment on the post-trip survey by several IP students. Students shared experiences in coursework and expectations as engineering students as well as similarities and differences in social life. Course loads are comparable between U.S. and Egyptian undergraduate programs; however, Egyptian students are encouraged to apply to master's degree programs in the U.S. and Europe because they will have an easier time financing their education and their degree will hold more prestige for them when they return to Egypt. The opportunity to participate in extra-curricular activities is also much more readily available to students in the U.S. Egyptian students are expected to focus on academia and research while students from the U.S. may include a variety of clubs, sports, and social commitments in their schedules. Shedding light on the American experience for Egyptian students interested in studying in the U.S. was an important component of the IP experience.

Comparison to Study Abroad Programs

A variety of study abroad programs are available to students at the UI (UI International Programs: http://international.uiowa.edu/), though most are not designed for engineering students. The diversity of programs includes both the traditional type of experience offered and a multitude of countries or geographic regions from which to select. Based on the authors' personal experiences, this section compares the fundamental differences between IP and other study abroad programs. An overview and example of the major characteristics of each program type is followed by a comparison of each to IIHR's short-course.

Service Learning Experiences

Service-learning, broadly defined, provides an opportunity for students to engage in experiential learning through projects that benefit society. Service learning courses incorporate a hands-on approach that teaches technical ideas as well as philosophies for appropriate technical, social, and economic designs in engineering. Perhaps most importantly, international service learning participants leave a tangible positive impact on the quality of life in the community in which they serve. For course participants, the projects also instill social responsibility and cultural awareness.

Another advantage to service learning courses is that they can change the perceptions of the citizens where a service-learning project takes place toward course participants. For example, their impression of Americans may be based solely on stereotypical media portrayals for lack of ever meeting an American in person. Service learning is an effective way to change these perceptions because of the sincerity of people helping their foreign peers side-by-side. In this regard, each service-learning participant is truly an ambassador for his or her country. The site-specific nature of the course, however, limits the range of experiences students have through this type of course.

Service learning courses offered through the UI are generally one to three weeks in duration. They are an efficient and effective way to help others as students gain an appreciation for our world's economic, social, and cultural diversity. Two examples of well-established programs at UI that provide service-learning opportunities are 1) Microfinance and Social Entrepreneurship in Tamil Nadu, India; and 2) The Xicotepec Project in Xicotepec, Mexico.

The UI program in Tamil Nadu, India is structured around the concept of working directly with community members and with different non-governmental organizations (NGOs). Also key to this experience is the role of microfinance - UI students learn about microfinance with hands-on experience in a country where microfinance is flourishing; there is arguably no better place to learn the value of microfinance than in a country where it is being practically applied. The UI program in Tamil Nadu provides several other valuable lessons: 1) it offers insights into different NGO priorities and functions; 2) students experience Indian culture first-hand; 3) the atmosphere engages senses not normally stimulated in the traditional classroom setting and facilitates a powerful learning experience; and 4) it encompasses an experience that alters students' perceptions of poverty, culture, values, priorities, and the meaning of "success" within a given context. Further, the ability to influence or act as a catalyst for positive change for other individuals provides an invaluable learning experience.

The UI program in Xicotepec, Mexico is an established partnership between UI and Rotary International. This partnership is based on UI students providing technical assistance to community members of Xicotepec through projects such as water purification system design and installation. A major component of this service-learning oriented class is preparation for design that incorporates social, cultural, and economic constraints into traditional engineering designs. Students are forced to incorporate nontraditional constraints into infrastructure design while experiencing a different cultural perspective.

Traditional Study Abroad Experiences

The most traditional study abroad experiences focus on assimilation and submergence into a culture dissimilar to one's own for an extended period of time, usually a semester or academic year. The experience usually involves partnership with a foreign host university and is centered in an academic environment. Different programs also have different foci. For example, some students focus on developing new language skills while others study in a country where their native language is spoken. Students embarking upon a semester study abroad experience usually find themselves enrolling in a regular course load abroad and experiencing a daily life similar to their foreign counterparts. This allows full immersion in a cultural setting with foreign peers where experiences help to globalize students by providing social, cultural, and academic experience in the foreign culture. Two semester-length academic programs available to engineers at UI are a reciprocal exchange program with Ajou University, Suwon, South Korea and a semester abroad program with the University of Canterbury, Christchurch, New Zealand.

Discussion of Study Abroad Courses with International Perspectives in Water Resources Science and Management

IIHR's IP course is an amalgamation of the variety of study abroad experiences offered by UI. Although it is a short-course, it straddles the line between short- and long-term courses by spending a portion of the course connecting with local faculty and students at a university in the host country. This interaction allows free dialogue with one's international peers, providing opportunity for discussion of differing experiences and not limiting the focus of interactions to academic affairs. These interactions provide opportunity, though in a different atmosphere than service-learning, to help reconcile cultural stereotypes and barriers. Relationships can often be built quickly in the environment fostered by IP. In both China and Egypt (2007 and 2009 respectively), for example, IP students were the first Americans some students had ever met or held discussion with, and vice-versa.

The opportunity to leave a lasting impression on local communities should not be viewed as less than that of service-learning or traditional study abroad but rather, we argue, different. International relationships established by IP students are made with a large and diverse group as they meet engineers and students in different parts of the host country or region. These relationships help build professional international networks and may lead to lifelong friendships and/or future research collaborations.

Because IP is a short-course, it is also easily assimilated into most traditional academic programs, providing an opportunity for students who may not usually consider study abroad offerings because they are disruptive to rigid academic programs endemic to engineering programs. Although IP is a short-course, it establishes a great amount of the rigor associated with traditional and service-learning programs by requiring projects that tie together technical engineering components with cultural, social, economic, and political lessons learned during the in-country experience.

A benefit of IP, especially as opposed to a service-learning course, is that participants see many different parts of a country and culture since IP itineraries generally include coverage of large geographic regions and a wide variety of water-related aspects. Students see that, like the U.S., most other countries and regions are not homogeneous but may vary dramatically in different regions. The opportunity to see the multi-faceted aspects of a country or region provides not only contrasting views of the region but also draws attention to the unifying cultural ideals that allow large geographic regions to identify as a single country or region. Moreover, usually IP students have different backgrounds that allow for discussions of realistic and holistic approaches to their inquiries on water and land resources. Finally, the discussions with the host faculty and students gravitate around the high-priority tasks of the research and management in the visited countries; hence the intellectual interactions may be superior compared to other courses. The nature of the course dictates that it provides lectures, first-hand visits, and unfiltered, sometimes conflicting perspectives and sources of information that must be digested. IP provides a unique collaborative learning environment where the class extends over the days and nights of group discussions.

Survey Results and Discussions

The 2008-2009 IP course to Egypt included an extensive post- and pre-trip survey of enrolled students. The surveys included open-ended and closed-ended questions. Questions garnered information that included: student motivation for enrolling in the course; course expectations (prior to the trip); fulfillment of course expectations (post-trip); adequacy of pre-trip preparation; satisfaction with specific course elements and locations visited; level of student understanding of topics or challenges unique to the host country or region; cultural experiences; best and worst course experiences/elements; and recommendations for course improvement.

Of the fourteen students who completed the pre-trip survey, three had never been abroad prior to this course and six students had short (a few weeks or less) international travel or study experience. The rest of the participants had longer or more extensive travel ranging from a semester abroad to military service stationed abroad. Only one student had been to Egypt, or any part of Africa, prior to this course.

The closed-ended questions from both surveys are compiled in Appendix C. Survey metrics for these questions were based on a scale of 1-10 (with 10 generally representing the highest positive response) and analyzed using standard statistical methods.

Table 1. Closed-Ended Questions Evaluating Reasons for Taking IP.

	Destination	**Duration**	**Cultural Exposure**	**Applicability to Personal Academic Goals**	**Cost**
Mean	7.0	7.1	7.6	6.8	7.7
S. Deviation	2.4	2.1	2.6	2.2	2.0
	Unique International Experience	**Networking**	**Boost to Future Career**	**Ability to Tour Non-Tourist Facilities**	**Timing**
Mean	8.2	7.2	7.2	7.2	7.5
S. Deviation	2.1	2.6	2.4	2.4	3.1

The pre-trip survey included questions to identify students' reasons for registering for IP with possible answers ranging from one (unimportant consideration) to ten (very important consideration) (Table 1). The strongest reasons for participating were for the unique international experience (mean response 8.2), cost (mean response 7.7), and timing (winter break, mean response 7.5). Of note here is the fact that IP is heavily subsidized by IIHR and the Office of Study Abroad (this year) to help make it available to a wide student body. For the Egypt offering of IP, for example, students were responsible for their roundtrip airfare to Cairo, tuition, and $1,083 for the course fee. This is a sharp contrast to the estimated trip expenditures of about $4,000 per student.

A t-test was used to evaluate the difference between group means for the significance in the difference between questions posed in both the pre-trip and post-trip survey (also summarized in Appendix C). The percentage recorded in the Appendix is the probability that the null hypothesis (the means of the two populations being equal) is true. Accordingly, percentages under 5% point to the alternative hypothesis (the means of the two populations differ) being true on a 95% confidence interval or greater. This analysis also assumes that the two sets of samples are paired and the two representative populations are distributed normally.

Table 2. Closed-Ended Questions with Significantly Different Pre-Trip and Post-Trip Responses.

Question (possible answers ranged from 1-10)	Pre-Trip Mean	Pre-Trip Standard Deviation	Post-Trip Mean	Post-Trip Standard Deviation	t-Test
How would you rate your current level of knowledge about Egyptian society? (10=excellent)	3.7	2.2	7.0	2.0	0.26%
How would you rate your current level of knowledge about water resources management issues in Egypt? (10=excellent)	3.0	1.1	6.8	1.8	0.01%
When not with the International Perspectives class, how do think you will be/were perceived/treated as an American in Egypt? (10=very well)	5.1	1.4	7.0	1.9	1.16%
Significance of the concern for language barriers? (10=great concern)	5.4	2.8	3.1	1.5	3.44%
Significance of the concern for personal security? (10=great concern)	6.6	3.2	4.3	2.1	2.56%
Significance of the concern for making a cultural faux pas (related to clothing, religion, gender, etc.)? (10=great concern)	5.9	3.0	3.6	1.7	3.92%

Only six out of the thirty-six questions had significantly different means between the pre- and post-surveys, including two of the most significant questions posed on the survey (Table 2). **Based on these surveys, students' perceived knowledge of Egyptian water resources management issues as well as their perceived knowledge of Egyptian culture rose significantly between the pre-trip and post-trip surveys.** These results support the claim that the overall objectives of the course, teaching students about water resources management as well as immersing them in another culture, were accomplished from the participants' perspective. Furthermore, based on the t-test evaluation, it is reasonable to assert that the difference in mean values was not random. The metric data is further supported by open-ended comments made on the post-trip surveys regarding what was learned. The following provide a cross-section sample of comments to two survey questions:

How well did the course meet your expectations? Please explain:

- *Very beneficial in the sense of being exposed to a new culture…*
- *…I had more personal gain than expected and more technical gain than I realized.*
- *…I had a great time on the trip and learned a lot about Egyptian culture and water resources issues. Having the Egyptian professors travel with us in South Egypt was unique and unexpected, and I enjoyed the visit to Cairo University.*

How well did you feel about the following elements of the itinerary: the NSF workshop?:

- *It was very interesting, and I liked hearing both the Americans' presentations as well as the Egyptians'.*
- *Great! In regards to content, this was a highlight of the trip.*

Likewise, many of the survey comments point to the why the importance of certain concerns (language barrier, security, making a cultural faux pas) decreased significantly from before to after the trip. It was noted by participants that having Egyptian colleagues accompany the group helped eliminate language barriers and the possibility of committing a cultural faux pas. It was also noted that the higher level of armed personal security and tourism police was a "significant cultural difference." Additional security concerns were prompted during the trip by rising the Israel-Gaza conflict.

Another highlight of the post-trip survey was the almost unanimous agreement that students would register for another IP course in the future if it could count toward graduate studies credit. One student stated "The trip was a lot of fun, and it was obvious that while we were there (Egypt) to learn, it was a concern that we were treated well and that they (our Egyptian hosts) wanted us to get the most out of the trip."

When comparing student opinions of IP, the open-ended responses demonstrated that the course gave students greater insight and sensitivity to important cultural differences between the U.S. and Egypt. For example, most students' pre-trip knowledge about Egypt was based mostly on the required pre-travel seminars. When asked what cultural differences students anticipated experiencing, typical answers included: *a more 'aggressive/chaotic' atmosphere*; *language, view and priority of environmental issues, and middle-eastern hospitality*; and *gender issues, economic and social disparities*. These issues were raised in the pre-trip materials. Whether experienced travelers or not, most students had never traveled to this region of the world and were often unsure of what to expect. When asked the same question at the end of the trip, students gave a much more informed response with varying details. Responses included: *very religious, aversion to alcohol, lack of punctuality*; *gender issues, acceptance of smoking*; and *poverty, traffic chaos*. Experiencing new cultures allows students to open their eyes to new viewpoints, and broadens their understanding of how decisions are made in that country or region, whether based on the social, political, or engineering realm. The experience of a different culture allows for continual refinement of understanding different viewpoints. This is pertinent to respecting decisions whether based in the social, political, or engineering realm.

Conclusion

Egypt 2008-2009 International Perspectives in Water Science & Management, the latest offering of IIHR-Hydroscience & Engineering's signature international course, provided an exceptional study abroad curriculum with concrete educational and professional value applicable to global engineering. It offered a unique blend of experiences compared to traditional study aboard and service learning courses, such as the opportunity to interact with students and professionals from the host country or region, tour a wide variety of water resources-related structures and laboratories, and serve as an ambassador for the U.S. Pre-trip survey results indicate that students enrolled in the course to take advantage of the course timing, cost, unique international experience, duration, and networking opportunities, among other reasons. A comparison of pre- and post-trip surveys show that students felt the experience gave them a greater understanding of Egyptian water resources management issues and Egyptian society. These results were supported by closed-ended and open-ended questions.

IIHR's IP course offerings have proven to be an outstanding experience, both personally and academically, for its participants. As the IP program continues to embark upon engineering-centered study abroad courses around the world, the recognition of the valuable resource it lends in education within engineering will spread. As one participant stated:

This course gives IIHR and University of Iowa engineering students an incredible opportunity to learn about international water resources issues while experiencing another culture in a fun environment. It has given me new perspectives of not only Egyptian culture, but my own culture. I am very thankful for being able to participate in this course with the other students and Dr. Muste – the instructor of the course.

References

1. Mutel, C.F., Flowing Through Time: A History of the Iowa Institute of Hydraulic Research, Published by the Iowa Institute of Hydraulic Research, Iowa City, Iowa, 1998.
2. Asman, R., Gans, A., Wendell, M., and Muste, M., "Multi-disciplinary International Study Abroad Short Course," IP China project web site, 2007.
3. Gaddi, M., Sexton, T., Muste, M., Patel, V.C., and P. Alvarez, "International Perspectives in Water Resources Management: The Paraná River Watershed," *World Transactions on Engineering & Technology Education*, 2:3, pp. 435-439, 2003.
4. Bell, M., Schrier, C., Muste, M., and Krajewski, W., "The University of Iowa's International Perspectives in Water Resources Planning Programme," *World Transactions on Engineering & Technology Education*, 2:1, pp. 79-85, 2003.

International Perspectives in Water Science and Management Egypt Winter 2009 165:841/053:185

International Research and Education Workshop Post-event Report

Submitted to Professor Marian Muste

Written by James Johansen and Kara Prior

Introduction

In December 2008, a group of University of Iowa students travelled to Egypt to take part in a course in international perspectives in water sciences and management. The participating students were mainly made up of environmental engineering graduate students, although there were undergraduates and other majors in attendance.

The goal of this course was to offer an intensive international experience. This experience is designed to include in depth exposure to technical, historical, cultural, social, economic, ethical, and environmental aspects of life in Egypt. The students saw new things, gained an understanding of the psyche of another culture, met new friends, and networked with professionals in their field. The group was led and accompanied by eight professors and researchers with expertise in water resources and management.

The schedule included a Nile River cruise upstream from Luxor and ending at the high dam in Aswan. On the south side of the dam the students were able to view Lake Nasir while Egyptian Tarek Tawfik, from the Central Laboratory for Environmental Quality in Egypt, explained the storage capacity and inner workings of the earthen dam shown in Figure 1.

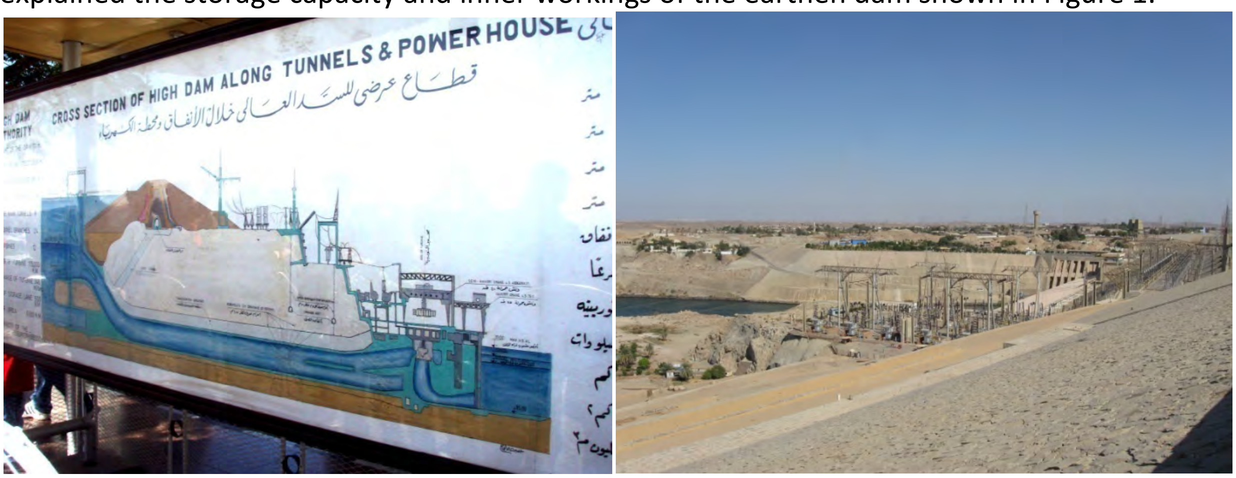


Figure 1: Cross Section of Aswan Dam (Left) and Picture of Nile River and Power Station Side of Dam (Right).

The river cruise and the various touristic sites visited gave the students a look at some of the history as well as a snapshot of the current Nile River environment. During this trip the students saw firsthand that the Nile River is main artery for life in Egypt, as it has been since ancient times. It currently supplies a vast majority of the water to Egypt’s industrial, residential, commercial, and agricultural entities. In ancient times, the Pharaohs installed, “Nilometers” shown in Figure 2 in their temples that measured the Nile River’s water table to determine the quantity of taxes that could be required each year.

Figure 2: The Nile-ometer (Left) at Kom Ombo Temple (Right).

The next segment of the trip was focused on the international research and education workshop titled “Coping with Challenges of Large River Basins.” This workshop had some of Egypt’s leading experts in water resource management in attendance. Twelve professionals presented during the workshop, six from America and six from Egypt. The presentations are summarized below in the knowledge presented section in Table 1. The women in the group also had an opportunity to meet with other female professionals and have discussions that are also summarized below.

After the workshop the coastal water regions were visited. The students went on a day trip to the Red Sea including the Suez Canal, where they learned that the income from the Suez Canal accounted for over 3% of Egypt’s gross domestic product. The Nile delta and Mediterranean was experienced on a day trip to Alexandria, which sits in the middle of the delta. The delta is a main agricultural, industrial, and population center for Egypt due to the wide spread water access from the delta. The Mediterranean Sea and Red Sea are displayed below in Figure 3.

Figure 3: Mediterranean Sea (Left) and Red Sea (Right).

Knowledge Presented

The goal of the workshop was to initiate a long-term, mutually beneficial collaborative foundation for joint capacity-building efforts for understanding water-related processes and developing science-based tools for decision-making in water resources. This goal can be seen in the brochure located in Appendix A. The workshop began with introductions of the people and parties present. The workshop then continued with presentations by Egyptian and American experts in the water resources field. Each presentation was followed by a brief discussion and interaction about the knowledge presented. There were two large discussion sessions, one each day of the workshop; where the group was split in half to discuss ways that collaboration can be facilitated in the future. These sessions are summarized in the things learned section. The people present at the conference came from various backgrounds. A participant breakdown can be seen in Appendix B. A more detailed list of participants with some contact information was included in Appendix C.

Table 1: International Water Resource Conference Presentation Summaries.

Professor Dr. Hussam Fahmy **Director of Nile Research Institute (NRI), National Water Research Center,** Hussam.fahmy@yahoo.com
Dr. Hussam Fahmy reported on current Egyptian cyber infrastructure. Dr. Fahmy first introduced a brief history of the NRI's creation and the main research that their institute focuses on. The NRI was created in 1990 to improve the practices of water resource policy makers, planners, and engineers in an effort to give these professionals better ways to manage the Nile River System. The research has focused on river bank quality impacts, reservoir sedimentation, and hydrology. Cyber infrastructure consists of computing systems, data storage systems, advanced instruments, visualization tools, and people linked by high speed networks. Dr. Fahmy explained that at the heart of cyber infrastructure vision is the development of a cultural community that supports a peer to peer collaboration in effort to share data and information resources, online instruments, and observatories. This allows for multi-disciplinary data sharing and modeling that anyone can add to or use. NRI currently displays information from instruments like echo-sounders, GPS, electronic Distance Measuring, water current meters, quality samples, and laboratory data. All of this data along with numerical models are stored in databases. Egypt currently has a website where information cannot be reached but Dr. Fahmy explained that there is much work yet to do. Collaboration between the Egyptian scientists and those at The University of Iowa may a starting point to perfecting a widely used river management tool.
Professor Dr. Mohamed Abdel-Mottaleb **Planning Sector Head, Ministry of Water Resources and Irrigation,** motaleb@mwri.gov.eg
Dr. Mohamed presented Egypt's current national water resource plan and the challenges that are faced within the country. The main problem is that Egypt's population is growing at a pace much faster than its water resources growth. This results in the per–capita water quota to be reduced and the per-capita agricultural land to be decreased. This could eventually lead to a reduction in the quality of drinking water for Egyptians. The current national water resource plan (NWRP) for Egypt was drafted in 2005. The main objective for the plan explained by Dr.

Mottaleb is to describe how Egypt will safeguard its water resources until 2017 with respect to quantity and quality. The main strategy used in the NWRP is the Integrated Water Resource Management (IWRM). This acronym is a planning and implementation process that is based on sound science. The NWRP is based on five pillars: Development of additional water resources, making better use of existing water resources, protecting public health and environment, implementing necessary institutional measures, and involvement of national stake holders. The Ministry is also doing some research into a Nile River forecasting system, a High Aswan Damn Decision Support System, and a data management system.
Professor Keri Hornbuckle **Department of Civil and Environmental Engineering Chair, IIHR-Hydroscience and Engineering, The University of Iowa, kchorn@engineering.uiowa.edu**
Dr. Keri Hornbuckle attended the international Research and Education workshop and presented her upcoming work. The discussion was based around the 2008 floods in eastern Iowa. Professor Hornbuckle's research is aimed at determining the potential release and dispersion of organic pollutants during extreme flood events on the Mississippi River and its tributaries. The main questions that her proposed research will aim to answer is what pollutants may have been released into the flood waters, what were the major sources of those pollutants, and what health risks and environmental hazards resulted from this pollution. Dr. Hornbuckle expects that the sediments that were transported in the 2008 floods carried harmful pollutants. She expects that sediment analysis will provide a way to discover what pollutants where transported and their origin. Dr. Hornbuckle also presented some of the particular pollutants that she expects to find such as musk's and fragrances from detergents and soaps. Some of the graduate and undergraduate students involved in sampling soils and now determining the pollutant levels were in attendance for the presentation.
Dr. Craig Just **Assoc. Research, IIHR-Hydroscience & Engineering, The University of Iowa,** craig-just@uiowa.edu
Professor Craig Just from The University of Iowa presented his research on Nutrient Processing and Mussel Habitat in the Mississippi in response to extreme water events. The expected result of this research is that intense deposition of particulate organic matter from extreme flooding alters the freshwater mussel and microbial food webs through physical and chemical means. Professor Just reported that Mussels prefer certain types of grain sizes. It was also reported that increasing organic carbon, like in a flood, increases fine grain size in the water. Mussels have effects on multiple aquatic ecosystem levels. It can be summarized that healthy populations of mussels result in a healthy aquatic ecosystem. To test this, mussels were collected and inserted in a tube that mimicked the sediment water interface that they were used to in nature. Once in these tubes different environments could be tested proving or disproving their conclusions. Dr. Just's team also developed real time water monitoring and sensing equipment to find high times in the nitrogen cycle that could have an impact on mussel health. The team found that mussels and bacteria play a role in the nitrogen cycle. They discovered that the flood did indeed have a negative impact on gulf hypoxia. Professor Just finished by explaining his idea of outfitting mussels with small sensors in order to have a super sensor for mussel bed conditions.

Dr. Mostafa Gaith
Irrigation and Hydraulics Department, Cairo University, magaith@yahoo.com

Dr. Mostafa Ghaith reported on the idea of incorporation of virtual water concepts in IWRM. It is known that different types of crops have different water requirements to produce them. Egypt and the semi arid countries nearby were analyzed with respect to their crop selection and their annual renewable fresh water resources. Once this was done it appeared that some countries were not growing the optimal crops for their climate. It was theorized that if water management between countries could collaborate to produce the optimum crop for their region the same spectrum of crops could be produced with less water usage in the areas that have major shortages. The other options to increase water resources are to reuse marginal quality water, decrease system losses, and use nonconventional methods. The potential of using virtual water management includes minimizing the food gap in Arab countries and improving food trade. There are also very many problems with this idea. One is that all things were not considered like farmer knowhow and unwillingness to change. This would also make each county more dependent on foreign trade and therefore less self sufficient and more vulnerable.

Larry J. Weber
Director, **IIHR – Hydroscience and Engineering, Edwin B Green Chair in Hydraulics,**
Civil and Environmental Engineering, University of Iowa, larry-weber@uiowa.edu

Larry Weber introduced IIHR- Hydroscience and Engineering and gave an overview of its programs, history, and participants. He then presented on the need for science-based adaptive management in large-river restoration, and the related research he has conducted on the Upper Mississippi and Columbia rivers. He is associated with the NESP Science Panel for the Upper Mississippi river, charged with developing a science-based adaptive management plan for "navigation, ecological and economic sustainability," which convened in 2005. The typical adaptive management cycle includes planning, design, build/implement, monitoring, and assessment, which Dr. Weber further explained through the example of fish passage problems he had been involved in addressing and monitoring. The unique life cycle of Pacific Salmon require passage between fresh headwaters of the Columbia and the Pacific Ocean through the Northwest United States. Despite careful original planning, all but a miniscule percentage of fish passing through a specific dam on the Columbia were being killed. It was found that the increased pressure moving under the dam was forcing fish to absorb dissolved gasses, which then expanded and killed the fish once pressure was normalized again downstream of the dam. Adaptive management techniques have succeeded in improving the number of fish surviving this passage, and this project is still in progress.

Marian Muste
IIHR-Hydroscience & Engineering, The University of Iowa, marian-muste@uiowa.edu

Marian Muste presented on the Role of Cyberinfrastructure-Based Platform in Water Science and Management. He stressed that this is a pressing need, as water resources are strained as never before. He also stressed the urgent need to surpass existing disconnects between science and management through communication and technology. He emphasized the usefulness of new resource management frameworks in answering questions about water's relationship with other aspects of the human environment. He cited a number of

Ecohydrologic Observatories are being developed in the United States and Europe, and their data is being entered into digital watershed models whereby researchers can share and analyze data, making data collection far less redundant and much closer to real-time. He also described a number of the many challenges faced in their design, in five categories: Hydro/Environmental Engineering; Information Systems; Computer Science; Socio-Economics; and Education, training, and outreach. He shared the example of the Clear Creek Digital Watershed, which combines the research of a number of researchers at IIHR, providing a continuous real-time simulation of water quality and warning levels for the stream. This information is available to the public on the Internet. He also discussed opportunities for capacity building in future collaboration and research projects.
Thanos Papanicolaou **IIHR - Hydroscience & Engineering, The University of Iowa,** athanasios-papanicolaou@uiowa.edu
Thanos Papanicolaou presented research he has been conducting with his group at IIHR. The overall goal of this study is to provide "statistically defendable hydraulic conductivity (the ability of soil to transmit water) estimates at the hill slope scale." His presentation began with definitions of "waterscape" (all the water present in a vertical cross section of a watershed, in the form of: precipitation, soil evaporation, plant transpiration, percolation, infiltration, and runoff) and "soilscape" (vertical cross section of soil horizons). In a research project on the Clear Creek watershed in Eastern Iowa, Papanicolaou found a discrepancy between available soil maps and measured hydraulic conductivities, which is acceptable for many purposes but not advanced watershed models. He found a correlation between the harmonic mean of a density function of the soil and the peak hydraulic conductivity distribution. There is need for further research in these areas.
Sherif M. El-Sayed **Manager, Nile Basin Capacity Building Network,** s.el-sayed@hri-egypt.org
Dr. Sherif presented on the Nile Basin Capacity Building Network (NBCBN). He noted that the Nile Basin covers more than 3 million square kilometers, the river itself is more than 6,000 kilometers in length, and that the basin spans ten countries: Burundi, D.R. Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda (five of which are among the poorest in the world). He notes that a large and growing population, environmental degradation, and poverty are among the key challenges. The challenge his project seeks to solve is the lack of interaction and cooperation among the institutions in the various countries. The NBCBN's "Main Concept" is to "create an environment in which professionals from the water sector sharing the same river basin would have the possibility to exchange ideas, their best practices and lessons learned," by developing human resources and increasing cooperation. This is done by creating international professional interest groups as well as networks within each country. The internet has been used as a major resource for sharing knowledge and assistance. There are currently more than 300 professionals involved, with 10 "nodes" and in-country connections, sharing information through a website, newsletter and magazine as well as through personal relationships.
Prof. Dr. Shaden Abdel-Gawad **President, National Water Research Center, Ministry of Water Resources and Irrigation, Cairo- Egypt**, shaden@nwrc-eg.org

Dr. Shaden presented on Water Quality Policy in Egypt. She stressed the challenges faced by Egypt, beginning with the booming population and seriously limited water resources. She noted the diversity of pollution sources, which further strain water resources, and the insufficient technology for treating wastewater. Improper law enforcement and insufficient financial resources for both political and technological advances each both limit water quality further. She discussed Integrated Water Resources Management, which aims to protect the environment and human resources by seeking ways to augment supplies and to control demand (she also offered some mechanisms for each of these). She described the National Water Quality Monitoring Program, which provides information, often in nearly real time, about the resources and runoff of water in Egypt. Using this program, a number of Priority Areas have been identified, so that water officials have a means of prioritizing their efforts. She stressed the principles present in Egyptian policy, including: a high level of protection; the principle of precaution; preventative action; correction at the source; the principle of "polluter pays"; information and research output exchange; and awareness (both by managers and by the general public). She stressed that while progress has been made in identifying problems and building the institutions to address them, there is much more work to be done.
The Right to Water: An Egyptian Perspective **Professor Dr. Sameh Abdel-Gawad, Professor of Environmental Hydraulics,** **Faculty of Engineering, Cairo University,** sameh@misrconsult.com
Dr. Sameh opened his presentation (after a brief geographic orientation of Egypt for the Americans in the audience) by explaining Egypt's water resources. 90% of the freshwater used in Egypt comes from the Nile, and all resources, despite currently being tapped to the fullest, are going to need to be increased as the population continues to boom. There is already a "food gap" of insufficient food supplies to some of the population, which has the potential to get much worse, and clean water for drinking is still not available to all rural residents. An added challenge is the fragmentation of water management: about nine different ministries and a number of NGOs are involved in managing Egypt's water. He identified four main components to satisfying the right to water: Water Quality, Accessibility, Availability, and Affordability. Steps to improving each of these aspects were identified, and Dr. Sameh noted that Egypt is a leader in this area in the Middle East., citing major improvements in investment and capacity of drinking water in recent decades. He cautioned that the "right to water" is a phrase often used in political talk but not acted on, and that we need to work now to begin creating the necessary institutions and infrastructure to provide water to everyone.

Figure 4: students and faculty look on during a presentation during the Cairo conference

Lessons Learned

The conference concluded with two large-group discussions about potential projects and topics for collaboration. The similarities of the Nile and Mississippi watersheds was again highlighted by the similarities in interests contributed by the participants. They were interested in investigating both the applicability and the limitations of large scale watershed models, and brought up concerns of temporal and spatial scope as well as interest in integrating hydrologic and hydrodynamic models. Both groups appreciated the unique importance of swamps and wetlands. Best management practices in agriculture, a major strain on water resources in both Egypt and the Midwestern US, were discussed. Both of the river systems involve industry-heavy and highly populated deltas, requiring consideration of ecological needs, weed management, and nutrient loads. It was noted that many of the questions discussed were complex and require an interdisciplinary response. Many of the issues were also incredibly large-scale, for which international collaboration will be indispensable. Protecting and managing coasts through sea level and composition changes as global climate change progresses and addressing pollution in these large rivers cannot be accomplished by any one jurisdiction.

Further Interaction

Visit at Cairo University

The students had an opportunity to interact with Egyptian faculty and experts when they toured the campus of Cairo University. They were shown multiple large scale models as shown in Figure 5 below.

Figure 5: Students look on while Cairo University faculty explain a model of a seaside industry's effluent system (Left) and students Look upon a large scale model of a portion of the Nile River (Right).

The students were also shown Cairo University's international student facilities, as well as lecture facilities and classrooms. The most treasured part of the visit to Cairo University was when the students had the opportunity to meet with some attending Cairo University graduate students. They were very pleasant to speak with. They expressed many of the same concerns with graduation and student life as the student feel in America. One Egyptian student was considering on moving to American to work but was worried about her fiancé's ability to get a visa. Contact information was exchanged to so that she could possibly get some advice from somebody living here if needed. Some student interaction images are shown below in Figure 6.

Figure 6: Student to student interaction at Cairo University.

Visit at NWRC

The students had another opportunity to interact with Egyptian faculty and experts later that week when they toured the National Water Research Center. They were shown water quality testing labs and equipment as well as facilities and other research labs shown in Figure 7. The NWRC manages much of the water quality testing done in the Nile River and the Delta region.

Figure 7: Egyptian giving tour of water quality testing lab (Left) and students and faculty looking at a model of the NWRC research facilities

Women Scientists' Evening

On the evening of January 5th, the five female students participating in the course, along with Keri Hornbuckle, met with a dozen or so female engineers and water specialists in the World Trade Center in Cairo. They discussed the roles that women play in water engineering and science in the United States and in Egypt, and compared experiences in classes and work in the two countries. I think all the Americans were surprised at how much closer to even the ratio of women to men is in engineering jobs and especially engineering degree programs. In Egypt about forty percent of engineering students are female; classes in the United States are often about ten percent female. Both cultures have a similar expectation about women raising children, at least traditionally. The Egyptian women at this meeting were extraordinary. They worked full time while studying, as all Egyptian students need to finance themselves, and once out of school worked full time, were the primary caregivers for their children, and kept their houses clean. It was inspiring to see how dedicated they were, and how prevalent that dedication is. A group of women are working to create a network to discuss gender issues in work in Egypt and around the Middle East and Northeast Africa, which provides a framework to continue working towards equality of opportunity in this field.

Conclusion

The trip concluded with a picturesque visit to the pyramids that had been looming out of reach at the edge of Cairo. The course met its goals of providing a memorable and meaningful experience to University of Iowa students. They gained an understanding of technical, historical, cultural, social, economic, ethical, and environmental aspects of life in Egypt, which will help them in their career and overall life paths. The discussions and the presentations at the conference were helpful to understand the comparisons and differences between the Nile and Mississippi water sheds. The main similarity is that both watersheds are very large and support large populations. This triggers problems in managing water quality, water flow control, and distribution. It was concluded that both countries could benefit greatly from an easy to use medium for technical communication. This would facilitate data and knowledge sharing. The creation of cyber infrastructure was proposed as a possible solution and chance for future collaboration. The class was truly a once in a lifetime experience and the friendships made will be cherished.

Figure 8: Students and faculty pose for a group picture before enjoying lunch at the international water resources workshop.

Appendix A:

University of Iowa Student Participants in the Workshop

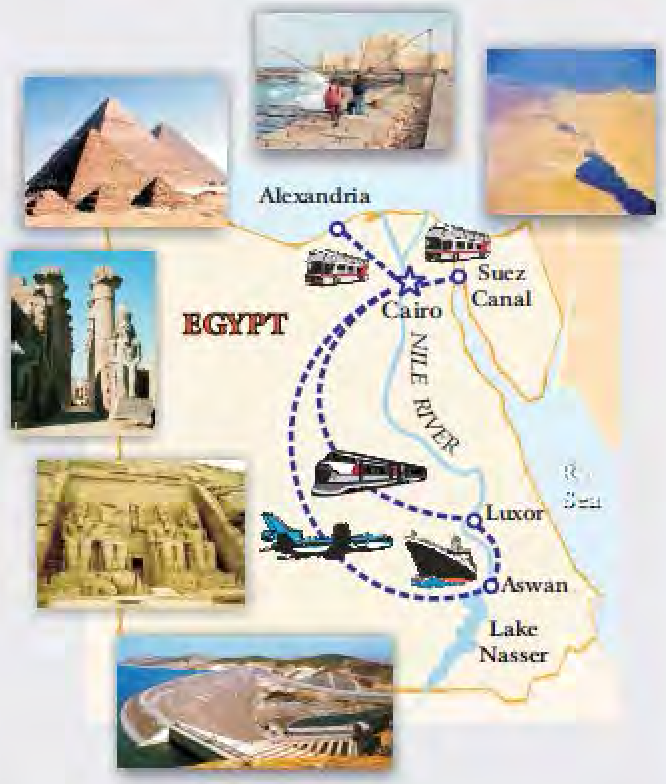
University of Iowa students are registrants in the course titled,

International Perspective in Water Science & Management

December 29, 2008 - January 10, 2009

International Perspectives is IIHR-Hydroscience & Engineering's hallmark study abroad course designed to offer an intensive international experience for American students and young professionals in engineering and sciences. Each year the course focuses on a different country or world region for in-depth exposure to technical, historical, cultural, social, economic, ethical, and environmental issues that impact planning and execution of water projects in that region. Most significantly, students are introduced to the realities and complexities of water and environmental issues in a world in which many water resources issues transcend political boundaries, requiring collaboration among specialists from multiple countries impacting and depending on a particular watershed.
Since 1997, *International Perspectives* students have visited water resources projects in various world regions, including the Narmada Valley in India, the island nations of Taiwan & Japan, the Three-Gorges Dam in China, the lower Danube River basin in Hungary, Poland and Romania, the Itaipu Dam on the border of Brazil and Paraguay, and the Southeast Anatolia Project in Turkey.

This year the course takes students to Egypt with special emphasis on the Nile River Basin. The technical focus will include field visits to major hydraulic structures on the Nile River, Suez Canal, including large-scale flood prevention and mitigation projects and hydro-power plants; irrigation systems in the Nile River Delta; and water treatment plants, and maritime ports. The course started in September 2008 on the UI campus with preparatory lectures on the history, culture, and water resources projects in Egypt presented by experts in these areas. During the visit abroad, participants will interact with local students, faculty, and experts in jointly organized workshops. The workshops will emphasize the planning, socio-economic and environmental impacts, rehabilitation programs and problems, legal, cultural and institutional aspects of water resources projects. Participants will also visit technical, historical, and cultural sites. The course finishes with post-visit written reports concluding the international and technical experience.



Course Participants (From several academic departments) include:

Travis Anderson
Jeremy Bril
Paul Eastling
Mohamed Habib
Eve Iversen
James Johansen
Jessica Kilgore
Carmen Langel
LlynnAnn Luellen
Jesse Piotrowski
Kara Prior
Michael Schaefer
Michael Schubert
Jessica Smith
Dustin Tardiff
Matthew Zager

The University of Iowa

Broadening the Role of Cyberinfrastructure in Water Resources Management:

Coping with the Challenges of Large River Basins

International Research and Education Workshop

Cairo, Egypt   January 5-9, 2009

To initiate a long-term, mutually beneficial collaborative foundation for joint capacity-building efforts for understanding water-related processes and developing science-based tools for decision-making in water resources.

Mississippi River Basin

Average Discharge
17,330 (m^3/s)

Drainage Area
3.35 million (km^2)

Coverage/Population
10 states
(72 million people)

Nile River Basin

Average Discharge
2,574 (m^3/s)

Drainage Area
4.76 million (km^2)

Coverage/Population
10 countries
(160 million people)

Building cyberinfrastructure-based observatories and observatory networks require vast intellectual multi-disciplinary expertise and extensive infrastructure that currently does not exist at a single institution (in the U.S. or abroad). The conceptual and operational framework on which these systems are built presents a significant challenge and, thus, requires a coordinated development plan that carefully considers available data, facilities, expertise, and technological systems. Despite rapid growth and the availability of advanced technology, scientific and engineering communities increasingly realize that there are a number of issues regarding the establishment of observatory networks that require a transition from our current research approaches. We must transition from: a) independent investigator research projects to long-term team studies; b) separated disciplines working independently to seamlessly integrated interdisciplinary work; c) many specialized models to community models; d) scattered field observations to observatories that cover large heterogeneous areas; and e) local facilities to shared facilities where scientists and engineers from multiple perspectives can reach across interfaces and work together at problem solving. **These ambitious goals require national and international capacity building and collaboration.**

Organized by:

IIHR-Hydroscience & Engineering
The University of Iowa
Iowa City, Iowa - USA

National Water Research Center, Cairo, Egypt

Cairo University
Cairo, Egypt

Workshop objectives will be met through general and breakout group sessions, as well as through hands-on demonstrations during field visits. Activities are also planned to encourage and facilitate interaction of workshop participants with students. For this purpose, the workshop will include student participants from both countries. A social event organized for women scientists will highlight contemporary topics on gender in the science and management of the water resources.

Agenda

Day	Time	Activity
January 4	17:30-19:00	• **Ice Breaker** Reception
January 5	9:00-9:30	• **Welcome/Opening Remarks** - M. Muste, R. Elkholy, T. Salaheldin • **Introduction** of the participants • **Overview** of the Workshop Goals - M. Muste
	9:30-12:30 (with 15 min break)	• **Theme 1:** Accomplishments/challenges in supporting the decision-making process in large-river basins - S.T. Gawad, L. Weber, M. Abdel-Moteleb, S.A. Gawad • **Discussions**
	12:30-13:30	• **Lunch**
	13:30-15:30 (with 15 min break)	• **Theme 2:** Synergy between water resources science and management through cyberinfrastructure - M. Muste, T. Salaheldin • **Discussions** • **Break-Out Group Sessions**
	18:00-20:30	• **Women Scientists Social Meeting**
January 6	9:00-12:00 (with 15 min break)	• **Theme 3:** Frameworks and components necessary to assemble multi-stage, multi-national network of digital observatories for research, management, and education - R. Elkholy, P. Kumar, M. Allam, M. Hondzo, T. Papanicolaou • **Break-Out Group Sessions**
	12:00-13:30	• **Lunch**
	13:30-17:00 (with 15 min break)	• **Theme 4:** Scientific themes, research, technology, and management resources common to Mississippi and Nile River Basins - K. Hornbuckle, H. Fahmy, C. Just, S. El-Mohamady • **Open Forum**
January 7	8:00-16:00 19:00	• **Visit** Giza Pyramids, Egyptian Museum, Khan el Kahlili Bazaar • **Networking** Reception
January 8	9:30-12:00 13:30-17:00	• **Visit** The National Water Research Center Institutes and Central Laboratory • **Tour** Sakkara, Step Pyramid, Mohamed Ali Mosque
January 9	8:00-12:00 13:30-17:00	• **Theme 5:** Influence of hydrologic conditions, land use, and human infrastructure on digital observatory design - all participants • **Workshop Closure** (strategies, assignments, student exchange) • **Student Presentations** followed by **Social and Networking Event**

Workshop Participants

Participant / Institution	Presentation Title
U.S.A	
Hondzo, Miki Professor, University of Minnesota	*Scaling Denitrification in Aquatic Ecosystems to its Controlling Environmental Drivers*
Hornbuckle, Keri Professor, IIHR[1]	*Potential Release of Persistent Organic Pollutants During Extreme Flooding of the Mississippi River and its Tributaries*
Just, Craig Assoc. Research, IIHR	*Sensing the Impact of Extreme Events on Nutrient Processing and Mussel Habitat in the Mississippi River*
Kumar, Praveen Professor, University of Illinois	*Considering the Complexity of Critical Zone Processes in Large River Basin Management*
Muste, Marian Research Engineer, IIHR	*The Role of Cyberinfrastructure-based Platforms in Water Science and Management*
Papanicolaou, Thanos Assoc. Professor, IIHR	*The Role of Management Practices in Soil Erosion and Sediment Transport in Large-River Restoration*
Weber, Larry Professor and Director, IIHR	*The Role of Science-based Adaptive Management for Large River Restoration*
Elhakeem, Mohamed Ass't. Research Engineer, IIHR	*Water Resources Management, Environmental & Ecological Aspects in Rivers & Lakes.*
Langel, Carmen Program Associate, IIHR	*International Education Programs*
16 Students University of Iowa	*International Perspectives in Water Science and Management Course*
Egypt	
Gawad, Shaden T. President, NWRC[2]	*National Water Quality Challenges in Egypt*
Allam, Mohamed Chair, Irrigation & Hydraulics Dept., Cairo University	*Incorporation of Virtual Water Concept in Integrated Water Resources Management*
Gawad, Sameh A. Professor, Cairo University	*Current and Future Challenges in Municipal Water and Sewage in Egypt*
Abdel-Moteleb, Mohamed Head, Planning Sector, MWRI[3]	*National Water Resources Plan of Egypt*
Fahmy, Hossam Director, NRI[5], NWRC	*Cyberinfrastructure for the Nile River*
El-Mohamady, Sherif Ass't. Professor, HRI, NWRC	*Nile Basin Water Experts Communication Network*
Elkholy, Rasha Assoc. Professor, NWRC	*Gender in Water Resources Management*
Salaheldin, Tarek Ass't. Professor, Cairo University	*Cyberinfrastructure for Environmental Management*
5 Researchers NRI, HRI, DRI[6], WRRI[7], NWRC	*Successful Egyptian Case Studies in Water Resources Management*
5 Students Cairo University	*Water Science and Management Training Programs*

[1] IIHR-Hydroscience & Engineering, The University of Iowa, U.S.A.
[2] National Water Research Center, Cairo, Egypt
[3] Ministry of Water Resources and Irrigation, Cairo, Egypt
[4] Hydraulics Research Institute, Cairo, Egypt
[5] Nile Research Institute, Cairo, Egypt
[6] Drainage Research Institute, Cairo, Egypt
[7] Water Resources Research Institute, Cairo, Egypt

Workshop organized by Marian Muste, Mohamed Elhakeem, IIHR—Hydroscience & Engineering Rasha Elkholy, NWRC, and Tarek Salaheldin, Cairo University

Appendix B:

International Workshop Participant Break Down.

American Professors and Researchers	8
American Graduate Students	11
American Undergraduate Students	3
Egyptian National Water Research Center (NWRC)	15
Egypt's Ministry of Higher Education and Scientific Research (MHESR)	1
Egypt's Ministry of Water Resources and Irrigation (MWRI)	2
Cairo University Professors and Researchers	13
Egypt's Helwan University Professors	6
Cairo University Students	5

Appendix C:

International Research and Education Workshop

Broadening the Role of Cyberinfrastructure in Water Resources Management:

"Coping with Challenges of Large River Basins"

مواجهة التحديات لأحواض الأنـهار الكبيرة

Organized by

IIHR-Hydroscience & Engineering
The University of Iowa
Iowa City, Iowa, USA

National Water Center,
Cairo, Egypt

Cairo University
Cairo, Egypt

List of Participants

Nile Valley Hall, Delta Barrages
Cairo, Egypt.
5 - 6 January, 2009

USA Participants

U.S.A. Professors and Researchers

1. **Prof. Miki Hondzo**
   Professor,
   University of Minnesota.

2. **Prof. Keri Hornbuckle**
   Chair Department of Civil and Environmental Engineering & Professor, IIHR-Hydroscience & Engineering
   The University of IOWA.

3. **Dr. Craig Just**
   Assoc. Research
   IIHR-Hydroscience & Engineering
   The University of IOWA.

4. **Dr. Marian Muste**
   Research Engineer,
   IIHR-Hydroscience & Engineering
   The University of IOWA

5. **Dr. Thanos Papanicolaou**
   Assoc. Professor,
   IIHR-Hydroscience & Engineering
   The University of IOWA.

6. **Prof. Larry Weber**
   Professor and Director
   IIHR-Hydroscience & Engineering
   The University of IOWA.

7. **Eng. Mohamed Elhakeem**
   Ass't Research Engineer
   IIHR-Hydroscience & Engineering
   The University of IOWA

8. **Dr. Carmen Langel**
   Program Associate
   IIHR-Hydroscience & Engineering
   The University of IOWA.

U.S.A. Ph.D. Students (from several academic departments)

9. **Eng. Jessica Kilgore**
10. **Eng. LlynnAnn Luellen**
11. **Eng. Kara Prior**
12. **Eng. Jessica Smith**
13. **Eng. Jesse Alex Piotrowski**
14. **Eng. James Paul Johanesen**
15. **Eng. Matthew Scott Zager**
16. **Eng. Dustin James Tardiff**
17. **Eng. Jeremy Scott Bril**
18. **Eng. Travis Jake Anderson**
19. **Eng. Paul Michael Eastling**
20. **Eng. Michael Andrew Schubert**
21. **Eng. Michael Vernon Schaefer**

Egyptian Participatns

Ministry of Higher Education & Scientific Research (MHESR)

23. **Prof. Dr. Maged Moustafa Al Sherbiny**
Assistant Minister for Scientific Research
Ministry of Higher Education and Scientific Research (MHESR)
Tel.: (202) 27221282
Fax: (202) 27221280
Email: maged123@link.net

Ministry of Water Resources & Irrigation (MWRI)

24. **Prof. Dr. Mohamed Abdel-Mottaleb**
Head, Planning Sector
Ministry of Water Resources and Irrigation
1 Gamal Abdel-Nasser St; Cornish El-Nil
Embaba, Giza, Egypt.
Tel.: (202) 35449456/ 35449486
Fax: (202) 35449456
Email: motaleb.mwri.gov.eg

25. **Dr. Mohamed Ahmed**
Director, Technical Office
Planning Sector

National Water Research Center (NWRC)

26. **Prof. Dr. Shaden Abdel-Gawad**
President,
National Water Research Center (NWRC)
Fum Ismailiya Canal, P.O. Box 74,
Shoubra El-Kheima 13411,
Cairo, Egypt.
Tel.: (202) 4444 6180 / 4444 7353
Fax: (202) 4444 7846 / 4444 6761
Email: shaden@nwrc-eg.org
nwrc@nwrc-eg.org

27. **Prof. Dr. Ahmed Khater**
Vice President, (NWRC
Fum Ismailiya Canal, P.O. Box 74,
Shoubra El-Kheima 13411,
Cairo, Egypt.
Tel.: (202) 44447353
Fax: (202) 44447846
Email: drkhater@nwrc-egypt.org
drkhater@yahoo.com
drkhater@hotmail.com

28. **Prof. Dr. Mohamed Fawzi**
Director,
Drainage Research Institute (DRI)
National Water Research Center
P.O. Box 13621, Delta Barrages,
El-Kanater El-Kairiya, Qalubia
Egypt.
Tel.: (202) 4218 4692
Fax: (202) 218 9152
Email: bakcmri@hotmail.com

29. **Prof. Dr. Hussam Fahmy**
Director
Nile Research Institute (NRI)
National Water Research Center
P.O. Box 13621, Delta Barrages,
El-Kanater El-Kairiya, Qalubia
Egypt
Tel.: (202) 42187034
Fax: (202) 42187152
Email: hussam.fahmy@yahoo.com
nri@hotmail.com

30. **Prof. Dr. Fathy El-Gamal**
Director
Water Resources Research Institute (WRRI)
National Water Research Center
P.O. Box 13621, Delta Barrages,
El-Kanater El-Kairiya, Qalubia
Egypt.
Tel.: (202) 4219 0381 / 4218 9437
Fax: (202) 4218 4344
E-mail: wrri@wrri.org.eg
drelgamal@wrri.org.eg

31. **Eng. Ibrahim El-Desouky**
Director
Hydraulics Research Institute (HRI)
National Water Research Center
P.O. Box 13621, Delta Barrages,
El-Kanater El-Kairiya, Qalubia.
Tel.: (202) 4218 8268
Fax: (202) 4218 9539
Email: i.desouky@hri-egypt.org

32. **Prof. Dr. Tarik Tawfik**
Director
Central Laboratory for Environmental Quality (CLEQM)
National Water Research Center
P.O. Box 13621, Delta Barrages,
El-Kanater El-Kairiya, Qalubia
Egypt.
Tel.: (202) 4217 0830
Fax: (202) 4217 4663
Email: tawfic@cleqm.org.eg

33. **Prof. Dr. Alaa Abdin**
Director
Strategic Research Unit (SRU)
NWRC Administration Building
El Kanater 13621, Qalyoubia,
Egypt
Tel: (202) 218 1259/ 218 3058
Fax: (202) 218 1259
Email: alaa_ea_abdin@yahoo.com

34. **Dr. Rasha El-Kholy**
Associate Professor,
National Water Research Center (NWRC)
Fum Ismailiya Canal
Email: relkholy@nwrc-egypt.org

35. **Dr. Sherief El-Mohamady**
Manager, Nile Basin Capacity Building Network
Hydraulic Research Institute (HRI)
Delta Barrages, El-Kanater El-Kairiya,
Qalubia, Egypt.
Email: s.el-sayed@hri-egypt.org

36. **Eng. Ahmed Mohamed Lotfy Youssef**
Civil Engineer,
Water Resources Research Institute (WRRI)
Delta Barrages, El-Kanater El-Kairiya,
Qalubia, Egypt.

37. **Eng. Marwa Ali Sayed Ali**
Civil Engineer
Water Resources Research Institute (WRRI)
Delta Barrages, El-Kanater El-Kairiya, Qalubia, Egypt.

38. **Eng. Rabab Eid Soliman**
Engineer,
Drainage Research Institute (DRI)
Delta Barrages, El-Kanater El-Kairiya, Qalubia.

39. **Eng. Naser Tawfik Hassan**
Researcher,
Nile Research Institute (NRI)
Delta Barrages, El-Kanater El-Kairiya, Qalubia, Egypt.

40. **Eng. Mohamed El-Sayed Embaby**
Assistant Researcher
National Water Research Center (NWRC)

Cairo University Professors & Researchers

41. **Prof. Dr. Mohamed Nasr Eldin Allam**
Head, Irrigation and Hydraulics Department
Faculty of Engineering
Cairo University,
Giza, Egypt
Tel.: 2(02) 567-8622
Fax: 2(02) 573-2949
E-mail: mallam@nile-consultans.com

42. **Prof. Dr. Sameh Abdel-Gawad**
Professor of Environmental Hydraulics,
Irrigation & Hydraulics Department
Faculty of Engineering, Cairo University (CU), Giza, Egypt.
Tel: (202) 7620366
Fax: (202) 37630377
Email: sameh@misrconsult.com

43. **Prof. Dr. Abdallah Bazarra**
Professor,
Department of Irrigation and Hydraulics
Cairo University, Faculty of Engineering
Giza, Egypt.

44. **Prof. Dr. Sherif Elmanadely**
Irrigation and Hydraulics Department
Faculty of Engineering
Cairo University,
Giza, Egypt

45. **Dr. Mostafa Gaith**
Irrigation and Hydraulics Department
Faculty of Engineering
Cairo University,
Giza, Egypt

46. **Dr. Amgad El-Ansari**
Irrigation and Hydraulics Department
Faculty of Engineering
Cairo University,
Giza, Egypt

47. **Dr. Ashraf Ghanem**
Irrigation and Hydraulics Department
Faculty of Engineering
Cairo University,
Giza, Egypt

48. **Dr. Ahmed Hassan Emam**
Irrigation and Hydraulics Department
Faculty of Engineering
Cairo University,
Giza, Egypt

49. **Dr. Ahmed Mohamed Abdel-Satar**
Irrigation and Hydraulics Department
Faculty of Engineering
Cairo University,
Giza, Egypt

50. **Dr. Ahmed Wagdy**
Associate Professor of Hydraulics
Irrigation and Hydraulics Department
Faculty of Engineering
Cairo University.

51. **Dr. Ahmed Helmi**
Irrigation and Hydraulics Department
Faculty of Engineering
Cairo University,
Giza, Egypt

52. **Dr. Tarik Salah El-Din**
Irrigation and Hydraulics Department
Faculty of Engineering
Cairo University,
Giza, Egypt

53. **Eng. Ibrahim Ali El-hefnawi**
Faculty of Engineering
Irrigation & Hydraulics Department

Helwan University Professors

54. **Prof. Dr. Mohamed Bakr Khalil**
Faculty of Engineering, Mataria
Helwan University (HU)

55. **Prof. Dr. Tahani Youssef**
Professor of Water Resources,
Civil Engineering Department,
Faculty of Engineering, Mataria
Helwan University (HU)
11718 Cairo, Egypt.
Tel: (202) 26332398
Fax: (202) 26332398

56. **Dr. Ehab Wafaee**
Faculty of Engineering, Mataria
Helwan University (HU)

57. **Dr. Ahmed Kassem**
Faculty of Engineering, Mataria
Helwan University (HU)

58. **Dr. Fatma Shaltut**
Associate Prof.,
Department of Irritation and Hydraulics, .
Faculty of Engineering, Mataria.
Helwan University (HU)
Tel.: (202) 22416298

59. **Dr. Tarek Elsayed**
Faculty of Engineering, Mataria
Helwan University (HU)

Contacts

University of Iowa Faculty and Staff Participants

Carmen Langel	carmen-langel@uiowa.edu
Craig Just	craig-just@uiowa.edu
Keri Hornbuckle	kchorn@engineering.uiowa.edu
Larry Weber	larry-weber@uiowa.edu
Marian Muste	marian-muste@uiowa.edu
Mohamed Elhakeem	melhakee@engineering.uiowa.edu
Thanos Papanicolaou	athanasios-papanicolaou@uiowa.edu

University of Iowa Student Participants

Dustin Tardiff	dtardiff@engineering.uiowa.edu
James Johansen	james-johansen@uiowa.edu
Jeremy Bril	jeremy-bril@uiowa.edu
Jess Smith	smithjlh@engineering.uiowa.edu
Jesse Piotrowski	jesse-piotrowski@uiowa.edu
Jessica Kilgore	jessica.kilgore@gmail.com
Kara Prior	kara-prior@uiowa.edu
LlynnAnn Luellen	llynnann-luellen@uiowa.edu
Matt Zager	matthew-zager@uiowa.edu
Michael Schubert	mikeaschubert@gmail.com
Michael Shaefer	michael.v.schaefer@gmail.com
Mohamed Habib	mohamedahmed-habib@uiowa.edu
Paul Eastling	peastlin@engineering.uiowa.edu
Travis Anderson	travis-anderson@uiowa.edu

Cairo University Participants

Abdallah Bazarra	abazaraa@eng.cu.edu.eg
Ahmed Hassan Emam	
Ahmed Helmi	
Ahmed Mohamed Abdel-Satar	
Ahmed Wagdy	abdeldayem@eng.cu.edu.eg
Amgad El-Ansari	
Ashraf Ghanem	aghanem@eng.cu.edu.eg
Ibrahim Ali El-hefnawi	

Mohamed Nasr Eldin Allam	mallam@nile-consultants.com
Mostafa Gaith	maghaith@eng.cu.edu.eg
Sameh Abdel-Gawad	sameh@misrconsult.com
Sherif Elmanadely	melmanadely@eng.cu.edu.eg
Tarik Salah El-Din	

Helwan University Participants

Ahmed Kassem
Ehab Wafaee
Fatma Shaltut
Mohamed Bakr Khalil
Tahani Youssef
Tarek Elsayed

Egyptian Research Participants

Ahmed Khater	drkhater@nwrc-eg-org
Ahmed Mohamed Lotfy Youssef	
Alaa Abdin	alaa_ea_abdin@yahoo.com
Fathy El-Gamal	drelgamal@wrri.org.eg
Hussam Fahmy	hussam.fahmy@yahoo.com
Ibrahim El-Desouky	i.desouky@hri-egypt.org
Maged Moustafa Al Sherbiny	maged123@link.net
Marwa Ali Sayed Ali	
Mohamed Abdel-Mottaleb	
Mohamed Amed	
Mohamed El-Sayed Embaby	nwrc@nwrc-eg.org
Mohamed Fawzi	bakcmri@hotmail.com
Naser Tawfik Hassan	
Rahab Eid Soliman	
Rasha El-Kholy	relkholy@nwrc-egypt.org
Shaden Abdel-Gawad	shaden@nwrc-eg.org
Sherief El-Mohamady	s.el-sayed@hri.egypt.org
Tarik Tawfik	tawfic@cleqm.org.eg

University of Minnesota Participants

Dr. Miki Hondzo	mhondzo@umn.edu

Dana Tours Participants

Ljubinka Andrijevic (Ms. Lou)	ljubinka.cai@yahoo.com