

Navid B. Saleh

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EDUCATION

PhD, Carnegie Mellon University, Pittsburgh, PA (*May, 2007*)
Major in Environmental Engineering and Science

MS, Carnegie Mellon University, Pittsburgh, PA (*August, 2004*)
Major in Environmental Engineering and Science

BS, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh (*August, 2001*)
Civil Engineering

APPOINTMENTS & POSITIONS

11/10-Present
Thrust Leader, Nano-Environmental Thrust,
University of South Carolina Nanocenter, Columbia, SC

01/09-Present
Assistant Professor, Department of Civil and Environmental Engineering,
University of South Carolina, Columbia, SC

06/07-12/08
Post-doctoral Research Associate, Yale University, New Haven, CT.
Supervisors: Menachem Elimelech and Lisa D. Pfefferle
Aggregation and Deposition Behavior of Carbon Nanotubes in Aquatic Environments

06/03-05/07
Graduate Research Assistant, Carnegie Mellon University, Pittsburgh, PA.
Advisors: Gregory V. Lowry and Robert D. Tilton
Developing Engineered Reactive Nanoparticles for in situ delivery to subsurface DNAPL.

AWARDS AND HONORS

Explicitly profiled in USC College of Engineering Brochure for Outstanding Research Performance, Oct., 2009
Best Poster Award, Gordon Research Conference, Environmental Sciences: Water, 2008.
Outstanding Teaching Assistant Award, Carnegie Mellon University, Pittsburgh, PA, 2007.
Quantitative Environmental Analysis (QEA), LLC Graduate Scholarship 2006-2007.
ACS Environmental Chemistry Graduate Student Award, 2006.
ACS 'Environmental Interfaces' Travel Grant Award 2006.
Sigma XI Grant in Aid of Research Award 2005-2006.
Air & Waste Management Association (A&WMA) Award 2005-2006.
Departmental Merit Scholarship, Carnegie Mellon University, Pittsburgh, PA, Jan-Dec, 2003.
Tau Beta Pi, The National Engineering Honor Society.
Sigma Xi, The Scientific Research Society.
Chi Epsilon, The National Civil Engineering Honor Society.

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Pi Epsilon, The National Environmental Science Honor Society.

Bibliographic Listings: *Marquis Who's Who in Science and Engineering*, 2010.

Bibliographic Listings: *Who's Who in Engineering Education*, 2008-present.

CENTER AFFILIATIONS

Thrust Leader, Nano-environmental Thrust Area, USC Nanocenter

Member, Virginia Tech's Center for Sustainable Nanotechnology (VTSuN)

RESEARCH GRANTS

Current Projects

As PI

1. NSF (CBET): Influence of diameter and chirality of single-walled carbon nanotubes on their fate and effects in the aquatic environment (\$400,000 for two yrs)
2. NSF (EEC): NUE: Nano in a Global Context for Engineering Students (\$200,000 for two yrs)
3. AFRL (Wright Patterson): Mechanistic Understanding of Nanomaterial Toxicity: Aggregation and Surface Interaction in Biologically Relevant Conditions (\$60,000 for first year with potential of >\$100,000/yr funding in future)
4. USC, Nanocenter: Exotic Hybrid Nanomaterials: Their Fate and Environmental Effects (\$20,000 for one yr)

As Co-PI

5. GS E&C Research Institute: Applications of Carbon Nanotubes in UF and MF Membranes: Pretreatment in Seawater Desalination. (\$230,000 for three years)
6. USC, PIRA: Graphene Nanoreinforcement for Concrete: Physical Compatibility and Fundamental Properties (\$20,000 for one yr)

Past Projects

1. USC, ROP: Understanding mobility of prevalent nanomaterials in bioreactor landfills (\$20,000 for one yr)

PEER REVIEWED PUBLICATIONS (PUBLISHED)

1. Philbrook, N A , Winn, L M, Afrooz, ARM N, Saleh, N B, Walker, V K "The effect of TiO₂ and Ag nanoparticles on reproduction and development of *Drosophila melanogaster* and CD-1" , *Toxicol Appl Pharmacol* , **2011**, (in press)
2. Philbrook, N.A., Walker, V.K., Afrooz, ARM N., Saleh, N. B., Winn, L. M. "Investigating the effects of functionalized carbon nanotubes on reproduction and development in *Drosophila melanogaster* and CD-1 mice", *Reproductive Toxicol* , **2011**, (in press).
3. Joseph, L.; Zaib, Q.; Khan, I. A.; Berge, N. D.; Yong-Gyun, P.; Saleh, N. B.; Yoon, T. " Removal of bisphenol A and 17a-ethinyl estradiol from landfill leachate using single-walled carbon nanotubes", *Water Res*, **2011**, *45*, 4056-4068.

4. Surdo, E. M.; Khan, I. A.; Choudhury, A. A.; Saleh, N. B.; Arnold, W. A. Barrier properties of poly(vinyl alcohol) membranes containing carbon nanotubes or activated carbon. *J. Hazard. Mater.* **2011**, doi:10.1016/j.jhazmat.2011.01.130.
5. Saleh, N. B.; Pfefferle, L. D.; Elimelech, M. Influence of Biomacromolecules and Humic Acid on the Aggregation Kinetics of Single-Walled Carbon Nanotubes. *Environ. Sci. Technol.* **2010**, *44*, 2412-2418.
6. Brady-Estevez, A. S.; Schnoor, M. H.; Vecitis, C. D.; Saleh, N. B.; Elimelech, M. Multiwalled Carbon Nanotube Filter: Improving Viral Removal at Low Pressure. *Langmuir* **2010**, *26*, 14975-14982.
7. Sirk, K. M.; Saleh, N. B.; Phenrat, T.; Kim, H. J.; Dufour, B.; Ok, J.; Golas, P. L.; Matyjaszewski, K.; Lowry, G. V.; Tilton, R. D. Effect of Adsorbed Polyelectrolytes on Nanoscale Zero Valent Iron Particle Attachment to Soil Surface Models. *Environ. Sci. Technol.* **2009**, *43*, 3803-3808.
8. Veronesi, B.; Tajuba, J.; Saleh*, N.; Ward, W.; Hester, S.; Carter, J.; Lowry, G. V. Functionally charged polystyrene particles activate immortalized mouse microglia (BV2): cellular and genomic response. *Nanotoxicology* **2008**, *2*, 130-143.
9. Saleh, N. B.; Pfefferle, L. D.; Elimelech, M. Aggregation Kinetics of Multiwalled Carbon Nanotubes in Aquatic Systems: Measurements and Environmental Implications. *Environ. Sci. Technol.* **2008**, *42*, 7963-7969.
10. Saleh, N. B.; Kim, H. J.; Phenrat, T.; Matyjaszewski, K.; Tilton, R. D.; Lowry, G. V. Ionic strength and composition affect the mobility of surface-modified Fe-0 nanoparticles in water-saturated sand columns. *Environ. Sci. Technol.* **2008**, *42*, 3349-3355.
11. Phenrat, T.; Saleh, N. B.; Sirk, K.; Kim, H. J.; Tilton, R. D.; Lowry, G. V. Stabilization of aqueous nanoscale zerovalent iron dispersions by anionic polyelectrolytes: adsorbed anionic polyelectrolyte layer properties and their effect on aggregation and sedimentation. *J. Nanopart. Res.* **2008**, *10*, 795-814.
12. Jaisi, D. P.; Saleh, N. B.; Blake, R. E.; Elimelech, M. Transport of Single-Walled Carbon Nanotubes in Porous Media: Filtration Mechanisms and Reversibility. *Environ. Sci. Technol.* **2008**, *42*, 8317-8323.
13. Saleh, N. B.; Sirk, K.; Liu, Y. Q.; Phenrat, T.; Dufour, B.; Matyjaszewski, K.; Tilton, R. D.; Lowry, G. V. Surface modifications enhance nanoiron transport and NAPL targeting in saturated porous media. *Environ. Eng. Sci.* **2007**, *24*, 45-57.
14. Phenrat, T.; Saleh, N. B.; Sirk, K.; Tilton, R. D.; Lowry, G. V. Aggregation and sedimentation of aqueous nanoscale zerovalent iron dispersions. *Environ. Sci. Technol.* **2007**, *41*, 284-290.
15. Long, T. C.; Tajuba, J.; Sama, P.; Saleh, N. B.; Swartz, C.; Parker, J.; Hester, S.; Lowry, G. V.; Veronesi, B. Nanosize titanium dioxide stimulates reactive oxygen species in brain microglia and damages neurons in vitro. *Environ. Health Perspect.* **2007**, *115*, 1631-1637.
16. Long, T. C.; Saleh, N. B.; Tilton, R. D.; Lowry, G. V.; Veronesi, B. Titanium dioxide (P25) produces reactive oxygen species in immortalized brain microglia (BV2): Implications for nanoparticle neurotoxicity. *Environ. Sci. Technol.* **2006**, *40*, 4346-4352.
17. Saleh, N. B.; Sarbu, T.; Sirk, K.; Lowry, G. V.; Matyjaszewski, K.; Tilton, R. D. Oil-in-water emulsions stabilized by highly charged polyelectrolyte-grafted silica nanoparticles. *Langmuir* **2005**, *21*, 9873-9878.

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18. Saleh, N. B.; Phenrat, T.; Sirk, K.; Dufour, B.; Ok, J.; Sarbu, T.; Matyjaszewski, K.; Tilton, R. D.; Lowry, G. V. Adsorbed triblock copolymers deliver reactive iron nanoparticles to the oil/water interface. *Nano Lett.* **2005**, 5, 2489-2494.

PEER REVIEWED PUBLICATIONS (SUBMITTED AND IN PREPARATION)

1. Zaib, Q, Khan, I. A., Yoon, Y., Flora, J. R. V., Saleh, N. B. "Systematic Ultrasonication Study for Suspending Single-Walled Carbon Nanotubes in Water", *J Nanosci Nanotechnol*, **2011** (in review)
2. Flora, J R V, Aich, N., Saleh, N. B. "Buckyballs spontaneously acquire surface charge in water: A Quantum modeling study", *Nanoscale*, **2011** (in review)
3. Khan, I. A., Afrooz, N., Flora, J. R. V., Ferguson, P. L., Sabo-Attwood, T., Saleh, N. B. "Fractal Structures of Single-Walled Carbon Nantoubes as a Function of Chirality", *Nano-Today*, **2011** (in review)
4. Aich, N., Flora, J. R. V., Saleh, N. B. "Preparation and Characterization of Stable Aqueous Higher Order Fullerenes", *Nanotechnol*, **2011** (in review)
5. Khan, I. A., Afrooz, N., Flora, J. R. V., Ferguson, P. L., Sabo-Attwood, T., Saleh, N. B. "Chirality Affects Aggregation Kinetics of Single-Walled Carbon Nantoubes", *Environ Sci Technol*, **2011** (in review)
6. Aich, N., Zohhadi, N., Khan, I. A., Matta, F., Saleh, N. B. "Novel Colloidal Approach for TEM Imaging of Carbon Nanotube Reinforced Cementitious Composites", *Composites Part A*, **2011** (in review)
7. Zaib, Q., Khan, I. A., Saleh, N. B., Flora, J. R. V., Yong-Gyun, P., Yoon, Y. "Removal of bisphenol A and 17 β -estradiol single-walled carbon nanotubes in aqueous solution: Adsorption and molecular modeling", *Water Air Soil Poll*, **2011** (in review)
8. M. Schrand, A.M., Lin, J.B, Garrett, C. M, Brownheim S.V., Afrooz, ARM N, Saleh, N., Hussain, M.S. "Dynasore Pretreatment Rescues Copper Nanoparticle Cytotoxicity", *J Phys Chem Lett*, **2011** (in review)
9. Schaeublin, N M, Braydich-Stolle, L K, Park, K, MacCusprie, R I, Vaia, R A, Hussain, S M, "Gold Nanoparticle Shape Determines Stress Response in Human Skin Cells", *Small*, **2011** (in review).
10. Garrett C. M., Schrand A. M., Afrooz, A R M. N., Braydich-Stolle, L K., Saleh, N. B., McDougal, J. N., Hussain, S. M. "Fractal Dimension of Gold Nanoparticle Aggregates Induced Differential Gene Expression", *Small*, **2011**, (in review)

PATENTS

Provisional Patent

Saleh, N. B., Matta, F., Ziehl, P., Aich, N., Zohhadi, N., Khan, I. A., "Novel Colloidal Approach for TEM Imaging of Carbon Nanotube Reinforced Cementitious Composites"; Patent# 61/626,617

REVIEWER FOR SCHOLARLY JOURNALS

ACS, Nano, Environmental Science and Technology (ES&T), Carbon, Critical Reviews in Environmental Science and Technology, Journal of American Chemical Society (JACS), Environmental Pollution, Water Research, Journal of Contaminant Hydrology, Journal of Colloid and Interface Sciences, Journal of Physical Chemistry, Journal of Environmental Toxicology and Chemistry, ACS Applied Materials and Interfaces.

CHAired POSITIONS (CONFERENCES)

Chair, Nanomaterials Interaction at Biological Interfaces, Division of Environmental Chemistry, American Chemical Society (ACS) Annual Meeting, San Diego, CA, March 25-29, 2012.

Chair, Role of Physicochemical Properties in Nanotoxicology, Environmental Effects of Nanoparticles and Nanomaterials, SETAC-Clemson University, Aug 22-26, 2010, Clemson, SC.

Chair, Colloidal and Interfacial Phenomena in Aquatic Systems (09019), Environmental Division, American Institute of Chemical Engineers (AIChE) Annual Meeting, Philadelphia, PA, November 16-21, 2008.

CONFERENCE PROCEEDINGS

Zohhadi, N., Aich, N., Khan, I. A., Matta, F., **Saleh, N. B.**, Ziehl, P., "Graphene Nanoreinforcement for Cement-Based Composites", 4th International Symposium on Nanotechnology in Construction, May 20-22, 2012, at Crete, Greece.

Joseph, L., Zaib, Q., Khan, I. A., Berge, N., Park, Y.-G., **Saleh, N. B.**, Yoon, Y. "Removal of Bisphenol A and 17 α -Ethinyl Estradiol from Landfill Leachate Using Carbon Nanotubes", American Water Works Association ACE, 2011, June 12-16 in Washington, DC.

Khan, I. A., Ferguson, P. L., Sabo-Attwood, T., **Saleh, N. B.** "Chirality affects aggregation kinetics of single-walled carbon nanotubes", ACS National Meeting, Mar 27-31, 2011, Anaheim, CA.

Khan, I. A., Ferguson, P. L., Sabo-Attwood, T., **Saleh, N. B.** "Fractal structures of single-walled carbon nanotubes in environmental and biologically relevant aqueous conditions: Role of chirality", ACS National Meeting, Mar 27-31, 2011, Anaheim, CA.

Afroz, ARM N., **Saleh, N. B.** "Aggregation kinetics of gold nanorods in aquatic systems: Role of aspect ratio", ACS National Meeting, Mar 27-31, 2011, Anaheim, CA.

Aich, N., **Saleh, N. B.** "Aggregation kinetics of endohedral metallofullerene-single-walled carbon nanohorn and nanotube peapods", ACS National Meeting, Mar 27-31, 2011, Anaheim, CA.

Aich, N., **Saleh, N. B.** "Aggregation kinetics of higher order fullerenes in aquatic environment", ACS National Meeting, Mar 27-31, 2011, Anaheim, CA.

Zaib, Q., Khan, I. A., Flora, J., Park, Y.-G., **Saleh, N. B.**, Yoon, Y. "The Effects of Water Chemistry on Removal of Bisphenol A and 17 β -Estradiol by Single-walled Carbon Nanotubes", 2010 Water Quality and Technology Conference, AWWA, Nov 14-18, Savannah, GA.

Aich, N., Afroz, ARM N., Khan, I. A., **Saleh, N. B.** "Deposition Behavior of Anisotropic Nanomaterials", ACS National Meeting, Aug 22-26, 2010, Boston, MA.

Khan, I. A., Ferguson, P. L., Sabo-Attwood, T., **Saleh, N. B.** "Systematic Change in Chirality Affects Aggregation Kinetics of Single-Walled Carbon Nanotubes", ACS National Meeting, Aug 22-26, 2010, Boston, MA.

Aich, N., **Saleh, N. B.** "Aggregation Kinetics of Fullerene-Single-walled Carbon Nanotube Hybrids", ACS National Meeting, Aug 22-26, 2010, Boston, MA.

Afroz, ARM N., Zaib, Q., Decho, A. W., **Saleh, N. B.** "Role of Nanoparticle Geometry on Nano-bio Interaction: A Quest to Separate Physics from Chemistry", ACS National Meeting, Aug 22-26, 2010, Boston, MA.

Sabo-Attwood, T., Bruschi-Richardson, L., Ariza, M. E., Khan, I. A., **Saleh, N. B.**, "Assessment of Immunomodulatory Potential of Engineered Nanoparticles" Environmental Effects of Nanoparticles and Nanomaterials, SETAC-Clemson University, Aug 22-26, 2010, Clemson, SC.

Brusch-Richardson, L., Ariza, M. E., **Saleh, N. B.**, Sabo-Attwood, T. "Development of a High Throughput Assay to Assess the Immunomodulatory Potential of Engineered Nanoparticles" Society of Toxicology 49th Annual Meeting, March 07-11, 2010, Salt lake City, UT.

Saleh, N. B. “Aggregation and Deposition Behavior of Carbon Nanotubes in Aquatic Environments” Clemson Carbon Conference, July 11-16, 2010, Clemson, SC.

Saleh, N. B., Pfefferle, L. D., Elimelech, M. “Aggregation and Deposition Behavior of Carbon Nanotubes” EPA Nano Grantees Workshop, November 9-10, 2009, Las Vegas, NV.

Saleh, N. B., Pfefferle, L. D., Elimelech, M. “Influence of Natural Organic Matter on Deposition Rate of Single-walled Carbon Nanotubes” American Chemical Society 237th National Meeting, March 22-26, 2009, Salt lake City, UT.

Saleh, N. B., Pfefferle, L. D., Elimelech, M. “Aggregation Kinetics of Carbon Nanotubes in the Presence of Biomacromolecules” American Chemical Society 237th National Meeting, March 22-26, Salt lake City, 2009, UT.

Saleh, N. B.; Pfefferle, L.; Elimelech, M. “Aggregation Kinetics of Carbon Nanotubes in the Presence of Biomacromolecules” AIChE Annual Meeting, Philadelphia, PA, November 16-21, 2008.

Saleh, N. B.; Pfefferle, L.; Elimelech, M. “Aggregation Kinetics of Multi-walled Carbon Nanotubes in Aquatic Systems” AIChE Annual Meeting, Philadelphia, PA, November 16-21, 2008.

Jaisi, P. D.; **Saleh, N. B.;** Blake, R. E.; Elimelech, M. “Filtration Mechanisms of Single-walled Carbon Nanotubes in Porous Media” AIChE Annual Meeting, Philadelphia, PA, November 16-21, 2008.

Saleh, N. B., Pfefferle, L. D., Elimelech, M. “Effect of Biomacromolecules on Aggregation Kinetics of Carbon Nanotubes” Presented for the Best Poster Award at the Gordon Research Conference, Environmental Sciences: Water, June 22-27, Holderness School, Holderness, NH.

Saleh, N. B.; Pfefferle, L.; Elimelech, M. “Aggregation Kinetics of Multi-walled Carbon Nanotubes in Aquatic Systems.” The 235th ACS National Meeting, New Orleans, LA, April 6-10, 2008.

Saleh, N. B., Phenrat, T., Tilton, R. D., Lowry, G. V. “Porewater velocity and collector grain size affects the mobility of surface-modified nanoiron in water-saturated porous media.” Division of Colloid and Surface Chemistry for the 233rd ACS National Meeting, Chicago, IL March 25-29, 2007.

Saleh, N. B., Sirk, K., Liu, Y., Phenrat, T., Dufour, B., Matyjaszewski, K., Tilton, R. D., Lowry, G. V., “Surface modifications enhance colloidal iron transport and deliver them to the NAPL/water interface”, 232nd ACS National Meeting, San Francisco, CA, September 10-14, 2006.

Saleh, N. B., Kim, H. J., Phenrat, T., Sirk, K., Dufour, B., Matyjaszewski, K., Tilton, R. D., Lowry, G. V. “Long-range transport of polymer-modified nanoiron in saturated porous sand and real aquifer media”, 80th ACS COLLOID AND SURFACE SCIENCE SYMPOSIUM, Boulder, CO. June 18-21, 2006.

Saleh, N. B., Sirk, K., Sarbu, T., Tilton, R.D., Matyjaszewski, K., Lowry, G. V., “Transport and DNAPL Targeting of Polyelectrolyte- and Surfactant-modified Nanoiron”, 230th ACS Meeting and Exposition. Washington, DC. August 28-September 1, 2005.

Saleh, N. B., Sirk, K., Sarbu, T., Lowry, G. V., Tilton, R.D., Matyjaszewski, K., Redden, G., “Targeted Delivery of Nanoiron to the NAPL-water Interface”, 79th ACS COLLOID AND SURFACE SCIENCE SYMPOSIUM, Potsdam, NY. July 12-15, 2005.

INVITED LECTURES

Saleh, N. B. “Nanomaterials for Environmental Remediation”, Masdar Institute of Technology, Masdar, UAE, December 12, 2011.

Saleh, N. B. “Carbonaceous Nanomaterials: Application for Environmental Remediation”, University of Arab Emirates University, Al-Ain, UAE, December 11, 2011.

Saleh, N. B. “Aggregation and Surface Interaction of Carbonaceous and Metallic Nanomaterials: Environmental and Biologically Relevant Conditions”, Wright Patterson Airforce Base, Dayton, OH, February 10, 2011.

Saleh, N. B. “Aggregation and Surface Interactions of Carbon Nanotubes in Aquatic Systems”, Virginia Tech, Mechanical Engineering, Blacksburg, VA, April 2010.

Saleh, N. B. “Fundamental Aggregation and Surface Interactions of Carbon Nanotubes in Aquatic Systems”, University of South Carolina, Mechanical Engineering, Columbia, SC, March 2010.

Saleh, N. B. “Fundamental Aggregation and Surface Interactions of Carbon Nanotubes in Aquatic Systems”, Institute of Environmental Toxicology, Clemson University, Columbia, SC, February, 2010.

Saleh, N. B. “Application and Implication of Nanomaterials”, Allen University, Columbia, SC, September, 2009.

Saleh, N. B. “Application and Implication of Nanomaterials”, University of South Carolina, Mechanical Engineering, Columbia, SC, April 2009.

Saleh, N. B., Lowry, G.V., “Developing Metallic Nanoparticles for In Situ Remediation of Subsurface DNAPL”, Chatham College, Pittsburgh, PA, October, 2004.

STUDENT SUPERVISION

CURRENT GRADUATE STUDENTS

Ifthekeer A. Khan (PhD candidate)

Research Area: Influence of chirality of single-walled carbon nanotubes on aggregation and deposition kinetics

A R M Nabiul Afroze (PhD candidate)

Research Area: Probing nano-geometry for nano-microbe interaction: A Quest to Separate Physics from Chemistry

Nirupam Aich (PhD candidate)

Research Area: Particle engineering for energy applications

CURRENT UNDERGRADUATE STUDENTS

Grace Beaty

Research Area: Composite nano-reinforced cementitious materials

Samuel A Rollings

Research Area: Carbon nanotubes enabled cartridges for emerging contaminant removal

PREVIOUS GRADUATE AND UNDERGRADUATE STUDENTS

Qammer Zaib (MS, Aug 2011)

Research Area: Carbon nanotube modified membranes for removal of endocrine disrupting compounds

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Current Position: PhD Candidate, Masdar Institute of Technology, Masdar, UAE

Tyler Clark (USC Undergraduate)
Research Area: Hybrid carbon nanomaterials

Atif A Choudhury (Vanderbilt University, Dept of Medicine, Health, and Society, Nashville, TN)
Research Area: Carbon nanotubes characterization for use in PVA barrier membranes

SERVICE AT USC

Undergraduate outreach committee, Spring 2009
Organizer of Civil and Environmental Engineering Seminar Series (ECIV 798), Fall 2009 & Spring and Fall 2010
Initiated Dick Pool and David Waugh Lecture Series at USC

PROFESSIONAL AFFILIATIONS

American Chemical Society (ACS)
The Association of Environmental Engineering and Science Professors (AEESP)
International Association of Colloids and Interface Scientists (IACIS)
American Water Resources Association (AWRA)
American Society of Civil Engineers (ASCE)
Environmental & Water Resources Institute of the ASCE
The Institution of Engineers, Bangladesh (IEB)

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