U.S. Department of Transportation
Federal Highway Administration

Hydrologic & Hydraulic News

July 2015
Vol. 3, Issue 1

New Multifunctional Flume System Installed at TFHRC J. Sterling Jones Hydraulics Laboratory

By Kornel Kerenyi

More than 30 years ago a 70-foot long and 6-foot wide tilting flume was installed in the Hydraulics Laboratory of the newly built Turner Building at the Turner Fairbank Highway Research Center (TFHRC) in McLean, VA. The main purpose of the flume was to study grate inlets and therefore the flume could be tilted and also rotated around the stream wise axis to simulate road side slopes. In the late 1980s the flume was modified to conduct sediment transport and bridge scour experiments. Many important and very valuable tests have been conducted in the flume by reputable researchers that have had a significant impact on current highway hydraulics design. J. Sterling Jones, who was the Laboratory Manager for more than 25 years, contributed with his experiments in the flume meaningfully to the bridge scour design and countermeasure guidelines in HEC-18 “Evaluating Scour at Bridges” and HEC-23 “Bridge Scour and Stream Instability Countermeasures Experience, Selection, and Design Guidance”.

Last Experiment in Old Flume

The tilting flume started aging after many years of conducting tests and could not fulfill new demands supporting the vision of the FHWA Hydraulics Research Program and, therefore, had to be replaced by a new Multifunctional Flume System.

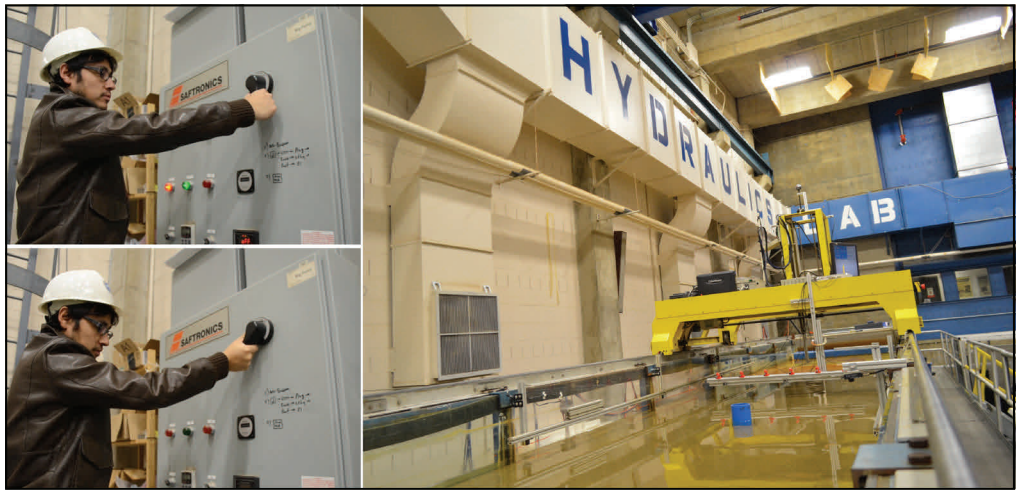
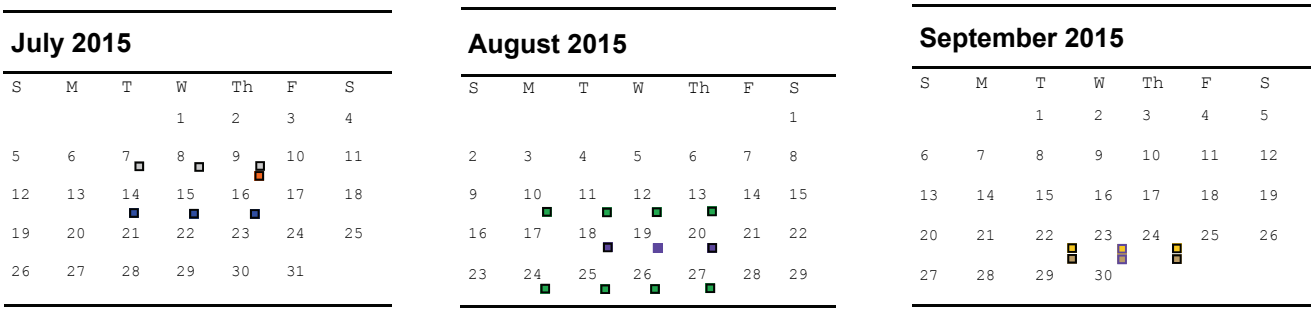


Photo 1—Final experiments in the old flume at the TFHRC J. Sterling Jones Hydraulics Laboratory.

(Continued on page 10)

Inside this issue:

Upcoming Hydraulic Events



JULY 2015:

- NHI Course 135095 —Baltimore, MD - July 7-9, 2015
- NHI Course 135047 —Trenton, NJ - July 9, 2015
- NHI Course 135048 —Trenton, NJ - July 14-16, 2015

AUGUST 2015:

- NHI Course 135041—San Antonio, TX - August 10-13, 2015
- NHI Course 135056—Columbus, OH - August 18-20, 2015
- NHI Course 135041—Columbia, SC - August 24-28, 2015

SEPTEMBER 2015:

- NHI Course 135065—Columbus, OH - September 22-24, 2015
- NHI Course 135090—Augusta, ME - September 22-24, 2015

For more information on NHI course, please visit: https://www.nhi.fhwa.dot.gov/

The FHWA Hydraulics Discipline:

Some Initial Background on Roles and Responsibilities

By Dan Ghere, Discipline Champion

The FHWA Hydraulics Discipline is currently comprised of 17 hydraulic engineers located in various offices within FHWA including the Washington D.C. Headquarters Office of Bridges and Structures (HIBS), Turner-Fairbank Highway Research Center (TFHRC), Resource Center (RC), and three Federal Lands Highway Divisions (FLHDs). Recognized collectively as the FHWA National Hydraulics Team (NHT), the key responsibilities and activities of the NHT include:

- **HIBS** provides policy, guidance and program direction in hydrologic and hydraulics (H&H) engineering.
- **TFHRC** oversees research activities to advance H&H engineering.
- **RC** advances, deploys, and assists H&H engineering to our field offices and customers such as State Departments of Transportation, Federal and local agencies, consultants, and others.
- **FLHD** provides hydraulic design support for bridges and roadway drainage systems (including culverts, storm drains, and ditches) for its customers from Federal agencies (Park Service, Forest Service and others).

What is the Hydraulics Discipline:

Since at least 1945, there has been some form of the NHT within the FHWA (or our predecessor, the Bureau of Public Roads). Several years ago, when the FHWA began to develop the discipline concept for categorizing various staff activities, the NHT approach both served as a model and became a natural member of the collective disciplines. All of the different disciplines are members of a Discipline Council. Additionally, each discipline has a sponsor within senior FHWA leadership (in our case, Associate Administrator for Infrastructure Walter “Butch” Waidelich). The NHT constitutes the smallest (but, in my opinion, obviously the most important) discipline within FHWA.

So, what are some of the specific roles and responsibilities within the discipline?

Joe Krolak (Leader of HIBS’s Hydraulics and Geotechnical Engineering Team and a HIBS Principal Bridge Engineer) serves as the Discipline Council Representative. As the Discipline Representative, he regularly meets with the FHWA Discipline Council and Management on administrative updates, programmatic and funding directives and opportunities, updates and guidance on discipline performance in accordance with FHWAs Strategic Implementation Plan, and discipline assessment and competency necessities.

(Continued on page 4)

The FHWA Hydraulics Discipline, cont.

Dan Ghere (Manager of the RC Hydraulics Technical Service Team) serves as Discipline Champion. A primary function of the discipline champion is to serve as the contact person on technical hydraulic issues of other disciplines, FHWA division offices, state DOTs, and other customers of FHWA. This contact involves either providing the necessary response or guiding the person to the correct NHT member who serves as the subject matter expert for the subject at hand. Another responsibility includes ensuring communication with our discipline sponsor, including raising and discussing discipline related issues (or serving as a conduit to relay any sponsor questions to the remainder of the discipline).

How do the other members of the NHT fit into this discipline model?

In the following issues of the Hydrologic and Hydraulic News I will introduce you to the hydraulic staff in each of the FHWA NHT offices with acknowledgement of the activities with which they are each engaged.

A Final Message:

Activities within the hydraulic discipline have been very productive this past year with numerous projects involving technological upgrades to NHI courses, hydraulic software, research on scour and countermeasure design, deployment of developed technologies, and providing technical assistance. Discussions of these active projects are presented to you through various articles in the FHWA Hydrologic and Hydraulic News and I encourage you to continue reading to hear more about our newest updates and activity progress. Our intent was to bring this Newsletter to you on a quarterly basis but schedules and project assignments often slow our release down to a semiannual publication. This semiannual release has proven beneficial and provides us with an ability to complete a more timely report on new and completed activities and will become our target frequency of release for future publications.

Welcome Carolyn Sourek to the NHT!

In May 2015, Western Federal Lands Hydraulic Section welcomed Carolyn Sourek to its team. Ms. Sourek earned a B.S. in Civil Engineering, 2007, from Santa Clara University. She has worked for consulting firms performing a variety of hydraulic functions: stormwater management, erosion control, hydrologic and hydraulic modeling, and fish passage. Her experience also includes designing water quality improvement structures/systems, stormwater sewer lines, and pumping systems. Her experience and reputation for excellence, tenacity, team work, communication, and working towards a solution benefit the WFL Hydraulics Section and its mission.

National Hydraulic Engineering Conference:

Oregon DOT Selected to Host the 2016 NHEC!

The 2016 National Hydraulic Engineering Conference (NHEC) Steering Committee is pleased to announce that it will partner with the Oregon Department of Transportation (ODOT) to host the 2016 conference. The Committee is excited about all that ODOT will bring to the conference: experienced staff, a beautiful location, interesting opportunities for site visits, etc. Conference planning will begin in July 2015. One of the initial steps will be to select a conference hotel and date (most likely August or September 2016). The Committee will send out a "Save-the-Date" notice as soon as possible for your planning purposes. For more information about this or previous conferences, please contact Cynthia Nurmi at cynthia.nurmi@dot.gov.

TRB-FTA-FHWA Joint Conference

Interested in Learning More About Resilience to Climate Change and Extreme Weather Events?

The Transportation Research Board, Federal Transit Administration, and FHWA would like to invite you to the First International Conference on Surface Transportation System Resilience to Climate Change and Extreme Weather Events to be held on September 16-18, 2015, at the National Academy of Sciences Building in Washington, DC. The conference will examine efforts to mainstream consideration of climate change and extreme weather resilience in all aspects of the transportation sector. The conference will focus on the consumers of climate information rather than the producers. Plenary panels will explore the needs of transportation agencies for actionable climate information and how to adapt transportation systems based on best available science, consistent with sound, risk-based, asset management principles. Conference tracks include Climate Science and Data, Planning for Resilience, Project Level Adaptation, Resilience in Operations and Maintenance Activities, International and Cross-cutting Initiatives, and Resilience and Tools.

Registration is now open for the conference. Please use this link to register:

http://www.cvent.com/events/first-international-conference-on-surface-transportation-system-resilience-to-climate-change-and-ext/event-summary-cba1008fb1724a6eb2edd2898f16fc91.aspx

For more information, please contact Brian Beucler at brian.beucler@dot.gov.

In the Lab with Kornel

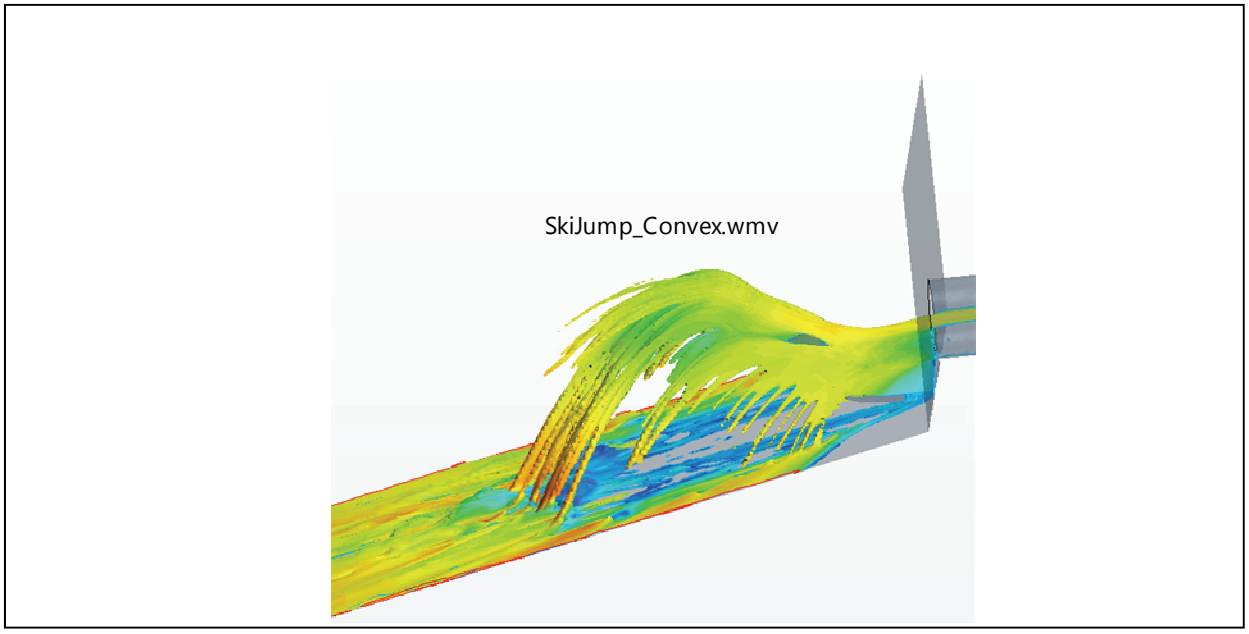
New Energy Dissipators for Small Culverts Outletting on Slopes

The Need:

Geometric constraints occasionally require DOTs to outlet small diameter culverts onto vegetated slopes. To minimize the erosion at the outlet, DOTs often place protection such as riprap or a concrete pad at the outlet. Sometimes this protection is insufficient to withstand the erosive velocities of the culvert outflows, especially when the culvert or slope is steep. Reduction of the erosive velocities by energy dissipation and flow dispersion over a large area would be desirable. To meet these desired objectives, the TFHRC Hydraulics Lab is analyzing and modifying two new energy dissipators.

The Bear Claw:

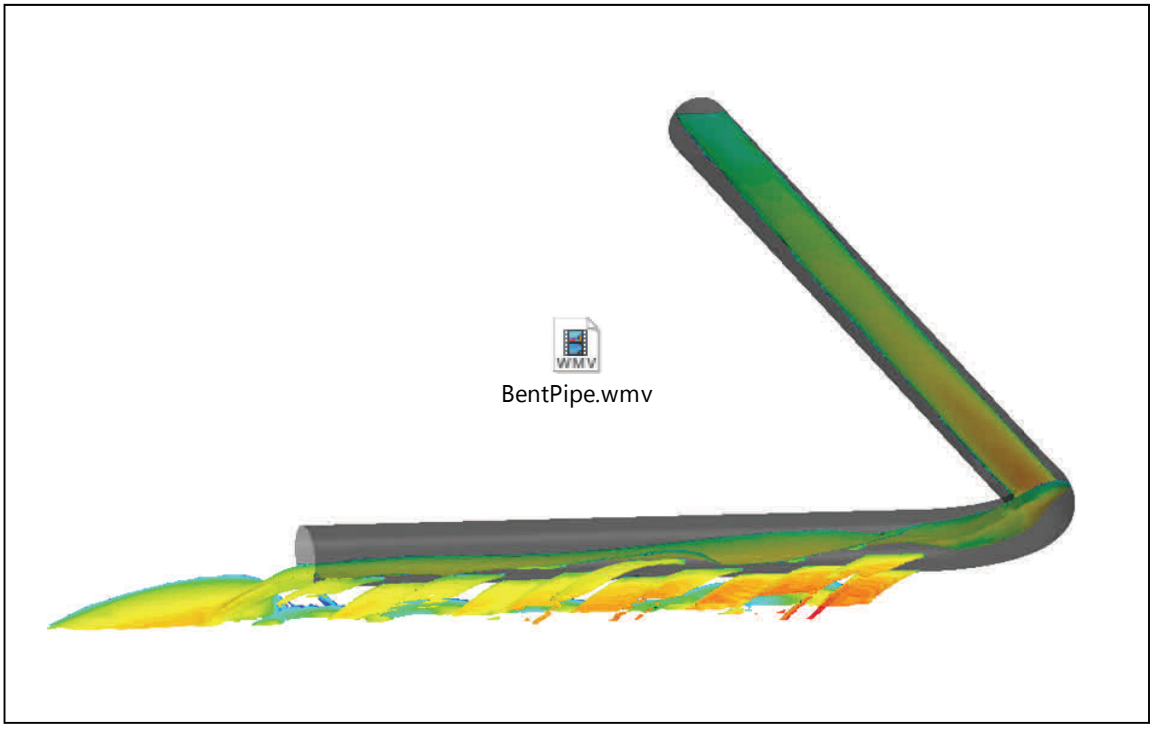
The Bear Claw or Ski Jump dissipator launches high velocity flows into the air and also separates the flow leaving the dissipator. The flow from the dissipator resembles spray from a shower head pointed upwards. The flow falling from the dissipator might also be designed to "rain" onto strategically placed leafy bushes to further disperse flow and absorb energy.



Video of Bear Claw Dissipator

The Bent Slotted Pipe:

The Bent Slotted Pipe turns the flow leaving the culvert parallel to the fill slope contours and then gradually releases the flow through slots cut into the parallel pipe. The end of the slotted parallel pipe remains open to reduce potential clogging. Variations on the length of pipe and slot configurations were examined. Thrust blocks or supports may be added to resist momentum forces of the flow as the pipe bends to become parallel to the fill slope contours.



Video of Bent Pipe Dissipator

Your Help Needed:

TFHRC Hydraulics Lab, through its partners at the Argonne National Laboratory, has completed conceptual computational fluid dynamics (CFD) simulations on the two dissipators. The next step is to simulate the dissipators in real world scenarios using CFD and physical modeling. Please consider sharing information on one of your State DOT sites with TFHRC Hydraulics Lab to test the two dissipators. If interested, please contact Kornel Kerenyi at kornel.kerenyi@dot.gov and Brian Beucler at brian.beucler@dot.gov. For more information about the CFD simulations, please contact Steven Lottes at steven.lottes@anl.gov.

Computing with Scott

Software and Training Updates

NHI Course 135095 Now Available!

The NHI Course 135095 Two-Dimensional Modelling of Rivers at Highway Encroachments is now available for hosting by state DOTs or others. The course provides a well-balanced mix of lessons, demonstrations, and exercises for a comprehensive introduction to two-dimensional modeling concepts, including; background data necessary to support a model, hydraulic modeling parameters, mesh development, model simulation parameters, model calibration, hydraulic structures, and reviewing two-dimensional model results. Extracting hydraulic parameters for use in bridge scour evaluation is also discussed. Each concept is demonstrated and participants are given hands-on exercises to apply what they have learned. Once all modeling concepts are covered a comprehensive exercise is provided for participants to apply their skills on a project from start to finish. To sign up for sessions currently scheduled or to host the course, please go to the NHI course site:

http://www.nhi.fhwa.dot.gov/training/course_search.aspx?tab=0&key=hydraulics&sf=0&course_no=135095

New Additions and Improvements to SRH-2D and SMS

FHWA continues to work to improve the SRH-2D modelling software and the SMS interface. The following are what we are working on now:

- **Improved bridge pressure flow capabilities** - deck overtopping will be added along with piers and obstructions within the 2D pressure flow zone.
- **Hydraulic results summary table** – this feature will allow a user to import a HEC-RAS cross section schematic or identify specific cross section locations and summarize key hydraulic parameters at these locations, including min., max., and average water surface elevation, velocity, depth, etc.
- **Enhanced plotting tools** - to better show cross sections and channel profiles.
- **Addition of the hydraulic toolbox in SMS—**to compute normal depth and critical depth rating curves for boundary conditions.
- **Quick reference guide** in SMS for guidance in preparing a SRH-2D model.
- **Data set comparison tool** to compare data sets from an existing conditions and a proposed conditions run or other data sets.
- **Tutorials**—for modeling hydraulic structures in SRH-2D.

Two-Dimensional Modelling User's Group Underway

The Two-Dimensional Modelling User's Group met in March, April, and May, with many state DOTs and their consultants in attendance. The focus of the forum is primarily to discuss recent modeling technology developments, provide training and technical support opportunities, and share 2D modeling techniques. The next meeting will be July 15th. If you would like more information about participating in the user's group, please contact Scott Hogan at scott.hogan@dot.gov.

Additional FHWA Software and Training Updates!

In addition to updates to SMS and SRH-2D, FHWA is also improving its additional software:

- HY8 Culvert Analysis Program—Adding Low flow Analysis.
- Hydraulic Toolbox—Adding Scour Plot and Summary Table.
- HY12—Stormdrain Analysis Program—Adding Pump Station and a Freeware WMS Version.

In the Lab with Kornel

Research Update: Scour in Cohesive Soils

Scour in cohesive soils has been a challenge for engineers and designers. Unlike noncohesive soils, practical measurement techniques and well accepted guidance on the scourability of cohesive soils has been severely lacking. The TFHRC Hydraulics Laboratory has developed and tested an erosion testing device that simulates open channel flow on a small scale. A research report documenting the Lab's findings is now available at

http://www.fhwa.dot.gov/publications/research/infrastructure/structures/bridge/15033/index.cfm.

For more information about this research, please contact Kornel Kerenyi at kornel.kerenyi@dot.gov.

Multifunctional Flume System, cont.

The last experiments in the old flume were completed in December 2014 giving the hydraulics lab team the opportunity to respectfully farewell the old flume (Photo 1 and Photo 2).

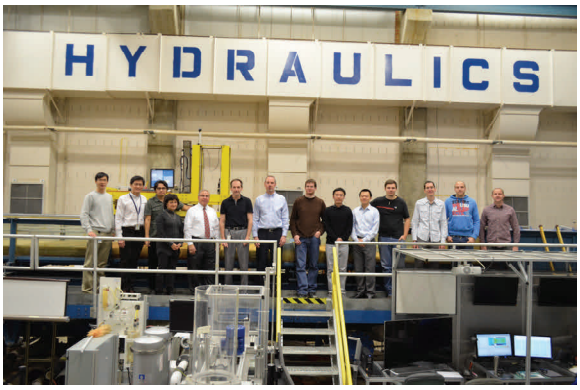


Photo 2— The hydraulics laboratories research team respectfully says "good bye old flume".

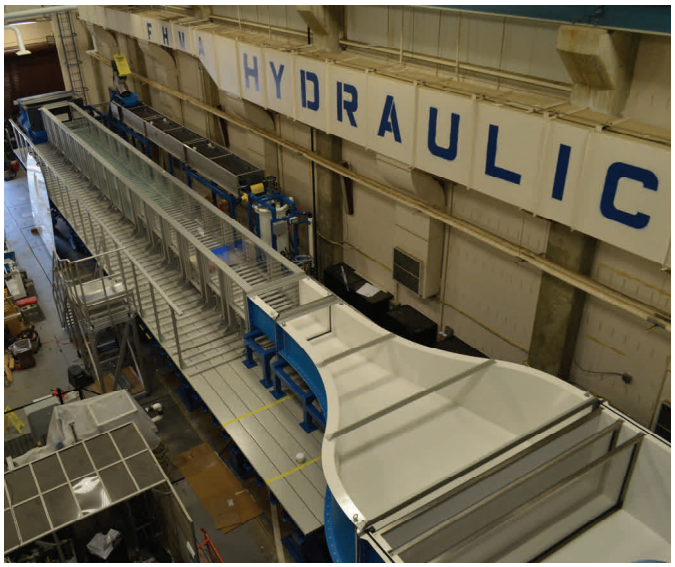
Vision for Future Experimentation and Research:

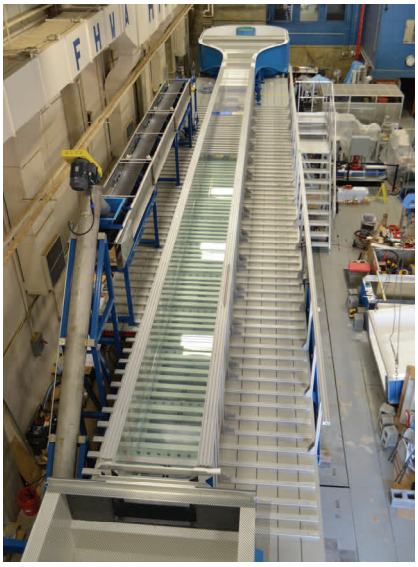
The new Multifunctional Flume System in the THFRC J. Sterling Jones Hydraulics Laboratory will be used to conduct highway hydraulic research of national importance including the functional areas of national hydraulics program and support the hydraulics research program's strategic vision. The vision of the program is to reduce experimental work and to conduct a significant part of the research using Computational Fluid Dynamics modeling. Future experimental work will require a large degree of flexibility setting up and dismantling experiments, as well as highly detailed and automated flow and sediment transport measurements to calibrate computational fluid dynamic models.

The New Multifunctional Flume System:

The Multifunctional Flume System features a 90-foot long and 13-foot wide tiltable working deck for setting up experiments (Photos 3a and 3b). Three-foot wide or alternatively six-foot wide flume channel sections can be mounted on the working deck. Both channel section alternatives include a 27-foot long sediment recess test section. If needed other hydraulic structures like culverts, pipes and drainage systems can be also installed and tested. The flume system also includes a 27-foot long flow inlet headworks (Photo 4) and a carefully designed outlet section including a sediment trap. A nationally unique feature of the new flume system is the design of the sediment recirculating system containing an inclined auger, conveyor belt and sediment infeed hopper (Photo 5). Diaphragm pumps push sediment from the infeed hopper into the flume. Particularly, sediment is injected into the channel from the bottom using computationally optimized and 3D printed infeed nozzles (Photo 6). The recirculating capability allows for a much more realistic river flow modeling.

The pump discharge capacity of the new flume is 45 cubic feet per second allowing flow velocities up to 5 feet per second. Two automated instrumentation carriages will hold sensors needed to measure flow and sediment transport/scour data. If needed the new flume can be also be modified to a wave tank for researching coastal hydraulics.





Photos 3a and 3b—Overhead View of New Multifunctional Flume System.

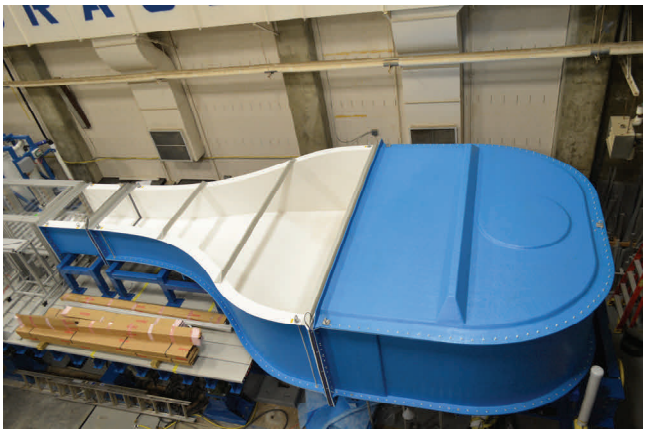


Photo 4—Overhead View of Inlet Headworks.

Photo 5— View of Conveyor Belt for Sediment Recirculation.

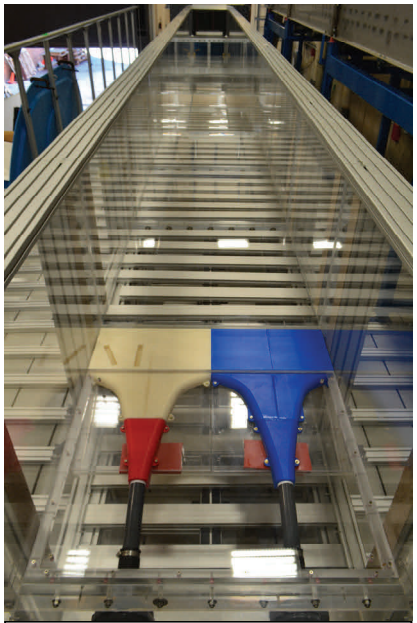


Photo 6—Infeed Nozzles for Recirculation Sediment.

For more information about the new flume system, contact Kornel Kerenyi at kornel.kerenyi@dot.gov.

Acknowledgements

We would like to thank the following for their contributions to the articles in the newsletter:

FHWA Headquarters Office:
Brian Beucler

FHWA Resource Center:
Dan Ghere
Scott Hogan
Cynthia Nurmi

Turner Fairbank Hydraulics Lab:
Kornel Kerenyi

Argonne National Lab:
Steven Lottes

FHWA Hydraulic Contacts

The FHWA Hydraulic Staff are available to assist you with FHWA Hydraulic related issues. A list of Hydraulic Staff may be found at:
http://www.fhwa.dot.gov/engineering/hydraulics/staff.cfm

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