TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): __FHWA____

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project #	**Transportation Pooled Fund Program - Report Period:**
TPF-5(164)	☐Quarter 1 (January 1 – March 31) 2013 √Quarter 2 (April 1 – June 30) 2013 ☐Quarter 3 (July 1 – September 30) 2013 ☐Quarter 4 (October 1 – December 31) 2013

Project Title:		
Fish Passage in Large Culverts with Low Flows		
Name of Project Manager(s): *Kornel Kerenyi*	**Phone Number:** *(202) 493-3142*	**E-Mail** *kornel.kerenyi@fhwa.dot.gov*
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**

Project schedule status:

√ On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	**Total Cost to Date for Project**	**Percentage of Work Completed to Date**

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	**Total Amount of Funds Expended This Quarter**	**Total Percentage of Time Used to Date**

Project Description:

A primary objective of this aspect of the fish passage study is to determine the local velocities and flow distributions in corrugated metal pipes and pipe arches. This information is proposed for use to supplement the guidance in the publication FHWA- NHI 01-020 Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5. Conventional open-channel culvert hydraulics provides the tools and software needed to compute the average velocity of flow at any culvert cross-section for higher flows, given the culvert shape, roughness, slope and boundary conditions. In order to more accurately evaluate the ability of fish to traverse corrugated metal culverts, it is desirable to look at the changes in the local average velocity of the flow adjacent to the culvert wall under low flow conditions. Other studies have documented the tendency of fish to seek out a swimming location with the lowest velocity of flow. The location of lowest velocity can generally be found immediately adjacent to the culvert wall.
The specific objectives of this task order are to develop local average velocity design charts for various hydraulic conditions in support of the "Fish Passage in large Culverts for low Flows" study, which will be incorporated into the FHWA publication HEC-26 "Culvert Design for Aquatic Organism Passage".

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

- One of the recommendation received from the participating state during the last quarter was that a composite Manning's n value that can be used for specified flow depth, pipe embedment, corrugation size, and D_{50} would be a great tool for designers to make informed choice and design in pipe and embedment for fish passage.
- After thorough discussion, a CFD testing scheme was determined. A matrix of various flow and embedment conditions was produced. CFD simulations were then carries out accordingly.
- Data analysis and numerical regression were carried out to identify and calibrate potential simplified equations convenient to engineering design.

Table 1 Test matrix

Type	Run ID	A (m^2)	D_{50}	L(m)	V (m/s)	A_b(m^2)	A_w(m^2)
No Embedment	C8F00V1D1	0.213	0.000	0.305	0.305	0.000	0.427
	C8F00V1D2	0.536	0.000	0.305	0.305	0.000	0.613
	C8F00V1D3	0.979	0.000	0.305	0.305	0.000	0.778
	C8F00V2D1	0.213	0.000	0.305	0.914	0.000	0.427
	C8F00V2D2	0.536	0.000	0.305	0.914	0.000	0.613
	C8F00V2D3	0.979	0.000	0.305	0.914	0.000	0.778
	C8F00V3D1	0.213	0.000	0.305	0.457	0.000	0.427
	C8F00V3D2	0.536	0.000	0.305	0.457	0.000	0.613
	C8F00V3D3	0.979	0.000	0.305	0.457	0.000	0.778
	C8F00V4D1	0.213	0.000	0.305	0.610	0.000	0.427
	C8F00V4D2	0.536	0.000	0.305	0.610	0.000	0.613
	C8F00V4D3	0.979	0.000	0.305	0.610	0.000	0.778
15% Pipe Diameter Embedment	C8F15V1D1P1	0.386	0.024	0.305	0.305	0.531	0.153
	C8F15V1D1P2	0.386	0.012	0.305	0.305	0.531	0.153
	C8F15V1D1P3	0.386	0.036	0.305	0.305	0.531	0.153
	C8F15V1D2P1	0.820	0.024	0.305	0.305	0.531	0.287
	C8F15V1D2P2	0.820	0.012	0.305	0.305	0.531	0.287
	C8F15V1D2P3	0.820	0.036	0.305	0.305	0.531	0.287
	C8F15V1D3P1	1.340	0.024	0.305	0.305	0.531	0.427
	C8F15V1D3P2	1.340	0.012	0.305	0.305	0.531	0.427
	C8F15V1D3P3	1.340	0.036	0.305	0.305	0.531	0.427
	C8F15V2D1P1	0.386	0.024	0.305	0.914	0.531	0.153
	C8F15V2D1P2	0.386	0.012	0.305	0.914	0.531	0.153
	C8F15V2D1P3	0.386	0.036	0.305	0.914	0.531	0.153
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	C8F15V2D3P3	1.340	0.036	0.305	0.914	0.531	0.427
	C8F15V3D1P1	0.386	0.024	0.305	0.457	0.531	0.153
	C8F15V3D1P2	0.386	0.012	0.305	0.457	0.531	0.153
	C8F15V3D1P3	0.386	0.036	0.305	0.457	0.531	0.153
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	C8F15V3D3P3	1.340	0.036	0.305	0.457	0.531	0.427
	C8F15V4D1P1	0.386	0.024	0.305	0.610	0.531	0.153
	C8F15V4D1P2	0.386	0.012	0.305	0.610	0.531	0.153
	C8F15V4D1P3	0.386	0.036	0.305	0.610	0.531	0.153
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	C8F15V4D2P3	0.820	0.036	0.305	0.610	0.531	0.287
	C8F15V4D3P1	1.340	0.024	0.305	0.610	0.531	0.427
	C8F15V4D3P2	1.340	0.012	0.305	0.610	0.531	0.427
	C8F15V4D3P3	1.340	0.036	0.305	0.610	0.531	0.427
30% Diameter Embedment	C8F30V1D1P1	0.462	0.024	0.305	0.305	0.681	0.126
	C8F30V1D1P2	0.462	0.012	0.305	0.305	0.681	0.126
	C8F30V1D1P3	0.462	0.036	0.305	0.305	0.681	0.126
	C8F30V1D2P1	0.942	0.024	0.305	0.305	0.681	0.247
	C8F30V1D2P2	0.942	0.012	0.305	0.305	0.681	0.247
	C8F30V1D2P3	0.942	0.036	0.305	0.305	0.681	0.247
	C8F30V1D3P1	1.485	0.024	0.305	0.305	0.681	0.380
	C8F30V1D3P2	1.485	0.012	0.305	0.305	0.681	0.380
	C8F30V1D3P3	1.485	0.036	0.305	0.305	0.681	0.380
	C8F30V2D1P1	0.462	0.024	0.305	0.914	0.681	0.126
	C8F30V2D1P2	0.462	0.012	0.305	0.914	0.681	0.126
	C8F30V2D1P3	0.462	0.036	0.305	0.914	0.681	0.126
	C8F30V2D2P1	0.942	0.024	0.305	0.914	0.681	0.247
	C8F30V2D2P2	0.942	0.012	0.305	0.914	0.681	0.247
	C8F30V2D2P3	0.942	0.036	0.305	0.914	0.681	0.247
	C8F30V2D3P1	1.485	0.024	0.305	0.914	0.681	0.380
	C8F30V2D3P2	1.485	0.012	0.305	0.914	0.681	0.380
	C8F30V2D3P3	1.485	0.036	0.305	0.914	0.681	0.380
	C8F30V3D1P1	0.462	0.024	0.305	0.457	0.681	0.126
	C8F30V3D1P2	0.462	0.012	0.305	0.457	0.681	0.126
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	C8F30V3D3P2	1.485	0.012	0.305	0.457	0.681	0.380
	C8F30V3D3P3	1.485	0.036	0.305	0.457	0.681	0.380
	C8F30V4D1P1	0.462	0.024	0.305	0.610	0.681	0.126
	C8F30V4D1P2	0.462	0.012	0.305	0.610	0.681	0.126
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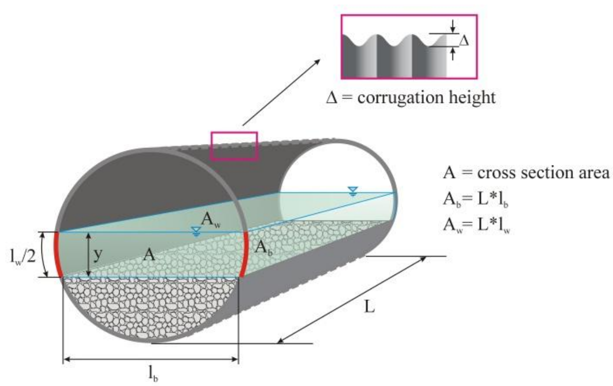

Figure 1 Flow and embedment conditions defined by geometric parameters

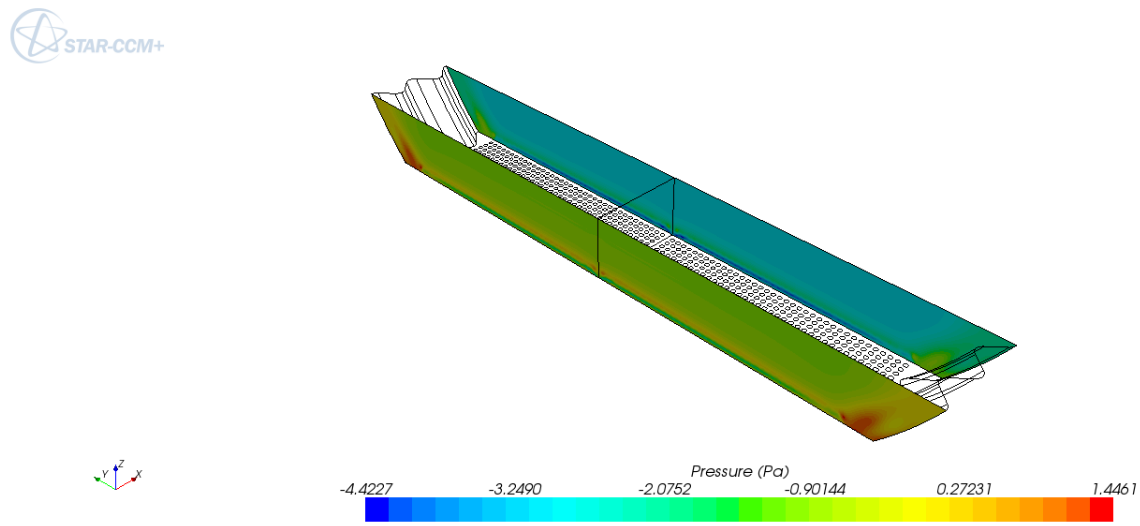

Figure 2 Pressure drop among cross-sections of the pipe model that can be used to find Manning's n

Anticipated work next quarter:

- Finalize the CFD simulation and data analysis to be added to the report.
- Conduct simulations on pipes with ledges for hydraulic performance and fish passage assessment.
- Amend report accordingly
- Circulate the report again for potential further comments.

Significant Results:

Necessary data for formulating Manning's roughness coefficient.

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

Potential Implementation:

Additional design aids that may be incorporated into FHWA HEC-26 "Culvert Design for Aquatic Organism Passage".