

# E&M Engineers and Surveyors, PC

Spring 2007

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## How to Replace a Bridge in 12 Hours

By: Chris Ernst, P.E.

The Chapman Brook (T-432) Bridge located in Ceres Township, McKean County, PA was replaced by a precast box culvert on October 25, 2006. The existing 10-ft. span steel stringer structure was in very poor condition (see photo) and the Township hired E&M to design a replacement structure. We submitted a General Permit Registration Package (GP-11) to the Pennsylvania Department of Environmental Protection for the replacement and we were successful in getting the bridge approved for replacement.



**Before**

The structure that we proposed to use for the replacement was a 20-ft. long precast box culvert with a 12-ft. span and a 4.5-ft. rise. The bottom of the box was to be filled in with 6 in. of gravel to create a natural stream bottom to satisfy the requirements of the GP-11. The final underclearance would therefore be 4-ft, which would match the underclearance of the existing bridge. 5-ft. long precast wingwalls were designed for all four corners of the box culvert. We designed the box culvert with 2-ft. deep precast

concrete cut-off walls on both the upstream and downstream ends of the box to prevent undermining of the structure. 1-ft high precast headwalls were designed for the top of the box to hold back the roadway pavement and to serve as connection points for the bridge railings. The clear width between the bridge railings was set at approximately 18 ft. which was an improvement from the existing bridge width of 15.5-ft. Riprap was installed on both ends of the box culvert and along the Chapman Brook streambank for approximately 100-ft. upstream of the box to prevent erosion of the streambank and scour at the structure.

Chapman Brook is a dead-end road that is used to access residences and a dairy farm, therefore the crossing could not be out of commission for very long. The options that we had were to construct a temporary roadway adjacent to the bridge replacement project or to replace the structure and provide access in a short period of time. The biggest problems with the temporary roadway option were the increase in earth disturbance (and possibly wetlands) and the additional expense in installing and removing the temporary roadway. The Township opted for the second alternative, which was to require the contractor to remove the existing bridge and install the precast box culvert and backfill enough to allow traffic to cross within one construction day.

The successful low bid contractor was A.L. Blades and Sons, Inc. of Hornell, NY for a price of \$98,400. The supplier of the precast concrete box culvert components was Kistner Concrete Products, Inc. of Lockport, NY. A.L. Blades successfully completed the demolition of the existing bridge, the installation of the precast box culvert and the backfilling of the structure within an approximate 12-hour time period on October 25, 2006. The installation of the riprap, bridge railing and pavement and the necessary



**After**

landscaping work was completed within 10 calendar days with no additional disturbance in access to the residences or the dairy farm.

### **Definitions**

By: Allan R. Vanderpoel, P.E.

Engineers take for granted that everyone knows the language of engineering. But often, engineers use terms that are Greek to all but a select few. Even the title “Civil Engineer” has some confusion as to its origin. So, following are some terms that may help in your next conversation with a civil engineer.

Civil Engineer: A broad field of engineering dealing with the planning, construction and maintenance of infrastructure. Civil Engineering is the oldest of all engineering fields. In fact, engineering was once divided into only two fields - military and civil. Civil engineering was defined to distinguish it from military engineering and serves civilization.

Professional Engineer: An individual licensed and registered under the laws of the state to engage in the practice of engineering. A Professional Engineer must have a college degree in Engineering, pass the Engineer-in-Training exam, have four years of experience, and pass the Professional Engineers exam.

Professional Land Surveyor: An individual licensed and registered under the laws of the state to engage in the practice of land surveying. A Professional Land Surveyor must have a combination of experience from a college degree and work, and must pass the Professional Land Surveyors exam.

### Bridges:

**Safe Load Capacity**: This is the load rating value that is based on the stress level deemed acceptable to

safely carry a type and tonnage of vehicle. This is often referred to as the inventory limit.

**Operating Limit**: The load rating value that is the upper limit of the acceptable bridge stress level.

**Live Load Bridge Deflection**: The amount of sag that a bridge will experience when a live load (typically a moving vehicle) crosses it. There are limits to the amount of deflection allowed in new bridges.

**Live Load**: Loads that cross a bridge. This is typically a vehicle, but it can also be pedestrians, or bicycles.

**Dead Load**: The weight of the bridge itself.

### Streams and Rivers:

**Watercourse**: A channel or conveyance of surface water having defined bed and banks, whether natural or artificial with perennial or intermittent flow. A roadside ditch can be a watercourse. (Pennsylvania definition)

**Floodplain**: The lands adjoining a river or stream that may be expected to be inundated by flood waters in a 100-year frequency flood. Construction in the floodplain can be permitted if certain requirements are met.

**Floodway**: The channel of the watercourse and portions of the adjoining floodplains which carry the flow of the 100-year frequency flood. If the floodway is not mapped by FEMA, the floodway extends perpendicular to the stream to 50 feet from the top of the stream bank. Construction in the floodway is generally prohibited.

### Water and Sewer Line Construction:

**Select Backfill**: A specified type of material (most often gravel) that is used to backfill a trench. This is done when the material excavated out of the trench is not good material, or if better backfill is needed under a roadway.

Bedding: The material placed immediately under the pipe to be installed. The bedding is typically a fine gravel that protects the pipe from rock and settlement, by giving it a bed to lay on.

Grade: The slope of the pipe. For sewer lines, there are minimum grades specified to insure gravity flow, and maximum recommended grades to prevent pipe and flow separation.

### **Green Areas, Wetlands & Wastewater Coexist**

By: Jeffrey C. Bahret, P.E.

Any type of development today, be it residential subdivision or commercial/ industrial plaza, requires the site planning engineer to derive more resourceful ways of satisfying the requirements of a multitude of involved agencies.

The developer's goal is nearly always the same, that being to maximize the land area which is revenue generating within his finite parcel. Although the subjects of green areas, wetlands and wastewater are recognized as very important necessary components of any project, they have the effect of being diametrically opposed to the developer's primary goal.

Although the site planning engineer can do little to reduce the size of any one particular classification; he can, through careful development, reduce the total combined area required by creating multiple purpose zones. Let's say a developer wants to create a residential subdivision of a 50-acre parcel.

The following conditions exist:

The municipal local zoning ordinance for residential subdivisions requires a minimum of 20 percent of the total parcel area be segregated out as common green area.

The site was surveyed and a five (5) acre area was found to have hydric soil types along with vegetation, which identifies it as a freshwater wetland.

The development is in an area where no public sanitary sewer facilities are available; and, therefore, on-site treatment and disposal of all wastewater must be provided.

The NYSDEC will require an advanced "tertiary" level of treatment before discharge to the on site intermittent tributary stream.

Taking these conditions at face value, the loss in development area is 10 acres for the green area, 5 acres for the potential freshwater wetlands and a minimum of 2 acres for the tertiary sand filters needed for final wastewater polishing.

Here's the alternative; combine all three types of non-capital return parcels to fit within the largest entity, that being the 10 acre green area. The combined multiple purpose zone method is dependent on creating a new manmade wetland. The new manmade wetland (5 acre minimum) would be constructed within the designated common green area and would allow for standard residential lot development within the originally identified potential wetland area.

Studies have shown that wetlands have an affinity for certain pollutants in wastewater. The bacteria and plants in wetlands are generally starving for phosphorus and nitrogen which the wastewater provides. The raw sanitary wastewater would require primary treatment and some aeration before discharge to the wetlands. The water coming out of the wetlands will be very clean, exceeding the level of advanced tertiary treatment required by the environmental regulatory agency. A controlled manmade wetland is a very dependable natural system that costs very little compared to advanced water treatment. In this example, we were able to regain 14 percent of the total development area for capital revenue benefit.

### **CIVIL ENGINEERING / LAND SURVEYING SCHOLARSHIP**

E&M Engineers and Surveyors, PC is please to announce the first annual scholarship award of \$1,000.00. The purpose of this scholarship is to encourage high school seniors from Allegany, Cattaraugus, Chautauqua, Erie and Wyoming Counties to pursue a career in the fields of Civil Engineering or Land Surveying.

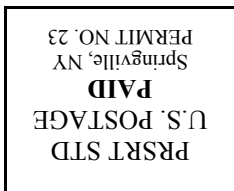
Another \$1,000.00 scholarship is available for seniors in McKean, Warren, Potter, Elk and Cameron Counties, PA

To be eligible for consideration, the following criteria will be used to select a high school senior:

- Student must intend to enroll in a matriculated program in the fields of Civil Engineering or Land Surveying; however, other engineering degrees will also be considered.
- Student must provide a letter of recommendation from a high school teacher or principal.
- Student must submit a 200 word (minimum) essay stating why you think Civil Engineering or Land Surveying are important professions.

Scholarship disbursement will be as follows: \$500.00 will be awarded to applicant by September, 2007 and the remaining \$500.00 will be awarded upon submission of first semester grade report.

All applications will be kept confidential and must be received at E&M Engineers and Surveyors office no later than June 8, 2007. Call Tina Haggerty at (716) 592-2851 or Michele Myers at (814) 362-5546 to request an application form or go to our website at [www.emengineers.com](http://www.emengineers.com).



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