PURDUE UNIVERSITY

CAPSTONE EXPERIENCE 2011

Lake Cypress Drainage Solution

Agricultural & Biological ENGINEERING

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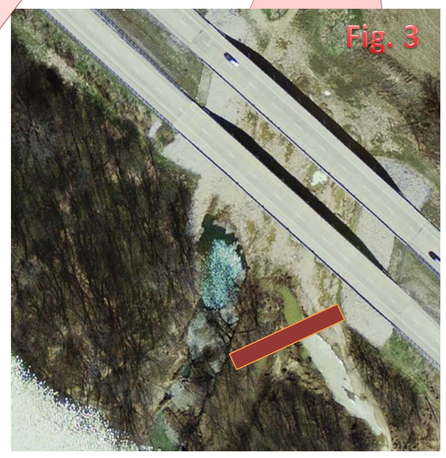
Problem Statement:

Cypress Lake is a former “borrow pit” located at the junction of I-65 and State Road 11 in southern Indiana near Seymour. Drainage was originally provided by two low water crossings. After a culvert was installed to facilitate site access, farm fields to the south of the lake began to flood more frequently. A good solution to this problem will increase the ability of the lake to drain through its main outlet, reduce alternate channel formation, decrease channel bank erosion, and honor the Indiana Department of Natural Resources’ commitment to habitat preservation.

Problem 1:
The culvert was only sized to pass 20% of our calculated flow. This backup caused problems such as scouring, road sink, and infrastructure degradation.

Problem 2:
The lack of bank cover acted in combination with the poor hydraulics of the culvert to cause heavy erosion on the banks of the outlet. Several trees have been undercut by this erosion, and are at risk of falling into the stream and causing blockage to the replacement structure.



Problem 3:
Near the main inlet (flowing under I-65), water was backing up and forming undesirable channels. As can be seen from picture three, a permanent wet area has formed as a result of this channeling and other erosion can be seen at the ground level.

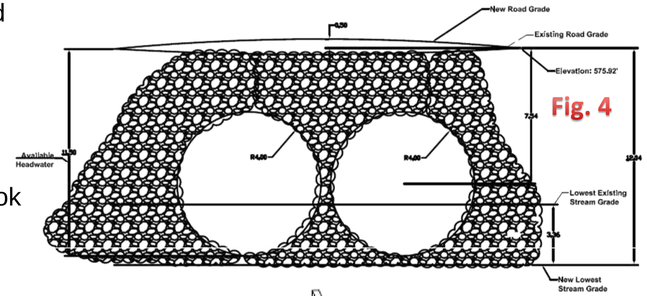
Tools used in analysis:
ArcMap, AutoCAD, Microsoft Excel, Hydraulic Tools V4-0, RTK survey, Total Station survey, TR-55 Method

Estimated Budget:

DESCRIPTION	*QUANTITY*	*UNIT COST*	*TOTAL*
Excavation & construction of earthen dike (cu. yd.)	4000	$4.45	$17,800.00
Armor-Mat Dike Protection (yd^2)	426	$25.00	$10,650.00
A-Jack Erosion Control	30	$25.00	$750.00
Landlok 300 Turf Reinforcement (yd^2)	653	$8.50	$5,550.50
Bank Excavation to 1:1 slope (yd^3)	616	$4.45	$2,741.20
CONSPAN unit & headwall	1	$68,100.00	$68,100.00
CONSPAN wingwalls	4	$5,100.00	$20,400.00
Concrete Foundation (yd^3)	12.45	$95	$1,182.75
TOTAL			**$127,174.45**

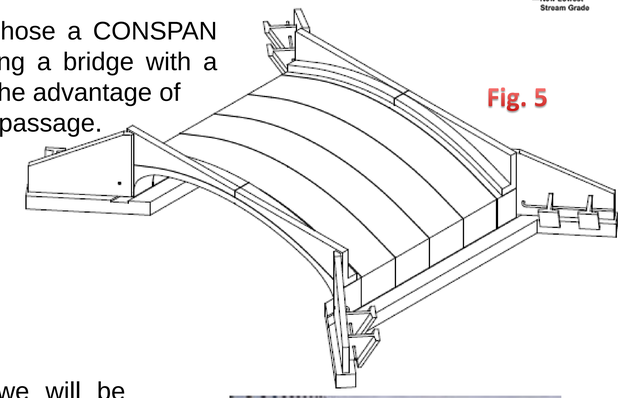
Alternative Solutions:

According to standards by the Natural Resources Conservation Service, culverts should be designed to carry the lower of either a 2yr-24hr design storm or bank full. Our new infrastructure was designed to carry a peak flow of 1060cfs, the calculated 2yr storm from TR-55. To carry this flow with a standard culvert, we found we needed two eight foot (diameter) culverts, shown in the AutoCAD drawing (Fig. 4). Note that the new streambed would have necessitated the dredging of the existing streambed. At a cost of $92/ft, our two 8’ culverts (31’ in length) would have cost a total of $5704 for the culvert materials. Concerns about the environmental effects of altering an existing stream-bed led us to look elsewhere.



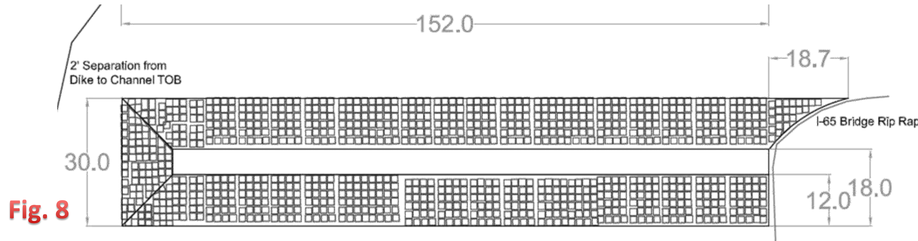
Chosen Solutions:

Problem 1: After evaluating our options we chose a CONSPAN arch from CONTECH (Fig. 5). We will be using a bridge with a span of 36’, and a rise of 11’. This will allow us the advantage of having a natural stream bottom suitable for fish passage.



Problem 2:
To combat erosion and tree undercutting, we will be employing A-Jacks (Fig. 6) and Landlok 300 Turf Reinforcement mats (Fig. 7) . The sizing for these products was based on the channel velocity (calculated using a cross-sectional based flow program available through CONTECH) and the shear stress ($\tau=\gamma RS$).

Problem 3:
Alternate flow patterns will be prevented by the use of an earthen dike (shown as from top, Fig. 8) . This structure will be built as shown on figure three.



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