STORM WATER THERMAL ENRICHMENT IN URBAN WATERSHEDS

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KIESER & ASSOCIATES (K&A) recently led a five-year thermal enrichment study, supported in-part by the Water Environment Research Foundation (WERF) and the Kalamazoo Community Foundation Environment Now Fund in Portage Creek and at the recently completed Consolidated Drain project site in Portage, Michigan. The Consolidated Drain is the single largest stormwater discharge to Portage Creek, a tributary to the Kalamazoo River. The Creek is also a designated coldwater trout stream. This research effort was initiated to evaluate and identify innovative and/or traditional approaches to moderate temperature impacts associated with urban stormwater runoff. The hypothesis of this project was that stormwater systems can be designed to eliminate major alterations to the stream ecology due to thermal enrichment through enhancement or substitution of traditional design and Best Management Practices (BMPs). This hypothesis was tested through monitoring and evaluation of the hydrologic and thermal regime of the Consolidated Drain system and the receiving stream, Portage Creek, both prior to and after installation of the system known as the Regional Stormwater Treatment and Trailways Facility.

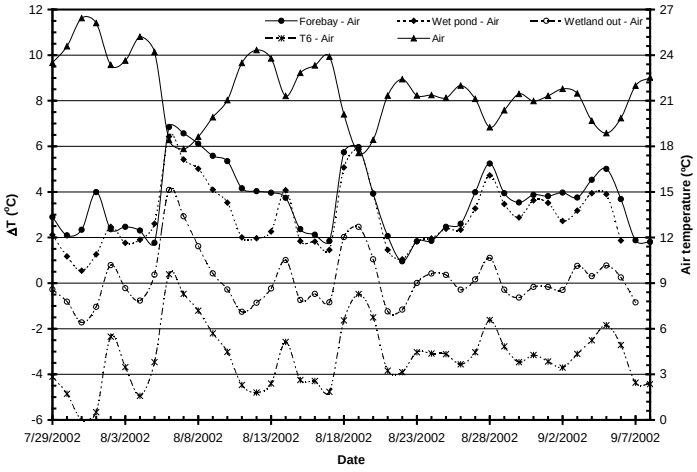
Continuous monitoring of the hydrologic and thermal conditions of the drain has taken place since spring of 1999. Water temperature, rainfall, stream flow, air temperature, relative humidity, and incoming solar radiation have all been measured at various locations throughout the study area using sensitive recording devices. These data provide valuable insight into how the alterations to the drain will affect the temperature of the water reaching Portage Creek.

The three objectives of this research included:

- Confirming the relationships between disrupted heat budgets found in urban areas and local hydrology;
- Quantifying the impacts of thermally enriched stormwater discharges on cold water temperature regimes as related to their influence on aquatic life and habitat; and
- Determining design criteria for stormwater BMPs and controls necessary to mitigate problems associated with stormwater thermal enrichment.

One of the key features of this project has been the development of transferrable assessment tools, evaluation protocols and stormwater Best Management Practices (BMPs) for other locations where the thermal impacts of urbanization continue to encroach upon and impair aquatic habitats. Results indicate that the 3-stage treatment design of the stormwater treatment facility is an effective means to treat thermally enriched stormwater. Mitigation of higher stormwater temperatures is not accomplished in the more traditional two-stage treatment process (i.e., forebay and wet detention). By the time the flash of thermally enriched stormwater flow moves through the natural wetland (5-10 day detention), a dense canopy coverage allows the pulse of water to return at least to ambient air temperatures before gradual release back into the drain.

With the changes that the Consolidated Drain has undergone, focus is on both chronic and acute changes in the thermal regime. Chronic warming refers to a general change in the heat budget of receiving waters due to BMP exacerbation or mitigation of temperatures. Acute refers to heat input associated with warm, flashy flows from impervious surfaces.



Detailed studies of Portage Creek both above and below the Consolidated Drain have identified the mitigation benefits of the constructed stormwater treatment system. Data also reveal other riparian corridor issues along Portage Creek and the Consolidated Drain that still negatively impact the thermal regime of this creek. Lack of riparian vegetation and shading, in sections of Portage Creek and immature drain channel plantings, along with other unmitigated stormwater discharges are the cause. Thus, this research has identified the benefits of integrated riparian corridor management and the need for diverse stream buffers.

Dr. William James of the University of Guelph, a collaborator on the project worked with K&A to develop and refine a heat budget model to better understand the linkages between solar inputs, impervious surface, treatment systems and runoff temperature. This model evaluates non-traditional BMPs such as permeable pavements, light colored pavements, infiltration strategies, shading and their effects on runoff temperature and volume.

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