Mitigating Heat Transfer from Impervious Surfaces to Stormwater Discharge

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Mobile Bay is home to Alabama's seafood industry and provides estuary service (a place to grow) for many fish and crustaceans. The main stormwater outfall for downtown Mobile flows directly into Mobile Bay. Little is known about thermal heat pollution attributed to stormwater outfalls to urban receiving waters. The temperature of stormwater (1st inch of flow) runoff flowing over impervious surfaces in downtown Mobile, AL have been recorded as high as 118oF during the month of July. Many dead juvenile fish and crustaceans have been observed at Mobile's downtown stormwater outfall. Pervious concrete (PC) or pervious asphalt (PA) pavements are a viable stormwater control measure (SCM). PC and PA are used in place of an impervious paved surface to both reduce and potentially treat stormwater runoff. This construction technology is well known as an urban stormwater mitigation practice, but has not been adequately evaluated for thermal heat removal effectiveness. This project hypothesizes that pervious pavement are a good at mitigating of thermal heat. This project: 1) Establishes benefits of pervious pavements in mitigating thermal heat removal; 2) Establishes a baseline measurement of heat removal effectiveness of pervious material when used as a solitary stormwater control measure; and 3) Establish pervious material role mitigating thermal heat removal when used in combination with other stormwater control measures. The methodology of this project uses a laboratory as a controlled environment. Traditional impervious and pervious pavement mesocosms are designed and constructed as pre-test to our hypothesis that PC can mitigate thermal heat pollution and contribute to a combined treatment train. A mesocosm is an experimental tool that brings a small part of the natural environment under controlled laboratory conditions. In this way mesocosms provide a link between observational field studies that take place in natural environments. Mesocosms provide an enclosure that is small enough that key variables can be brought under control. Test cells are constructed for two common types of paving materials used in urban areas concrete and asphalt). The cells are designed to simulate the appropriate installation method, including fill (impervious) or retention (pervious) subbase and soil below the 4 inch slabs. Water is applied to the test cell surfaces via simulated rain fall. The runoff is captured in a vessel and temperature is taken prior to entering the mesocosms. This simulated "Treatment Train" is designed to capture the simulated stormwater runoff for impervious materials or allow infiltration for the pervious materials prior to the runoff entering the mesocosm. Unique to this project is using a data logging system and thermistors located in various locations within the cells. The pavement material test cells (or in combination with mesocosms) were subjected to electric infrared heat for a predetermined time. The test cells (with and without mesocosms) were then subjected to a simulated 1" rainfall event for 1 hour duration. Temperature data was recorded from the test cells and water collection simultaneously during pre-test, heating periods, rainfall event and post-test periods using thermistors and thermal imaging technology. Preliminary results show a temperature reduction in the water infiltrated through pervious pavements showing potential in the ability to mitigate thermal heat. This research has the potential to impact estuary conditions in Mobile Bay and beyond. Thermal pollution to receiving waters is an urban stormwater problem throughout the world that negatively impacts fish and wildlife habitat. Pervious pavements show potential in mitigating the temperature of water flowing through them resulting in estuary protection.

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