The Use of GIS to Model Sea Level Rise Inundation
An adaptation methodology to identify vulnerable transportation infrastructure
Christian Treat and Dr. Michelle Oswald
Bucknell University, Department of Civil and Environmental Engineering

BACKGROUND
One of the most anticipated effects of climate change is sea level rise. Permanent inundation and temporary flooding due to storm surges are the most serious effects of sea level rise that will continue to worsen in frequency and intensity with rising water levels. Transportation infrastructure is extremely susceptible to even minimal increments of sea level rise, which causes structural damage, service interruptions, and travel delays.

To prevent enormous economic damage, adaptation practices are required. Adaptation involves response strategies, including retreat, accommodation, and protection that ensure the welfare of at-risk infrastructure. Retreat emphasizes abandonment, accommodation emphasizes conservation, and protection emphasizes defense.

Transportation agencies have been limited in incorporating adaptation into their planning process. As a result, the need for developing adaptation tools and methods are critical to encouraging agencies to begin to adapt.

PURPOSE
Opportunities for adaptation can be effectively captured using GIS through spatially displaying and analyzing relationships between land use, hydrology, and infrastructure elevation. GIS is already in use for transportation agencies, but inclusion of GIS applications for climate change needs to become more widespread and ready for use in agencies that are pressed for time and limited resources. Based on these needs, we have developed a straightforward methodology and applied it to a case study region in Philadelphia County.

TRANSIT INUNDATION MODELING METHOD
The following five-step process is part of an iterative risk management adaptation strategy:
1. Define the study area, based on agency jurisdiction, proximity to coastal zones, and extent of transportation network in the area.
2. Gather relevant spatial data through agency websites, university websites, and data clearinghouses.
3. Create inundation layers based on a range of predicted sea level rise scenarios.
4. Analyze data by mapping transportation and projected sea level rise scenarios, and quantify the impact by calculating summary statistics.
5. Synthesize results by identifying vulnerabilities in the network to allow for proactive decision-making by transportation agencies.

FRAMEWORK FOR TRANSIT INUNDATION MODELING METHOD (TIMM)

RESULTS
Based on the projected inundation levels, Southern Philadelphia is at risk for a significant amount of sea level rise. Accordingly, infrastructure in this area is the most vulnerable and transit planning should prioritize projects centered in this region.

CONCLUSION
Due to the criticality of public transportation infrastructure as well as the pending threat of climate change impacts, adaptation planning methods such as TIMM are essential. TIMM is a five-step process that is repeatable, straightforward, GIS-based, and uses publicly available geographic data. Thus, TIMM addresses the primary needs identified with existing methods and models, and along with the case study application, serve as a foundation for how agencies can begin to adapt to sea level rise.