Field Seminar No. 1
The Delaware Floodplain: Impacts of Severe Storms on Infrastructure in a Low-Lying State
October 30, 2017

University of Delaware
Sharp Campus
Lewes, Del.

Opening Remarks/Chair (Gerald Kauffman, UDWRC)

GIS Mapping/Flood Inundation Analysis (A. Homsey, UDWRC)

Questions:

1. In addition to exposure for roads, did you look at depths and how it would render roadways and be inoperable?
   Answers:
   - Each segment is coated with depth
   - We did do it with inundation model
   - If a road has water on it it's an issue anyway
   - Next phase-mapping scenario 1, 2, 3 ft. inundation

   Other comments
   - Great evaluation part to show whether road is impacted or not
2. Did you use the latest LiDAR data?
   Answers:
   - For sea level rise – 10 dem
   - Inundation – flood evaluation cat 3 Slosh model
3. Issues in NJ, what's the extent of LiDAR data for bathymetry – did you map it out?
   Answer:
   - Didn't look at bathymetry – it's used in slosh model instead

Culvert/Bridge Hydraulic Analysis (G. Kauffman, UDWRC)

Questions:

1. None

Web Flood Mapping Interface (D. Racca/E. Best, UD CADSR)

Something to think about – consider how to estimate beach population during hurricane season

Questions:

1. On your data issues, you had that property taxes don't translate to real value so what alternative sources are you using?
   Answers:
   - Using internet sources that show low and highest value but can take an average
   - Difficult to do it accurately
   - Can be reasonably sure about home values
2. On outcomes piece, right now Sussex County is working on a comprehensive plan, is this information being provided to them?
   Fundamental issue - there's very poor addressing of these kind of issues
   Answers:
   - Our responsibility is not to make policy
   - Happy to talk with public and others about questions they may have

3. What is the time frame of this data projected forward given sea level rise?
   Answers:
   a. Sea level rise projections were taken from sea level rise report in terms of the next 30 years
   b. We assume 0.5-meter sea level rise (18 inches)
4. What sea level rise scenario do we plan for?
   Answer:
   - Cat 3 hurricane
5. Comments:
   - Some of the gaps in population could be fed by the travel demand type data
   - Product called Airsage
     - Uses cell phone data xyt
     - Is a commercial product, can see where people are and how they're moving
     - Origin and destination
   - Landscan – looking at nighttime population
   - There's detailed employment data which can help
   - We'll need commercial products to help too
6. Did you look at conservative sea level rise and at what decade out it would create engineering problems for Route 1? How far out would you have to project that before sea level rise alone would render the network?
   Answer:
   - There is a document: Delaware Sea Level Rise Vulnerability Assessment
7. Other comments:
   - Sea level rise is extremely noisy – not a nice smooth line – with a constant rate
   - Data is jumping year to year but then not
   - Very tricky
   - Storms on top of that could be dead vs another could be very active
   - Decade time scales – that's when you see sea level rise start to move up
   - Interesting that everything stops at 2100

Coastal Inundation Mapping and STREAMSTATS (N. Bates, DGS)

Questions:

1. Is the LiDAR data available?
   Answer:
   - Yes, variety of websites that it's available

2. How long has LiDAR readings been available (in general)
   Answer:
   - Mid-1990's
3. Can you see if land movement (up or down) has been detected (subsidence)?
   Answers:
   - There's other technology that can be used
   - Accuracy of LiDAR is in cm so if you're looking for mm then you won't see it

Delaware Coastal Flood Modeling and Issues (Mike Powell, J. Hayden, DNREC)

Questions:

1. The national insurance crime bureau has done fly overs of before and after scenarios, do you see that kind of information being incorporated into the way we're beginning to map and model?
   Answers:
   - Info would be useful for validating models in the future
   - Validation data is lacking in today's models

Other comments:

- Can see the number of rooftops blown off, vegetation impacts,
- Giving information to FEMA

2. Comments:
    - Real-time learning, the Slosh model is only run by NHC for hurricanes. Equations based on movement in hurricanes down south
    - Can't use Slosh model for here (in DE)
    - Slosh – long term planning
    - Need to come up with new system for specific storms (not long-term scale)
3. Comments:
    - It seems like you need a menu of potential storm effects to determine what storm will likely be
    - Knowing where the storm will go is so critical
    - Can't really model in real time but can predict for what might happen – give scenarios
    - Preferred predicted approach – tide gages
    - Coastal flood monitoring system – info from model is updated every 6, 12 hours
    - Both NOAA surge model and DE BOS model – updated every 6 hours
    - Utilize atmospheric wind profiles

Vulnerability Assessment along SR 1 near Dewey Beach (L. Trout/D. Janiec)

Questions:

1. With the marsh buffering, does it have an effect on the shoreline?
   Answers:
    - No, protects against energy
    - Mostly to break down wave energy

Community Resilience Planning Guide to Transportation (S. Cauffman, NIST)

Questions:

1. What are the interdependencies built into resiliency?

Answers:

- We've tried to put it into the hands of the local government to input a trajectory a way to establish goals
- Can be building to it but if hazard occurs, now the plan is in place so can use resources
- Build up resilience over time but if something happens, it's a better way of building back without a plan in place

2. Comments:
    - Recently we've had 3 inter-related case studies – they can be treated in isolation or inter-related - political aspect is becoming big
    - 3 events – dividing national capacity – cascading cloud of impact on resiliency
    - 85% of people (in FEMA) are now deployed to one of three areas
    - Puts strain on ability to support recovery
3. The state of DE is updating the hazard mitigation plan, do you see some of this factoring into FEMA's future work?
   Answers:
    - We hope so – trying to implement it into a more forward approach
    - Try to get resilience put into planning process
    - Trying to build back in a better way to minimize investment in the long run
    - All planning ways are done is silence – opportunity to integrate planning efforts but using resilience planning
4. Comments:
    - If you look at things from the UN level – exactly where they're going

    - Coherence
    - Ex. Sustainable development goals
    - Planning is cohesive, planning mindset is being asked for
    - Extremely effective in areas where it's been applied
5. How you got your design hazard performance? How is it generated?
   Answers:
    - Established by community's planning team
    - Community set goals – what they believe to be right set of goals for their area
    - Actual data – based on engineering judgement of what the hazard would do
    - To get "blue boxes" takes significant thought process, data, etc.
    - Can do a lot of planning in workshop with team
6. In this process, is the element of mitigation brought in?
   Answers:
    - Mitigation in this process is mitigating risk
    - Use as FEMA mitigation vs climate mitigation
    - State working on pilot projects – tried to do asset management project – green- house gas measurements and resiliency
    - Have a new report – trying to do something new
    - Report is available

Storm Surge Risk to DelDOT SR-9 (S. Croope, DelDOT; D. Stander/C. Meenan, RMS)

Questions:

1. In talking about risk and resiliency, there's also another set of complexities. All of the development taking place is putting greater strain on roads. Should the roadway be made to handle greater capacity? Making roads better will increase movement over road, which increases threat to environment, increase in flooding, etc. At what point does it become counterproductive?
   Answers:
    - There are different ways to look at being resilient and sustainable
    - Will eventually stop growing but no one wants to think about that
    - Adverse process
        - If not aware, bad feedbacks can occur
        - How do you change that?
2. Is anyone starting to deal with carrying capacity?
   Answers:
    - Closest to that was retreat (people retreating) – not something easy to do
    - If an agenda can be organized of development, it can help
    - How many people have the courage to actually say it?
3. Comments:
    - Comprehensive plan addresses carrying capacity? – must by law contain sections about certain things but doesn't mandate how good the content is
    - Apart of TIS will incorporate TID in Sussex County

Delaware Infrastructure Impacts (J. Pappas/B. Urbanek, DelDOT)

Questions:

1. Comments:
    - Perhaps not enough revenue to be resilient
    - Elevating and bridging is the answer except it's really expensive
    - Hard to elevate roads because over time the soil weakens and will put roads back to square one

Attendees:
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RMS was commissioned to develop a Risk and Resilience Framework for DelDOT. The purpose: to provide an objective process to help enable DelDOT's leadership team to identify, quantify and manage the risks to its network within the context of its overarching priorities and goals. The framework addresses the iterative and continuous nature of the process of building resilience. It explains how the risks must be quantified by a range of means, and ultimately measured against a well-defined set of tolerances, or resilience targets, on an ongoing basis.

The efficacy of the Risk and Resilience Framework has been illustrated with a specific case study. That case study applies the risk quantification methodology to the risk presented to Delaware's State Route 9 from hurricane induced storm surge damage.

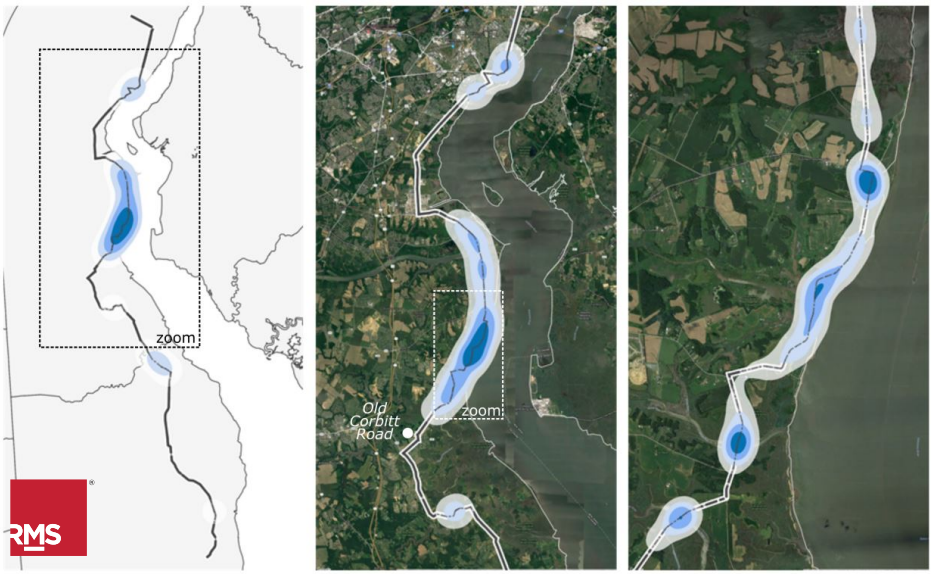

FIGURE 1 STORM SURGE MAP OF AVERAGE ANNUAL LOSS (AAL) FOR SR9

In this technical case study example, a range of outputs from RMS probabilistic storm surge models are used to quantify and communicate the potential for damage to SR9. Outputs include probabilistic Exceedance Probability curves, which describe the potential for damage across the full range of frequency and severity, as well as deterministic scenario analyses, and relative risk maps of the road.

Figure 1 illustrates one of these maps, showing three progressive zooms of the relative Annual Average Loss (in USD) to DelDOT infrastructure in the area around Old Corbitt Road. Figure 2 shows an example exceedance probability curve. It shows how much of SR9 will be damaged at various probabilities. Insightful risk metrics such as these help to support cost-benefit decisions for resilience-building investments – under both present and future sea level rise scenarios.

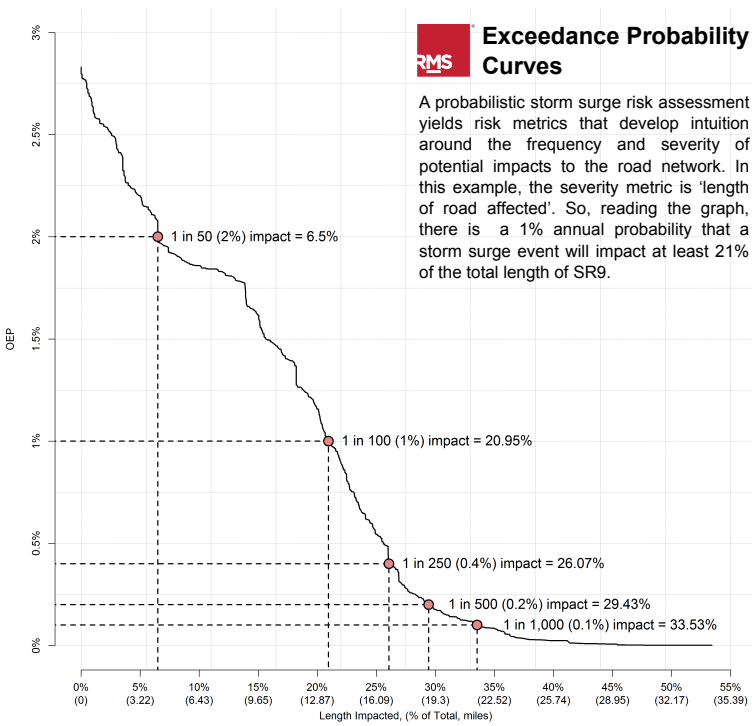

FIGURE 2 EXCEEDANCE PROBABILITY CURVE FOR IMPACT TO ROAD NETWORK FROM STORM SURGE