








Major Infrastructure in Major Cities: Challenges and Lessons Learned Navigating Flood Control Projects Funded through HMA

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Project Background
A golf course in a flood-prone area






The Proposed Project: Inwood Forest Detention Basin

Located in northwest Houston in the Inwood neighborhood.

Concept is to use a former golf course to create a series of 12 interconnected basins to act as stormwater detention.

Community outreach efforts began in August 2018 as the design process began.

Project Size/Funding

Initial estimates for the project cost were in the range of ~\$47M

Large-scale project that clearly involves a lot of coordination

Multiple Local-Level Partners

Harris County Flood Control District

City of Houston – Public Works

Agency Coordination

TDEM

FEMA



Hurricane Harvey HMGP Funding

FEMA Hazard Mitigation Grant Program

Funding becomes available post-disaster

Projects aimed specifically at reducing future risk

Typically, the cost share is 75% federal funds and 25% non-federal funds

Must demonstrate that the project is **cost-effective**, which often requires performing a Benefit-Cost Analysis



Hazard Mitigation Assistance Guidance

Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, and Flood Mitigation Assistance Program
February 27, 2015



Application for HMGP Funding

Post-Harvey, the City of Houston put in an application for several large-scale infrastructure projects through the HMGP program.

Initial project applications must include information on...

- Scope of Work
- Budget
- Project Schedule
- Benefit-Cost Analysis



BUT, this information is often conceptual at application stage and therefore potentially subject to change through the life of a large project.

SO, for large-budget projects without a finalized design, the project is often phased and local governments can receive funding to complete design prior to the award/commitment from FEMA of construction dollars.



Phase I Funding

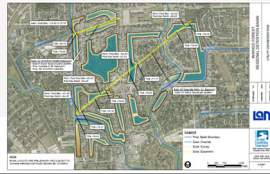
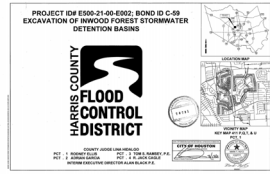
City received funding for Phase I in the amount of around \$7-8M.

This allowed for the development of an engineered project design that moved past the conceptual level.

How does this fit into BCA?

With the initial project application, the City used Hazus, which is a FEMA-damage estimation software to calculate the potential project benefits.

This estimate allowed for approval of Phase I funding, but was not detailed enough (census block vs building level) for FEMA to approve as a final BCA. So as part of its Phase I Deliverables, the City needed to provide a more detailed BCA using the updated design information.



BCA Basics



LOSSES AVOIDED
(Benefits)

Compared To

PROJECT BUDGET
(Costs)

At its core, a Benefit Cost Analysis is a ratio (BCR) of the benefits identified from doing the project to the costs of completing the project.

In the disaster world, we frequently estimate losses avoided as benefits.



Challenges and Phase II

Keeping the project viable through BCA

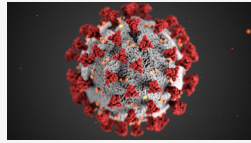


Main Challenges

Phase I design was not completed until a couple years after initial project application was developed. In that time something happened...

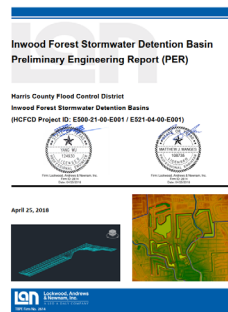
Increase in construction costs nationwide due to COVID-19 pandemic and related supply chain issues. Projects were costed originally in 2018/2019 and, in the intervening years, the cost estimates could essentially be thrown out the window.

Combine this with the Hazus concerns and essentially, we had to start from scratch to build a new BCA.



Data FEMA Requests as Backup

- Existing and Proposed Terrain
- Existing and Proposed Water Surface Elevation (WSE)
- H&H Models (RAS, HMS)
- Preliminary Engineering Report (PER)
- Related Memos
- Detailed BCA and Depth Damage Function (DDF) Calculation



How Did We Do It?

Methodology for Creating a New BCA for Inwood



Getting Benefits to a > 1.0

For federal projects, it is important to do analysis for many different recurrence intervals rather than just 100yr and 500yr.

This leads to more benefits and sometimes the more frequent recurrence intervals can actually improve your BCR the most.

Annualized Results: Before Mitigation Clear

Recurrence Interval (years)	Damages and Losses (\$)	Annualized Damages and Losses (\$)
1	45,028,761	7,500,594
10	120,974,777	11,336,620
25	295,206,013	7,277,264
50	446,489,221	5,350,352
100	638,283,596	6,962,881
500	1,180,018,350	2,373,518
Sum Damages and Losses (\$)		Sum Annualized Damages and Losses (\$)
2,724,799,128		40,603,229



Takeaways

- ✓ Finding a compromise
 - ✓ Data
 - ✓ Level of detail
- ✓ Resource availability/capacity issues
- ✓ Creative solutions
- ✓ Positive trajectory: changes to FEMA policy







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