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FEDERAL TRANSIT ADMINISTRATION

Unit 4: Data Documentation and Case Study

Hazard Mitigation Cost Effectiveness Analysis Course

January 2014

U.S. Department of Transportation
Federal Transit Administration

Unit Objectives

1) Understand documentation requirements for use of the FTA HMCE tool.
2) Understand the key inputs of the tool.
3) Identify the sources of documentation necessary to support key inputs.
4) Provide examples of “acceptable” and “unacceptable” documentation.
5) Successfully complete a FTA HMCE Tool BCA using a case study demonstration.

HMCE Tool - Documentation Issue

- Issue: The FTA HMCE Tool is based on the DFA module used in FEMA's BCA software. FEMA hazard mitigation project BCAs prepared using the DFA module sometimes do not meet program requirements due to insufficient or incorrect documentation of event damages, service losses, and recurrence intervals. Therefore, we anticipate this may be an issue for resilience projects prepared using the HMCE Tool.
- Potential Solution: An understanding of techniques to document event damages, service losses, and recurrence intervals may result in more cost-effective transit resilience projects.

Documentation Guidance and Resources

Section	Input	Unit	User Guide Page	Potential Documentation Sources	Project Documentation Sources
III	Total Project Initial Cost	Dollars	D-1	• Local historic cost data • Current contractor bids • Published unit costs	•
III	Project Useful Life	Years	A-1	• Default Values, User Guide Appendix A	•
III	Remaining Useful Life of Assets to be Protected	Years	B-1	• Default Values, User Guide Appendix B	•
III	Annual Project Operation and Maintenance Cost	Dollars/ Year	D-1	• Transit agency estimates	•
III	Discount Rate	Percent	NA	• Default Value, 7%	•
IV	Cost of Loss of Services for Transit Passengers	$/ Passenger/ Hour	D-1	• Default value, $15.58 • Regional estimates	•
IV	Current Federal Mileage Rate	$/Mile	D-1	• Default value, $0.56, from GSA	•
IV	Loss of Service During Construction	Various	D-1	• Construction schedule, plans, and maps • Transit agency records	•
IV	Delay or Extra Travel Time	Hours	D-1	• Project construction plan detour routes	•

Refer to Appendix D of the User Guide and the HMCE Data Documentation Template for additional guidance on documentation

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Key Inputs in the HMCE Tool

The DFA Module requires documentation of the following key data:

- Project Costs
- **Event Damages**
- **Event Service Losses**
- **Event Recurrence Intervals (RIs)**
- Post-Resilience Damages and Losses (Project Effectiveness)

Documenting Project Costs

- The five-step process for estimating the resilience project costs was discussed in Unit 2
- Project Cost elements:
  - Initial project cost – includes pre-construction, construction (base/hard), and ancillary (contractual) costs
  - Operation & maintenance (O&M) costs
  - Estimated service interruption costs
- Project Cost documentation sources:
  - Local historic cost data
  - Current contractor bids
  - Published unit costs

Documenting Event Damages

- Event damages (Unit 2) may include Physical Damages to Fixed Structures and Rolling Stock, Response and Recovery costs, and Other Damages
- There are two types of damage events (Unit 3):

1) <u>Historic Damages</u>
   - Based on records from <u>actual</u> past disaster events
   - Need a minimum of one known RI events or three unknown RI events occurring in different years

2) <u>Expected Damages</u>
   - Based on damages <u>predicted</u> from a theoretical model or engineering analysis.
   - Need a minimum of one or more known RI event

Documenting Historic Damages

Historic Damage documentation sources:

- Disaster damage worksheets - FEMA *Project Worksheets* (PWs)
- FTA's 28-day and 60-day Damage Assessment Reports
- Insurance Claims
- Repair Records
- News articles citing credible sources

The Port of New York and New Jersey

PortViews

Port Comes Back After Hurricane Sandy: Part One

On the morning of November 4, 2010, the first of five cargo ships slid toward its berth at the Elizabeth Port Authority Marine Terminal.

On any other day, such an event would be business as usual. But this vessel was the first one cleared to dock after Hurricane Sandy ripped up the northeast coastline, causing unprecedented damages and altering long held paradigms for storm preparedness.

"No one believed there could be a 13-foot storm surge ever in this port, and there was," said Richard Larrabee, director of the Port Authority's Port Commerce department. "I talked to people who have worked here for 30 years who said they never feared for their lives but they did that night."

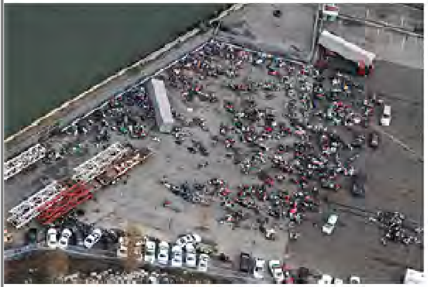
David Brady concurs. The Vice President of Administration for Global Terminals, Mr. Brady has worked at the port for 31 years.

"I've never seen an event close to this," he said. "We've never flooded before but this time we found ourselves between one and four feet underwater depending on which part of our facility you were at."

The storm surge spared few port assets. On the Jersey side of the Hudson, up to 14,000 new cars were devoured by rising water as they waited on the docks. Forty percent of the port's cargo cranes were temporarily disabled. Some 2,500 trucks critical to transporting freight throughout the region were effectively destroyed due to salt-water contamination.

The weather damaged shipping containers. One floated across the Arthur Kill from Staten Island. Seven more drifted across the Buttermilk Channel to pile like so many Lincoln Logs on the seawall at Governor's Island. High winds and thundering waves snapped a barge at Greenville Yards in half.

And so on.



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225 Park Avenue South
New York, NY 10003
www.portnynj.com

For news and article ideas:
Damon DiMarco
Phone: (212) 435-6401
ddimarco@panynj.gov

Hilary McCarron
Phone: (212) 435-6915
Fax: (212) 435-6934
hmccarro@panynj.gov

Documenting Expected Damages

Expected Damage documentation sources will vary based on the structure type and hazard to be mitigated.

1) Building Damages tied to FEMA BCA software or HAZUS-MH
   - **Flood** Depth Damage Functions
   - **Hurricane Wind** Damage Functions
2) Facility Damages tied to Engineering Studies

Documenting Historic Service Losses

- Types of Historic Service Losses:
  1) Loss of Rail or Ferry Service
  2) Loss of Bus Service
  3) Passenger Vehicle Delays
- Remember that for each type of service loss, documentation must be provided for…
  - cost of lost transit service – based on value of passenger time ($/passenger/hour),
  - delay or extra travel time (hours), and
  - actual loss of function (LOF) durations for each historic event (days).

Historic Service Losses - Examples

MTA .info

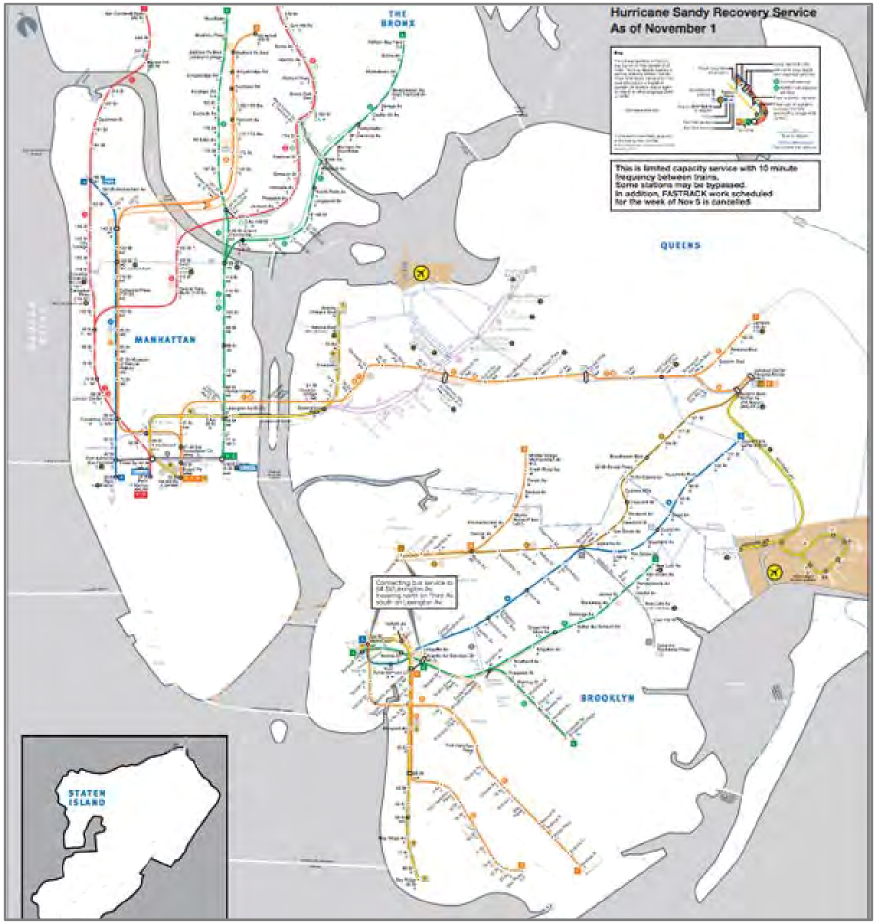
Accessibility | Text-only

Home | Schedules | Fares & Tolls | Maps | Planned Service Changes | MTA Info

Average Weekday Subway Ridership

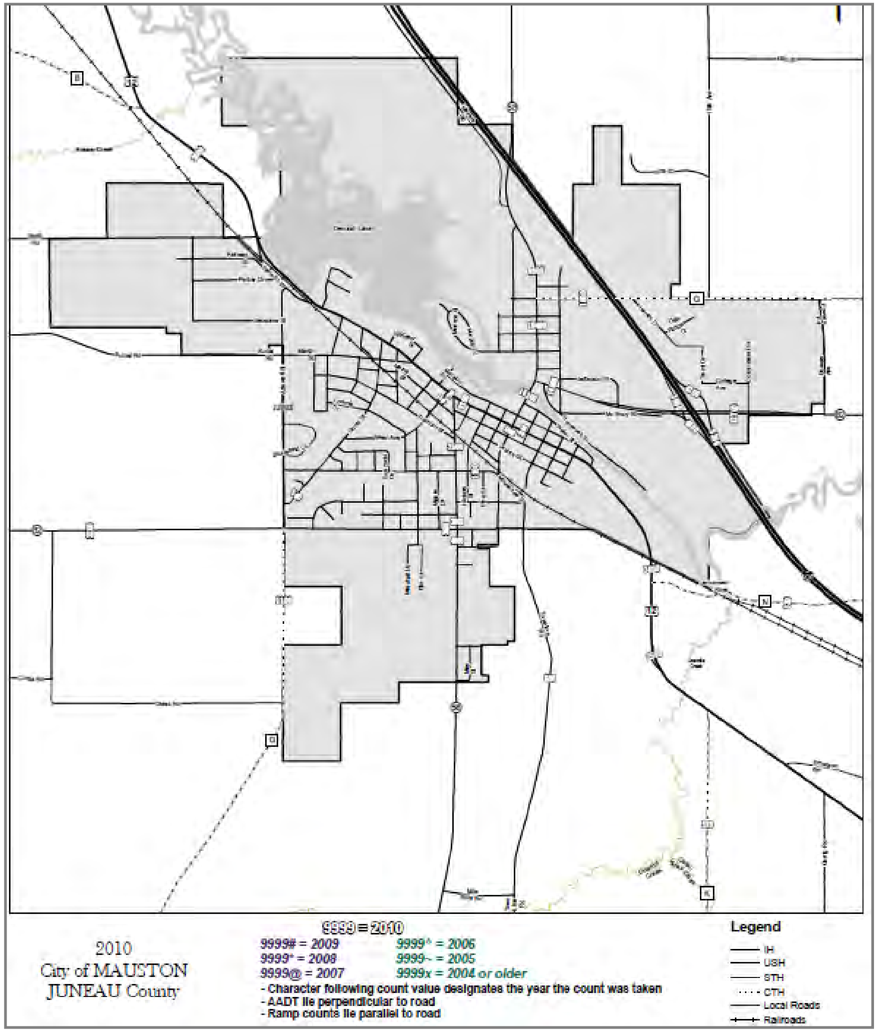
Station (alphabetical by borough)	2007	2008	2009	2010	2011	2012
The Bronx						
138 St-Grand Concourse 4 5	2,720	2,926	2,969	3,013	3,076	3,183
149 St-Grand Concourse 2 4 5	10,384	11,395	12,056	12,744	13,422	13,599
161 St-Yankee Stadium B D 4	24,258	26,511	26,061	26,159	26,631	27,604
167 St 4	8,564	9,125	9,054	9,220	9,351	9,699
167 St B D	8,747	8,913	8,848	8,839	9,054	9,264
170 St 4	7,958	8,661	8,848	9,234	9,259	9,518
170 St B D	6,273	6,421	6,255	6,054	6,155	6,303
174 St 2 5	6,514	6,876	6,801	7,227	7,049	7,018
174-175 Sts B D	4,669	4,822	4,603	4,537	4,660	4,706
176 St 4	4,606	5,105	4,312	4,517	5,383	5,623
182-183 Sts B D	4,898	4,747	4,612	4,550	4,546	4,507
183 St 4	3,371	5,890	5,954	6,071	6,162	6,319
219 St 2 5	2,727	2,982	3,049	3,261	3,337	3,413

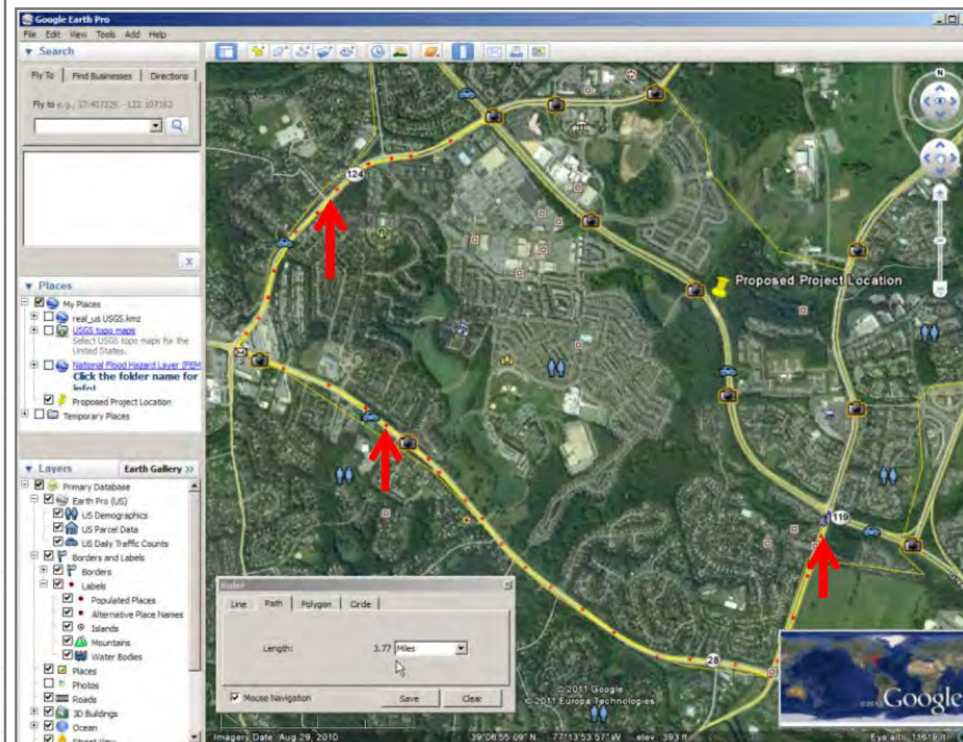
Source: Metropolitan Transportation Authority



Source: Metropolitan Transportation Authority

Historic Service Losses – Examples
(continued)





Documenting Expected Service Losses

- Types of Expected Service Losses – Same as Historic Service Losses:
  1) Loss of Rail or Ferry Service
  2) Loss of Bus Service
  3) Passenger Vehicle Delays
- As with historic losses, the following documentation must be provided for each type of service loss…
  - cost of lost transit service – based on value of passenger time ($/passenger/hour),
  - delay or extra travel time (hours), and
  - actual loss of function (LOF) durations for each historic event (days).

Documenting Event Recurrence Intervals (RIs)

1) Historic Damages: Analysis based on…
   - One or more events with known recurrence intervals;
   - Three or more events of unknown recurrence intervals; or
   - A combination of three or more known and unknown recurrence intervals.
2) Expected Damages: Analysis based on one or more known recurrence interval events.

Historic Damage Events – Known Recurrence Intervals (RIs)

Approaches for Estimating Recurrence Intervals

1) Flood Elevations or Discharges Tied to Identified Flood RIs
2) Determined by Hydrologist or Other Qualified Agency/Expert
3) Estimated using Climatological Data
4) Estimated Using Rain Gauge Data
5) Other Approaches

Flood Elevations or Discharges Tied to Identified Flood RIs - Examples

King County, Washington
Hydrologic Unit Code 17110012
Latitude 47°33'09", Longitude 122°02'48" NAD27
Drainage area 56.6 square miles
Contributing drainage area 56.60 square miles
Gage datum 35.99 feet above sea level NGVD29

Output formats
- Table
- Graph
- Tab-separated file
- peakfq (watstore) format
- Reselect output format

Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
1964	Jan. 01, 1964	8.90	1,950
1965	Jan. 29, 1965	8.84	1,600
1966	Jan. 07, 1966	6.52	876
1967	Dec. 13, 1966	8.14	1,480
1968	Dec. 25, 1967	6.86	1,090
1969	Jan. 05, 1969	9.07	1,960
1970	Jan. 24, 1970	6.28	824
1971	Jan. 09, 1971	8.54	1,710
1972	Feb. 28, 1972	10.23	2,260
1973	Dec. 26, 1972	6.78	964
1974	Jan. 16, 1974	7.43	1,160
1975	Feb. 20, 1975	8.11	1,390
1976	Dec. 03, 1975	11.46	2,870
1977	Dec. 26, 1976	4.93	398
1978	Dec. 15, 1977	8.87	1,670
1979	Dec. 01, 1978	6.91	836
1980	Dec. 15, 1979	10.70	1,940
1981	Dec. 26, 1980	8.24	1,180
1982	Jan. 24, 1982	10.64	1,920
1983	Jan. 05, 1983	11.18	2,110
1984	Jan. 25, 1984	11.79	2,330
1985	Dec. 14, 1984	5.98	460
1986	Jan. 19, 1986	11.52	2,300
1987	Nov. 24, 1986	13.20	3,100
1988	Mar. 26, 1988	8.77	1,250
1989	Apr. 05, 1989	9.51	1,330
1990	Jan. 09, 1990	13.50	3,200
1991	Nov. 24, 1990	13.43	2,410
1992	Jan. 28, 1992	8.65	1,110
1993	Mar. 23, 1993	7.44	739
1994	Mar. 03, 1994	6.35	471
1995	Feb. 19, 1995	10.80	1,740
1996	Feb. 08, 1996	12.84	2,420
1997	Jan. 01, 1997	11.16	1,830
1998	Oct. 30, 1997	7.48	729
1999	Nov. 26, 1998	11.18	1,870
2000	Nov. 12, 1999	8.79	1,150
2001	Apr. 30, 2001	5.51	431
2002	Nov. 14, 2001	11.50	2,080
2003	Mar. 13, 2003	7.37	858
2004	Jan. 29, 2004	10.48	1,750
2005	Dec. 11, 2004	9.53	1,460
2006	Jan. 11, 2006	9.68	1,500
2007	Nov. 06, 2006	11.50	2,080

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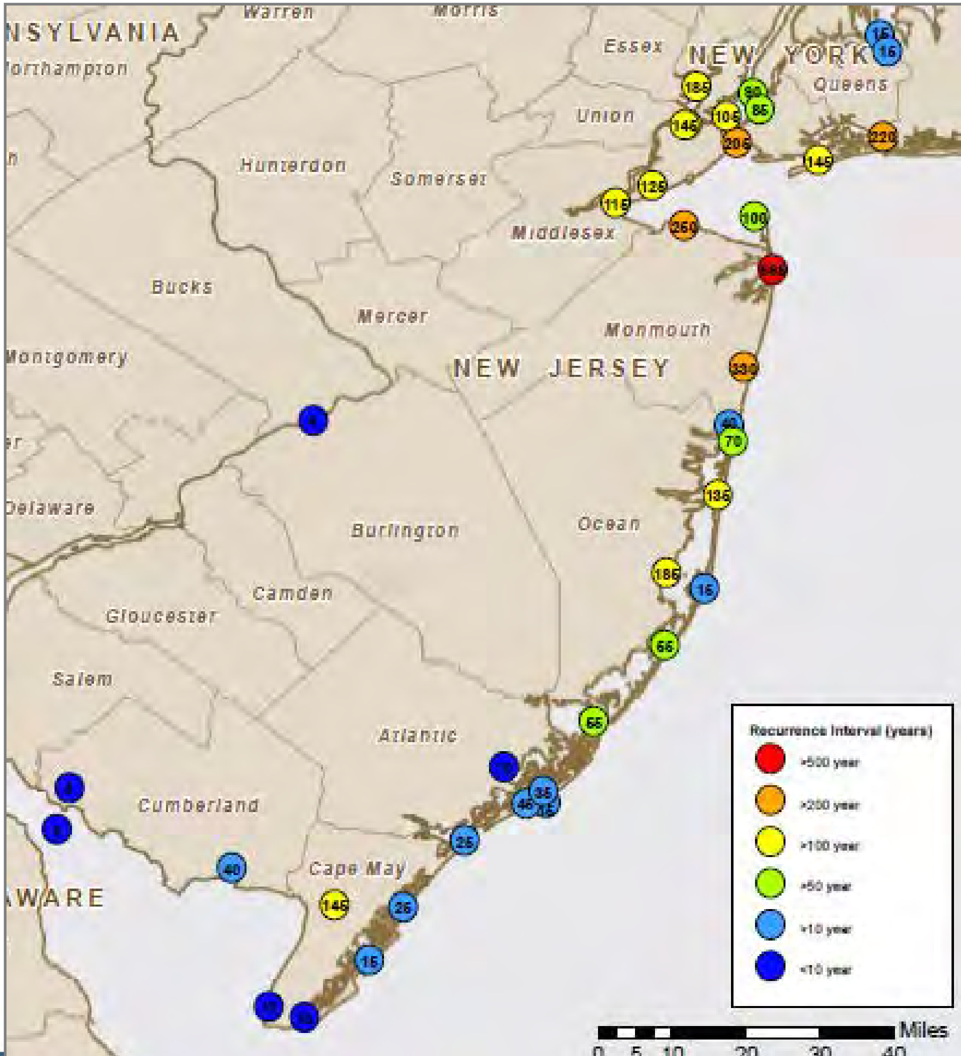
Determined by Hydrologist or Other Qualified Expert - Example



- *How to Use the FTA HMCE Tool* User Guide, Appendix C, provides guidance on estimating storm surge flood recurrence intervals for Hurricane Sandy in New York and New Jersey

Historic Damage Events – Unknown Recurrence Intervals (RIs)

HMCE Tool Requirements When Using Historic Events with Unknown RIs

1) Minimum of three hazard events occurring in different years where either:
   - The RIs of all events are unknown, **or**
   - The RIs of up to two events are known **and** have total damage values that exceed the total damage values of all the other unknown RI events
2) Analysis Duration based on the age of the structure or a minimum of 10 years; whichever is greater

Historic Damage Events – Unknown Recurrence Interval (RIs) (continued)

Documentation must include the historic event damages and the Year Built for the facility to be mitigated

Documentation Sources

- Historic hazard event damages/losses can be documented using approaches and sources listed previously for other historic damage events
- Year Built can be documented using tax records or facility records provided from public/transit agency representative or included in a signed letter from a transit agency official

NOTE: For facilities with multiple structures of different construction dates, the construction date of the oldest structure in the group must be used for the Year Built

Historic Damages with Unknown RIs – Analysis Duration Adjustments

The Analysis Duration is a key component to determine RIs for unknown RI events, and can present difficulties for facility(ies) that are older or where the Year Built is unknown

Adjustments to Analysis Duration

A **User Input Analysis Duration** may be used when one of the following situations apply

1) Discontinuities in Damage Records
2) Replacement of Facility
3) Change in Local Flow Conditions
4) Use 50-year Project Useful Life

Notes Regarding Analysis Duration Adjustments

Important Reminders:

- The HMCE Tool uses a minimum Analysis Duration of 10 years
- Significant documentation requirements apply for User Input Analysis Durations less than 30 years
- No historic events that occur before the start of the adjusted Analysis Duration may be included in the analysis
- Inflation calculations do not go back before a Year Built of 1908.

Change in Local Flow Conditions - Examples

Department of Public Works

January 1, 2011

Mr. John Smith
Florida Division of Emergency Management

Subject: PDM-PJ-00-FL-2011-01
Property Acquisition
FEMA Region

Dear Mr. Smith,

This letter concerns the acquisition of 1234 Lake Drive in Jacksonville, FL. The following paragraphs provide additional information on the USACE Flood Creek study, changes in the hydrology and hydraulics of the watershed, and updated water surface elevations for various design storm events.

In 1995, the USACE realigned 5000' of existing channel on Flood Creek from 1st Street to 10th Street. This project was designed to provide protection from the 5-year storm event. Additionally, significant development in the area began in the 1990's, leading to an increase in impervious area.

A hydrology and hydraulics study, the USACE Flood Creek study, was performed in 2005 to update the data in the effective Flood Insurance study. The new study includes updated hydrologic information based on 2005 landuse parameters and hydraulics updates including the realignment of Flood Creek. The following table compares the water surface elevations from the effective FIS dated June 1, 1980 and the 2005 USACE Flood Creek study.

Table 1. Comparison of Water Surface Elevations at 1234 Lake Drive

Profile	10-year WSEL (ft)	25-year WSEL (ft)	50-year WSEL (ft)	100-year WSEL (ft)
Effective FIS	1.5	2.7	3.4	5.3
USACE study	1.8	3.1	4.0	5.9

The comparison of the study results indicates that a significant change in the watershed occurred in 1995, causing a substantial increase in water surface elevations at the project location. Therefore, the City proposes to use the period from 1995 to 2011, 17 years, as the analysis duration for the purpose of analyzing the cost-effectiveness of the mitigation project.

Sincerely,
City Engineer

Expected Damage Events – Known Recurrence Intervals (RIs) Only

Approaches for Estimating Recurrence Intervals

1) Estimated Event RIs from Engineering Studies
2) Estimated Flood Event RIs based on FEMA BCA Flood Module
3) Other Approaches for Wind Events
   - Hurricane wind event RIs based on FEMA BCA Hurricane Wind Module
   - Wind event RIs from ASCE 7

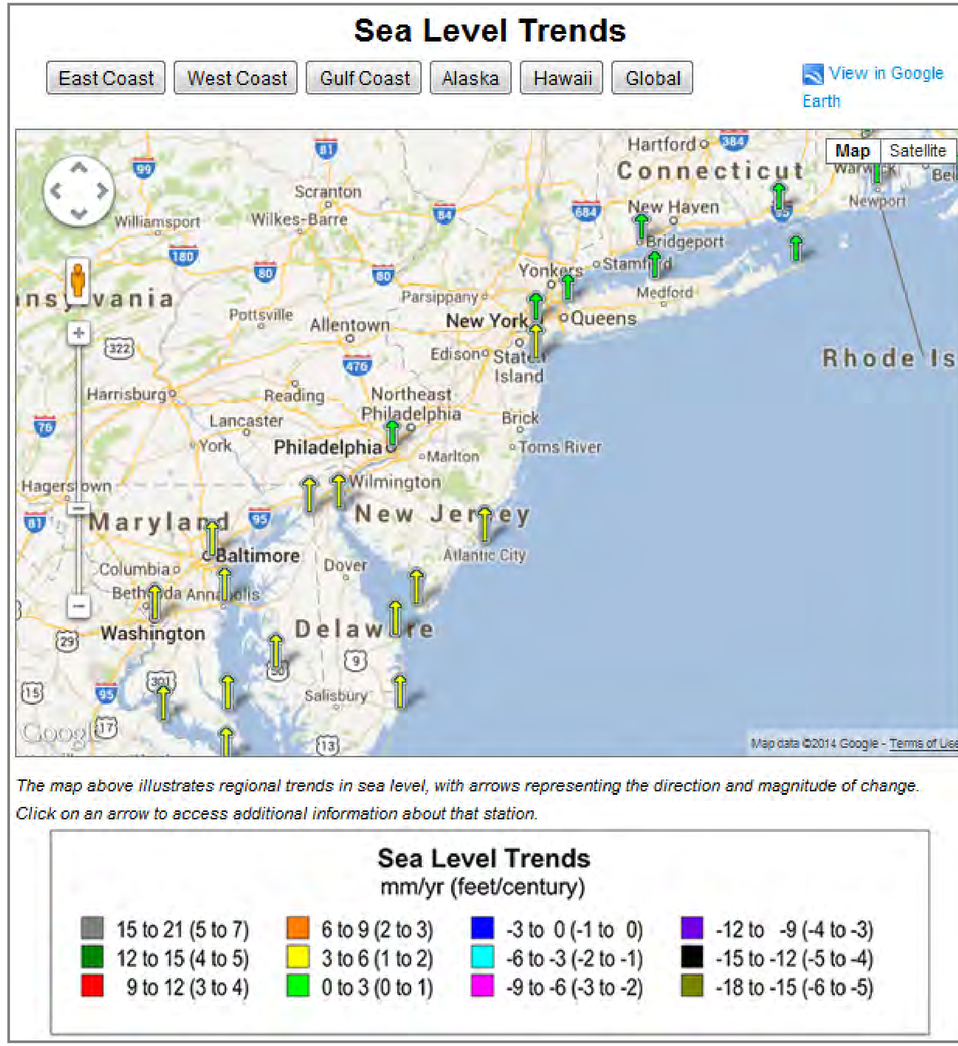
Impact of Sea Level Rise (SLR) on Event Recurrence Intervals

- Transit resilience projects may consider the impacts of sea level rise (SLR)
- In December 2013, FEMA released information on incorporating SLR into BCA on the FEMA website (http://www.fema.gov/media-library/assets/documents/89659) which can be applied to HMCE analysis of resilience projects
- SLR impacts reduce coastal flood/surge RIs for Historic or Expected Damage Events, thereby increasing pre-resilience damages and losses for the same event(s)

Sea Level Rise (SLR) Documentation

SRL may be documented using <u>government- produced or academic/peer-reviewed sources</u>, including:

- NOAA Center for Operational Oceanographic Products and Services' Mean Annual SLR Trend Data
- USACE Climate Change Adaptation Sea Level Change Curves
- Globalchange.gov; which provides more information specific to New Jersey and New York



Source: NOAA - Sea Level Trends Data

Post-Resilience Damages and Losses (Project Effectiveness)

Remember that very few resilience projects are 100% effective at reducing all future damages and losses - nearly all projects have some residual risk/damages

Post-Resilience damages and losses will depend on the project type and the design level of effectiveness. **Refer to the HMCE Tool User Guide for details.**

<u>Project Effectiveness – Documentation Sources</u>

- Engineering or Technical Report – Good documentation source to indicate design level or effectiveness and estimate post-Resilience project damages service loss durations; provide complete copy of the report
- Detailed project scope with plans and specifications

Documentation Dos and Don'ts

Documentation DOs

1) DO provide all necessary supporting documentation for event damages, losses and RIs
2) DO provide complete technical support data
   - Best available hazard data
   - Recurrence interval estimates
   - Transit studies and engineering reports
3) DO Explain justification and provide documentation for data that supersedes standard or default values.
4) DO Organize the supporting data documentation using a list of file attachments identified in the HMCE Tool.

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Documentation Dos and Don'ts
(continued)

Documentation DON'Ts

1) DON'T forget to include explanation of any assumptions made
2) DON'T use unreliable or non-credible documentation sources
3) DON'T assume that the grant reviewer has access to all of the same date that the you do

Standard for Good Documentation:
Someone other than the original analyst can readily verify and re-create the data inputs and results in the HMCE Tool.

DFA Documentation Review – Project Costs

Acceptable Documentation	***Unacceptable*** Documentation
✓ Initial project costs that include pre-construction, construction and ancillary costs ✓ Maintenance costs estimated by transit agency ✓ Project costs based on local historic costs, current contractor bids, or published unit costs	✓ Hard construction costs that do not reflect pre-construction costs or contractual costs ✓ Lump sum estimates ✓ Old project cost estimates that have not been updated to reflect current conditions and costs

DFA Documentation Review – Event Damages

Acceptable Documentation

- ✓ Disaster Damage Worksheets such as FEMA *Project Worksheets*
- ✓ Insurance claims or damage repair records from the transit agency
- ✓ Damages estimated based on FEMA BCA or HAZUS-MH damage functions

Unacceptable Documentation

- ✓ Extrapolated damages
- ✓ Transit system maintenance costs not tied to damage events
- ✓ Newspaper articles that do not cite credible sources (i.e., other than homeowner accounts)

DFA Documentation Review – Event Service Losses

- For FEMA standard values for services, refer to FTA HMCE Tool and User Guide

Acceptable *Documentation*	***Unacceptable*** *Documentation*
✓ Transit agency records of average daily ridership	✓ Population/census data not correlated to transit service area
✓ Transit agency service losses for lines/systems to be addressed by the project	✓ Global ridership and service losses not connected to the specific project
✓ DOT traffic counts and detour time estimates with maps (passenger vehicles)	✓ "Ballpark" estimates of traffic counts/detour times without maps (passenger vehicles)

DFA Documentation Review – Event Recurrence Intervals (RIs)

Acceptable **Documentation**

- ✓ Copies of engineering/ technical expert reports
- ✓ RIs linked to documented FIS data and USGS stream gage data or NOAA data
- ✓ Using unknown event RI data with supporting documentation of Analysis Duration

Unacceptable **Documentation**

- ✓ Assuming all recurring damage events occur at the 1-year RI
- ✓ Extrapolated event RIs
- ✓ Using unknown event RI data with no supporting documentation of User Input Analysis Duration

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DFA Documentation Review – Post-Resilience Damages and Losses

- Remember most resilience projects do not eliminate all future damages and losses (except acquisition/relocation)

Acceptable Documentation	***Unacceptable*** Documentation
✓ Engineering or technical report ✓ A detailed project scope that clearly indicates the level of effectiveness ✓ Plans or specifications	✓ Assuming no post-Resilience damages or losses for non-acquisition projects ✓ Poorly-defined project scopes with no clear level of effectiveness

Case Study Demonstration

- Case Study Demonstration resilience project involves protection of a commuter railroad tunnel from the 500-year storm event.
- Case Study Demonstration will be reviewed in two parts:
  - **Part 1:** Expected Damages
  - **Part 2:** Historic Damages

NOTE: Case Study Demonstration materials provided to allow webinar and in-class participants the opportunity to gain some "hands-on" experience with the HMCE Tool

Case Study Demonstration, Part 1: Tab 2: Sections I and II

Section I - Applicant Information						
Applicant:	MCRTA					
Address Line 1:	1 Metro Plaza					
Address Line 2:						
City:	Metro City		Select State:	Select State	Zip:	
Phone 1:	555-704-1776	Ext:	Phone 2:		Ext:	

Section II - Project Information					
Project Name:	Metro River Westville Tunnel Entrance Flood Barriers				
Application Date:	01/21/14	Analyst:	Leslie Knope		Enter the date from the grant application and the name of the person conducting the analysis.
Analysis Year:	2014	Analysis Date:	1/21/2014		The Analysis Year is 2014. Enter the date the analysis was conducted.
Transit Mode(s) Protected by Project:	☐ Subway/Inner City Rail ☐ Bus ☑ Light/Commuter Rail ☐ Ferry ☐ Intercity Passenger Rail ☐ Other	If Transit Mode is "Other," please specify:			Select the mode or modes of transit that the proposed project is designed to protect against. The transit mode(s) need to be based on the current version of the grant application form from FTA.
Primary Hazard Protected by Project:	◉ Flood ○ Hurricane/Coastal Storm ○ Wind ○ Snow/Ice Storm				Select the one primary hazard that the proposed project is designed to protect against.
Secondary Hazard(s) Protected by Project:	☐ Flood ☑ Hurricane/Coastal Storm ☐ Wind ☐ Snow/Ice Storm				Select the secondary hazard or hazards that the proposed project is designed to protect against.
Brief Project Description:	Extend the tunnel entrance walls and expand upon the existing flood barrier system				In this section, describe the primary and secondary hazards the system has faced and is likely to face in the future, and what is being proposed to reduce the damages in the future and increase the sustainability of the transit system against the primary hazard.

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

Ready 100%

Tab 2: Section III

Section III - Cost Information		
Total Project Initial Cost:	$ 10,000,000	Total Project Cost from grant application. This includes initial cost of project study and design and contractual and construction costs.
Source/Documentation of Total Cost Estimate:	Engineering Study	
Project Useful Life (Years):	50	Enter the Standard Useful Life of proposed improvements.
Remaining Useful Life of Assets to be Protected (Years):	25	Enter the estimated remaining useful life of assets to be protected. This is an optional entry and is not used in tool calculations.
Annual Project Operation & Maintenance (O&M) Cost:	$ 500,000	Enter the Average Annual Cost associated with Operation and Maintenance (O&M) of the proposed project (improvements) in comparison to current asset O&M costs. Enter a positive number if this project results in an increase in overall annual O&M cost of the facility; enter zero if there will be no change in the O&M of the facility; or enter a negative number (the difference between current and future O&M costs) if this project would decrease the overall annual O&M cost of the facility.
Source/Documentation of Annual O&M Cost:	Engineering Study	
Discount Rate (%):	7.00	The default value of 7% as set by the Office of Management and Budget (OMB) is pre-populated in the tool. Use of a different value needs to be fully documented. Enter Discount Rate as a percent (e.g. enter 7 for 7%).
Present Value Coefficient:	13.80	
Present Value of Annual O&M Costs:	$ 6,900,373	

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

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Tab 2: Section IV

Section IV - Cost Associated with Interruption in Transit Services during Project Construction/Implementation		Notes
		Enter costs due to project construction resulting in temporary loss of transit services leading to delay or additional travel times for passengers in the transit mode(s) directly impacted by project construction/ implementation as well as impacts on alternate transit modes in this section. Leave this section blank if this cost does not apply to your project. If construction will halt the services for a few hours each day and/or it reduces services (no complete loss of services), enter the data for the affected reduced portion of service loss.
Cost of Loss of Services for Transit Passengers ($/Passenger/Hour):	$ 15.580	The default value per unit of services is $15.58/passenger/hour for all transit modes (all rail, ferries, and buses) and is pre-populated in the tool. To use a different regional value requires documentation of the selected value.
Current Federal Mileage Rate ($/Mile):	$ 0.560	The federal mileage rate is pre-set to $0.56 effective 1/1/2014. The current federal mileage rate may be looked up on the GSA website: www.gsa.gov/portal/content/100715.
Duration of Loss or Reduction of Services (Days):	0.00	
Impacts Due to Delay and/or Extra Travel Time for Transit Mode Under Project Construction		
Delay or Extra Travel Time (Hours):	0.00	If the transit line under project construction has an alternate route that could be used to reach their ultimate destination, then the delay time should reflect only the additional detour time it takes to the destination. Or, if the transit line under construction needs to travel at a reduced speed under hazardous conditions, then use the delay time to reflect the extra travel time. If an alternative mode of transit is available, then investigate alternate transit modes as shown below; otherwise, use one half day (12.0 hours) to reflect loss of services associated with the one-way trip loss.
Average Daily Number of Passengers:	0.00	For average daily number of transit service passengers, enter the average daily number of passengers carried one-way by the affected transit line.
Loss of Transit Services Cost:	$ -	
Impacts Due to Delay and/or Extra Travel Time and Miles for Alternate Transit Modes		
Additional Time per One-way Trip (Hours):	0.00	If the transit line under project construction requires the use of alternate transit modes for passengers to reach their ultimate destination, then input the information here.
Additional Travel Miles:	0.00	
Alternate Transit Mode (Rail, Ferry, Buses)	**Other Alternate Transit Mode (Vehicles)**	
Number of One-way Traffic Trips per Day: 0.00	Number of One-way Traffic Trips per Day:	

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

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Tab 2: Section IV (continued)

Impacts Due to Delay and/or Extra Travel Time for Transit Mode Under Project Construction					
Delay or Extra Travel Time (Hours):	0.00				If the transit line under project construction has an alternate route that could be used to reach their ultimate destination, then the delay time should reflect only the additional detour time it takes to the destination. Or, if the transit line under construction needs to travel at a reduced speed under hazardous conditions, then use the delay time to reflect the extra travel time. If an alternative mode of transit is available, then investigate alternate transit modes as shown below; otherwise, use one half day (12.0 hours) to reflect loss of services associated with the one-way trip loss.
Average Daily Number of Passengers:	0.00				For average daily number of transit service passengers, enter the average daily number of passengers carried one-way by the affected transit line.
Loss of Transit Services Cost:	$ -				
Impacts Due to Delay and/or Extra Travel Time and Miles for Alternate Transit Modes					
Additional Time per One-way Trip (Hours):	0.00				If the transit line under project construction requires the use of alternate transit modes for passengers to reach their ultimate destination, then input the information here.
Additional Travel Miles:	0.00				
Alternate Transit Mode (Rail, Ferry, Buses)		**Other Alternate Transit Mode (Vehicles)**			
Number of One-way Traffic Trips per Day (Rail/Ferry/Buses):	0.00	Number of One-way Traffic Trips per Day (Vehicles):			
Average Number of Passengers per Trip:	0.00	Average Number of Passengers per Vehicle:	1.67		The default national average is 1.67 passengers per passenger vehicle is pre-populated in the tool based on current national study data. To use a different regional value requires documentation of the selected value.
Loss of Services Cost (Rail/Ferry/Buses):	$ -	Loss of Services Cost (Vehicles):			
Total Cost due to Interruption of Services:	$ -				
Total BCA Project Costs:	Total Project Cost including O&M and Interruption of Services Loss:		$ 16,900,373		This is the cost to be used in evaluation of the Benefit-Cost Ratio (BCR).

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

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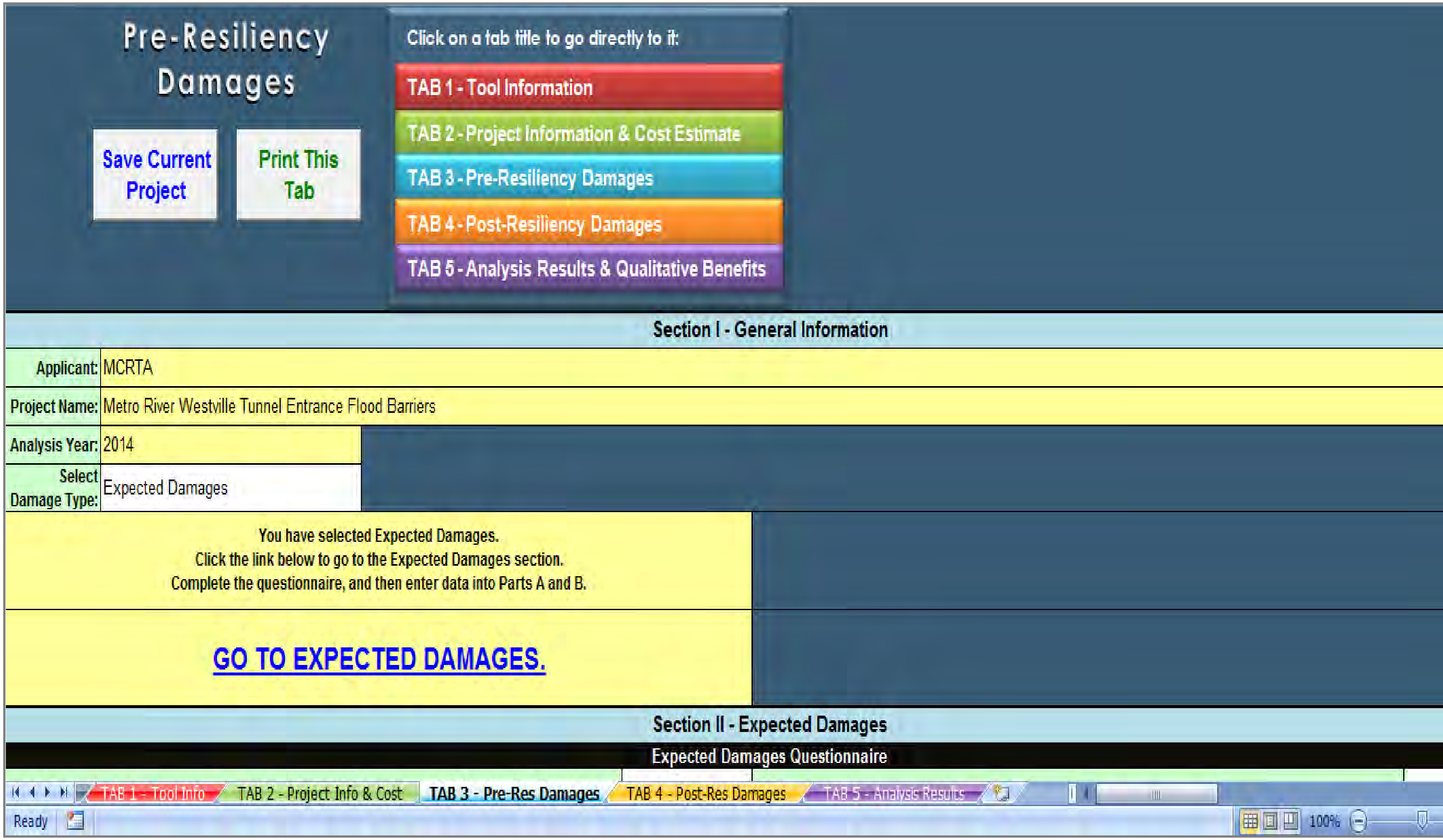
Tab 3: Section I



Tab 3: Section II

Section II - Expected Damages			
Expected Damages Questionnaire			
How many documented expected damage events do you have? (This may include Hurricane Sandy or some other large, catastrophic event.)	3	For how many of these expected damage events do you know the Recurrence Intervals (RIs)?	
Errors: (must be corrected to proceed with analysis)			
Warnings: (must be addressed to conduct a valid analysis)			
Conclusions: (provide directions on analysis approach based on completed questionnaire)	A valid analysis may be conducted using two or more damage events of known RIs.		
Source/Documentation of Expected Damages:	H&H Study		
Expected Damages Part A			
	Physical Damages Costs	Response and Recovery Costs	Other Damage Costs (enter description of other damages below)

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

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Tab 3: Expected Damages, Part A

Expected Damages Part A												
	Physical Damages Costs				Response and Recovery Costs				Other Damage Costs			
	(includes permanent repairs to damaged fixed structures and rolling stock)				(includes costs of emergency protective measures and temporary repairs or measures that can be avoided by the proposed project)				(enter description of other damages below)			
Recurrence Interval (Years)	Physical Damage Costs for Fixed Structures ($)	Physical Damage Costs for Rolling Stock ($)	Base Year for Physical Damages Estimation (4-digit Year)	Physical Damages (Inflated to Analysis Year)	Response and Recovery Costs ($)	Base Year for Response and Recovery Estimation (4-digit Year)	Response and Recovery (Inflated to Analysis Year)	Other Damage Costs ($)	Base Year for Other Damages Estimation (4-digit Year)	Other Damages (Inflated to Analysis Year)		
50.00	$ 1,000,000	$ 250,000	2014	$ 1,250,000	$ 100,000	2014	$ 100,000	$ -	2014	$ -		
100.00	$ 5,000,000	$ 3,000,000	2014	$ 8,000,000	$ 100,000	2014	$ 100,000	$ -	2014	$ -		
500.00	$ 30,000,000	$ 5,000,000	2014	$ 35,000,000	$ 500,000	2014	$ 500,000	$ -	2014	$ -		

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

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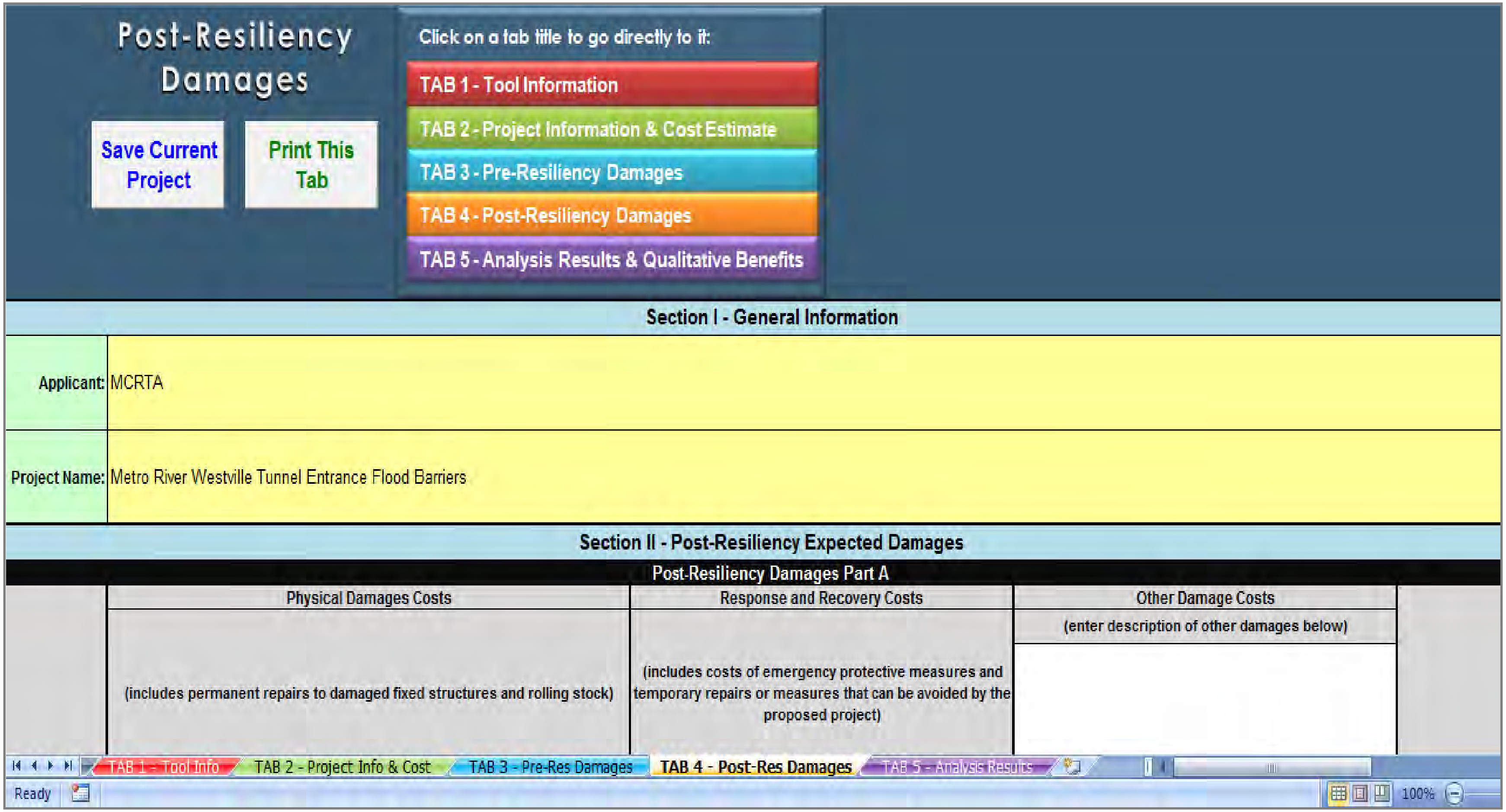
Tab 3: Expected Damages, Part B

Expected Damages Part B										
Cost of Loss of Transit Services for Passengers ($/Passenger/Hour):	$ 15.580									
Current Federal Mileage Rate ($/Mile):	$ 0.560									
	Damages Due to Delay and/or Extra Travel Time for Passengers in Rail or Ferry Services				Damages Due to Delay and/or Extra Travel Time and Miles for Passengers in Buses					
Recurrence Interval (Years)	Delay or Extra Travel Time (Hours)	Average Daily Number of Passengers	Duration of Loss or Reduction of Rail or Ferry Services (Days)	Loss of Services Damages (Rail or Ferry)	Additional Time per One-way Trip (Hours)	Additional Travel Miles	Duration of Loss or Reduction of Services (Days)	Number of One-way Traffic Trips Per Day (Buses)	Average Number of Passengers per Bus	Loss of Services Damages (Buses)
50.00	2.00	500000.00	1.00	$ 15,580,000	0.00	0.00	0.00	0.00	0.00	$ -
100.00	2.00	500000.00	3.00	$ 46,740,000	0.00	0.00	0.00	0.00	0.00	$ -
500.00	2.00	500000.00	10.00	$ 155,800,000	0.00	0.00	0.00	0.00	0.00	$ -
Overall Expected Damages to be Used in BCR Calculation										

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

Ready 100%

Tab 4: Section I



Tab 4: Post-Resilience Damages, Part A

Section II - Post-Resiliency Expected Damages										
Post-Resiliency Damages Part A										
	Physical Damages Costs				Response and Recovery Costs			Other Damage Costs		
	(includes permanent repairs to damaged fixed structures and rolling stock)				(includes costs of emergency protective measures and temporary repairs or measures that can be avoided by the proposed project)			(enter description of other damages below)		
Recurrence Interval (Years)	Physical Damage Costs for Fixed Structures ($)	Physical Damage Costs for Rolling Stock ($)	Base Year for Physical Damages Estimation (4-digit Year)	Physical Damages (Inflated to Analysis Year)	Response and Recovery Costs ($)	Base Year for Response and Recovery Estimation (4-digit Year)	Response and Recovery (Inflated to Analysis Year)	Other Damage Costs ($)	Base Year for Other Damages Estimation (4-digit Year)	Other Damages (Inflated to Analysis Year)
500.00	$ 30,000,000	$ 5,000,000	2014	$ 35,000,000	$ 500,000	2014	$ 500,000	$ -	2014	$ -

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

Ready

Tab 4: Post-Resilience Damages, Part B

Post-Resiliency Damages Part B

Cost of Loss of Transit Services for Passengers ($/Passenger/Hour):	$ 15.580
Current Federal Mileage Rate ($/Mile):	$ 0.560

	Damages Due to Delay and/or Extra Travel Time for Passengers in Rail or Ferry Services				Damages Due to Delay and/or Extra Travel Time and Miles for Passengers in Buses						
Recurrence Interval (Years)	Delay or Extra Travel Time (Hours)	Average Daily Number of Passengers	Duration of Loss or Reduction of Rail or Ferry Services (Days)	Loss of Services Damages (Rail or Ferry)	Additional Time per One-way Trip (Hours)	Additional Travel Miles	Duration of Loss or Reduction of Services (Days)	Number of One-way Traffic Trips Per Day (Buses)	Average Number of Passengers per Bus	Loss of Services Damages (Buses)	Total Part B Damages
500.00	2.00	500000.00	10.00	$ 155,800,000	0.00	0.00	0.00	0.00	0.00	$ -	$ 155,800,000

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

Ready 100%

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Tab 5: Analysis Results

Analysis Results & Qualitative Benefits

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Click on a tab title to go directly to it:

- TAB 1 - Tool Information
- TAB 2 - Project Information & Cost Estimate
- TAB 3 - Pre-Resiliency Damages
- TAB 4 - Post-Resiliency Damages
- TAB 5 - Analysis Results & Qualitative Benefits

Section IV - Final Results of BCA			
Reduction in Annual Damages:	$	1,124,104	
Total Project Benefits:	$	15,513,471	
Total BCA Project Costs:	$	16,900,373	
Benefits Minus Costs:	$	(1,386,902)	
Benefit-Cost Ratio (BCR):		0.92	BCR is NOT greater than 1.0; although the project is not considered cost-effective based on the quantitative information provided, it may be cost-effective based on a review of the qualitative information provided.

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Case Study Demonstration, Part 2: Tab 2: Sections I and II

Section I - Applicant Information		
Applicant:	MCRTA	
Address Line 1:	1 Metro Plaza	
Address Line 2:		
City:	Metro City; Select State: Select State; Zip:	
Phone 1:	555-704-1776; Ext: ; Phone 2: ; Ext:	
Section II - Project Information		
Project Name:	Metro River Westville Tunnel Entrance Flood Barriers	
Application Date:	01/21/14; Analyst: Leslie Knope	Enter the date from the grant application and the name of the person conducting the analysis.
Analysis Year:	2014; Analysis Date: 1/21/2014	The Analysis Year is 2014. Enter the date the analysis was conducted.
Transit Mode(s) Protected by Project:	☐ Subway/Inner City Rail ☐ Bus ☑ Light/Commuter Rail ☐ Ferry ☐ Intercity Passenger Rail ☐ Other; If Transit Mode is "Other," please specify:	Select the mode or modes of transit that the proposed project is designed to protect against. The tra mode(s) need to be based on the current version of the grant application form from FTA.
Primary Hazard Protected by Project:	◉ Flood ○ Hurricane/Coastal Storm ○ Wind ○ Snow/Ice Storm	Select the one primary hazard that the proposed project is designed to protect against.
Secondary Hazard(s) Protected by Project:	☐ Flood ☑ Hurricane/Coastal Storm ☐ Wind ☐ Snow/Ice Storm	Select the secondary hazard or hazards that the proposed project is designed to protect against.
Brief Project Description:	Extend the tunnel entrance walls and expand upon the existing flood barrier system	In this section, describe the primary and secondary hazards the system has faced and is likely to fac future, and what is being proposed to reduce the damages in the future and increase the sustainabi transit system against the primary hazard.

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

Ready 100%

Tab 2: Section III

Section III - Cost Information		
Total Project Initial Cost:	$ 10,000,000	Total Project Cost from grant application. This includes initial cost of project study and design and contractual and construction costs.
Source/Documentation of Total Cost Estimate:	Engineering Study	
Project Useful Life (Years):	50	Enter the Standard Useful Life of proposed improvements.
Remaining Useful Life of Assets to be Protected (Years):	25	Enter the estimated remaining useful life of assets to be protected. This is an optional entry and is in tool calculations.
Annual Project Operation & Maintenance (O&M) Cost:	$ 500,000	Enter the Average Annual Cost associated with Operation and Maintenance (O&M) of the proposed (improvements) in comparison to current asset O&M costs. Enter a positive number if this project r an increase in overall annual O&M cost of the facility; enter zero if there will be no change in the O the facility; or enter a negative number (the difference between current and future O&M costs) if th would decrease the overall annual O&M cost of the facility.
Source/Documentation of Annual O&M Cost:	Engineering Study	
Discount Rate (%):	7.00	The default value of 7% as set by the Office of Management and Budget (OMB) is pre-populated in t Use of a different value needs to be fully documented. Enter Discount Rate as a percent (e.g. enter
Present Value Coefficient:	13.80	
Present Value of Annual O&M Costs:	$ 6,900,373	

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

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Tab 2: Section IV

Section IV - Cost Associated with Interruption in Transit Services during Project Construction/Implementation		Notes
		Enter costs due to project construction resulting in temporary loss of transit services leading to dela additional travel times for passengers in the transit mode(s) directly impacted by project constructi implementation as well as impacts on alternate transit modes in this section. Leave this section bla cost does not apply to your project. If construction will halt the services for a few hours each day and reduces services (no complete loss of services), enter the data for the affected reduced portion of se loss.
Cost of Loss of Services for Transit Passengers ($/Passenger/Hour):	$ 15.580	The default value per unit of services is $15.58/passenger/hour for all transit modes (all rail, ferries, buses) and is pre-populated in the tool. To use a different regional value requires documentation of selected value.
Current Federal Mileage Rate ($/Mile):	$ 0.560	The federal mileage rate is pre-set to $0.56 effective 1/1/2014. The current federal mileage rate ma looked up on the GSA website: www.gsa.gov/portal/content/100715.
Duration of Loss or Reduction of Services (Days):	0.00	
Impacts Due to Delay and/or Extra Travel Time for Transit Mode Under Project Construction		
Delay or Extra Travel Time (Hours):	0.00	If the transit line under project construction has an alternate route that could be used to reach their destination, then the delay time should reflect only the additional detour time it takes to the destina if the transit line under construction needs to travel at a reduced speed under hazardous conditions, the delay time to reflect the extra travel time. If an alternative mode of transit is available, then in alternate transit modes as shown below; otherwise, use one half day (12.0 hours) to reflect loss of s associated with the one-way trip loss.
Average Daily Number of Passengers:	0.00	For average daily number of transit service passengers, enter the average daily number of passenge carried one-way by the affected transit line.
Loss of Transit Services Cost:	$ -	
Impacts Due to Delay and/or Extra Travel Time and Miles for Alternate Transit Modes		
Additional Time per One-way Trip (Hours):	0.00	If the transit line under project construction requires the use of alternate transit modes for passeng reach their ultimate destination, then input the information here.
Additional Travel Miles:	0.00	

Alternate Transit Mode (Rail, Ferry, Buses)		Other Alternate Transit Mode (Vehicles)	
Number of One-way Traffic Trips per Day	0.00	Number of One-way Traffic Trips per Day	

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

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Tab 2: Section IV (continued)

Impacts Due to Delay and/or Extra Travel Time for Transit Mode Under Project Construction		
Delay or Extra Travel Time (Hours):	0.00	If the transit line under project construction has an alternate route that could be used to reach their ultimate destination, then the delay time should reflect only the additional detour time it takes to the destination. Or, if the transit line under construction needs to travel at a reduced speed under hazardous conditions, then use the delay time to reflect the extra travel time. If an alternative mode of transit is available, then investigate alternate transit modes as shown below; otherwise, use one half day (12.0 hours) to reflect loss of services associated with the one-way trip loss.
Average Daily Number of Passengers:	0.00	For average daily number of transit service passengers, enter the average daily number of passengers carried one-way by the affected transit line.
Loss of Transit Services Cost:	$ -	

Impacts Due to Delay and/or Extra Travel Time and Miles for Alternate Transit Modes		
Additional Time per One-way Trip (Hours):	0.00	If the transit line under project construction requires the use of alternate transit modes for passengers to reach their ultimate destination, then input the information here.
Additional Travel Miles:	0.00	

Alternate Transit Mode (Rail, Ferry, Buses)		Other Alternate Transit Mode (Vehicles)		
Number of One-way Traffic Trips per Day (Rail/Ferry/Buses):	0.00	Number of One-way Traffic Trips per Day (Vehicles):		
Average Number of Passengers per Trip:	0.00	Average Number of Passengers per Vehicle:	1.67	The default national average is 1.67 passengers per passenger vehicle is pre-populated in the tool based on current national study data. To use a different regional value requires documentation of the selected value.
Loss of Services Cost (Rail/Ferry/Buses):	$ -	Loss of Services Cost (Vehicles):		

Total Cost due to Interruption of Services:	$ -	
Total BCA Project Costs: Total Project Cost including O&M and Interruption of Services Loss:	$ 16,900,373	This is the cost to be used in evaluation of the Benefit-Cost Ratio (BCR).

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

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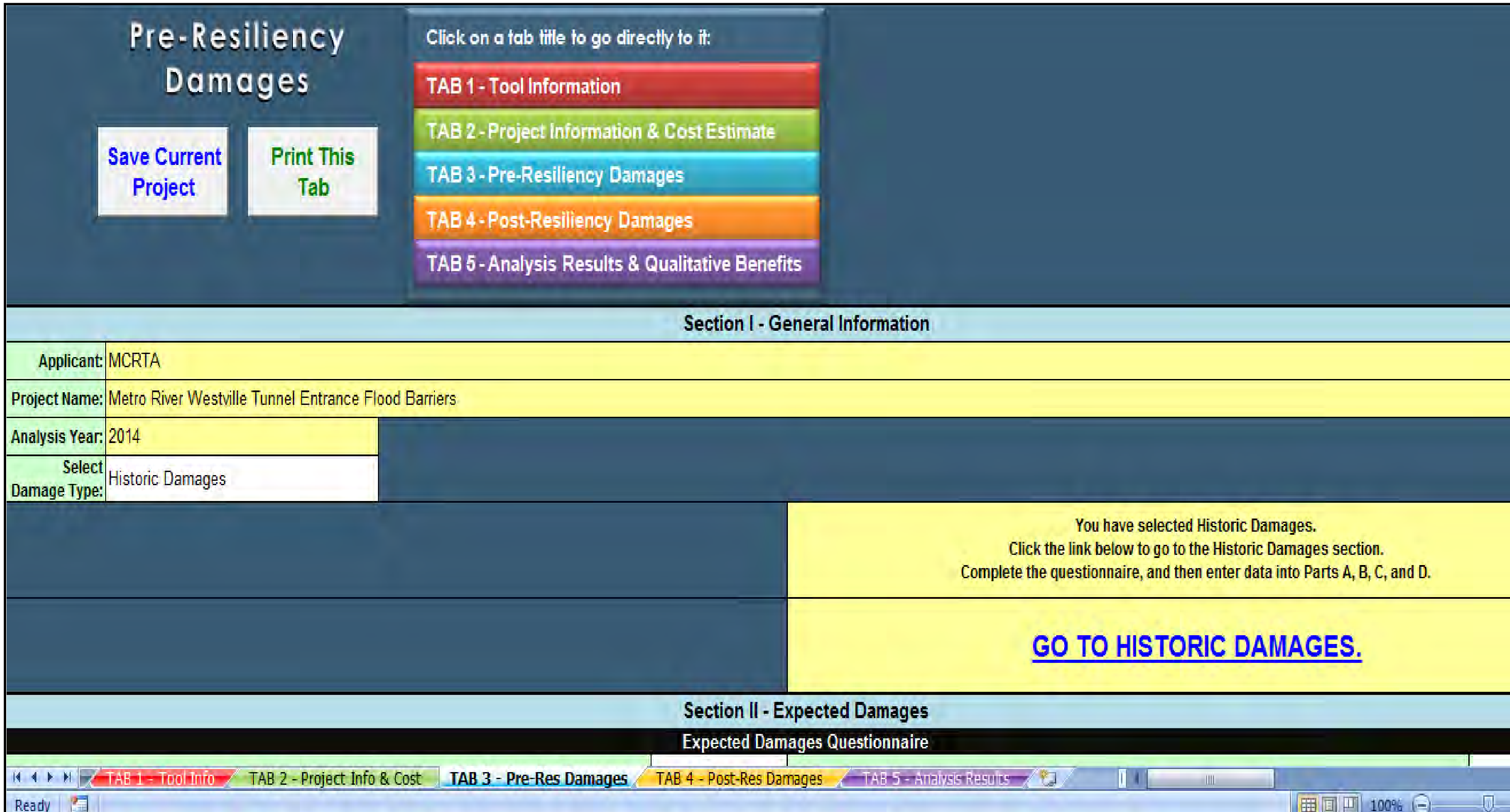
Tab 3: Section I



Tab 3: Section III

Section III - Historic Damages	
Analysis Year :	2014
Year Built (4-digit Year):	1953
Analysis Duration (Years):	62
User Input Analysis Duration (Years):	
Selected Analysis Duration (Years):	62

Historic Damages Questionnaire

How many documented historic damage events do you have? (This may include Hurricane Sandy or some other large, catastrophic event.)	3	For how many of these historic damage events do you know the Recurrence Intervals (RIs)?	1

Errors: (must be corrected to proceed with analysis)	
Warnings: (must be addressed to conduct a valid analysis)	The known RI event must have the highest Total Historic Damages to conduct a valid analysis!
Conclusions: (provide directions on analysis approach based on completed questionnaire)	Two historic events of unknown RIs and one historic event of known RI (see WARNING) is sufficient to conduct a valid analysis.
	MCRTA Records

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

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Tab 3: Historic Damages, Part A (Unknown Recurrence Interval)

Historic Damages Part A (Unknown Recurrence Interval)										
	Physical Damages Costs (includes permanent repairs to damaged fixed structures and rolling stock)				Response and Recovery Costs (includes costs of emergency protective measures and temporary repairs or measures that can be avoided by the proposed project)			Other Damage Costs (enter description of other damages below)		
Event Year (4-digit Year)	Physical Damage Costs for Fixed Structures ($)	Physical Damage Costs for Rolling Stock ($)	Base Year for Physical Damages Estimation (4-digit Year)	Physical Damages (Inflated to Analysis Year)	Response and Recovery Costs ($)	Base Year for Response and Recovery Estimation (4-digit Year)	Response and Recovery (Inflated to Analysis Year)	Other Damage Costs ($)	Base Year for Other Damages Estimation (4-digit Year)	Other Damages (Inflated to Analysis Year)
1965	$ 1,000,000	$ 250,000	1965	$ 12,784,619	$ 100,000	1965	$ 1,022,769	$ -	1965	$ -
2002	$ 2,500,000	$ 1,000,000	2002	$ 5,316,430	$ 100,000	2002	$ 151,898	$ -	2002	$ -

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

Ready 100%

Tab 3: Historic Damages, Part B (Unknown Recurrence Interval)

Historic Damages Part B (Unknown Recurrence Interval)										
Cost of Loss of Transit Services for Passengers ($/Passenger/Hour):	$ 15.580									
Current Federal Mileage Rate ($/Mile):	$ 0.560									
	Damages Due to Delay and/or Extra Travel Time for Passengers in Rail or Ferry Services				Damages Due to Delay and/or Extra Travel Time and Miles for Passengers in Buses					
Event Year (4-digit Year)	Delay or Extra Travel Time (Hours)	Average Daily Number of Passengers	Duration of Loss or Reduction of Rail or Ferry Services (Days)	Loss of Services Damages (Rail or Ferry)	Additional Time per One-way Trip (Hours)	Additional Travel Miles	Duration of Loss or Reduction of Services (Days)	Number of One-way Traffic Trips Per Day (Buses)	Average Number of Passengers per Bus	Loss of Services Damages (Buses)
1965	2.00	300000.00	1.00	$ 9,348,000	0.00	0.00	0.00	0.00	0.00	$ -
2002	2.00	500000.00	3.00	$ 46,740,000	0.00	0.00	0.00	0.00	0.00	$ -
Overall Historic Damages to be Used in BCR Calculation (Not Including Catastrophic Events to be Entered in Parts C and D)										

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

Ready 100%

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Tab 3: Historic Damages, Part C (Known Recurrence Interval)

Historic Damages Part C (Known Recurrence Interval)												
		Physical Damages Costs (includes permanent repairs to damaged fixed structures and rolling stock)				Response and Recovery Costs (includes costs of emergency protective measures and temporary repairs or measures that can be avoided by the proposed project)			Other Damage Costs (enter description of other damages belo			
Damage Year (4-digit Year)	Known Recurrence Interval (Years)	Physical Damage Costs for Fixed Structures ($)	Physical Damage Costs for Rolling Stock ($)	Base Year for Physical Damages Estimation (4-digit Year)	Physical Damages (Inflated to Current Year)	Response and Recovery Costs that can be Avoided by Proposed Measures ($)	Base Year for Response and Recovery Estimation (4-digit Year)	Response and Recovery (Inflated to Current Year)	Other Damage Costs ($)	Base Year for Other Damages Estimation (4-digit Year)	Other (Inflate
2012	400.00	$ 35,000,000	$ 1,000,000	2012	$ 37,984,467	$ 500,000	2012	$ 527,562	$ -	2012	$

Historic Damages Part D (Known Recurrence Interval)	
Cost of Loss of Transit Services for Passengers ($/Passenger/Hour):	$ 15.580
Current Federal Mileage Rate ($/Mile):	$ 0.560

		Damages Due to Delay and/or Extra Travel Time for Passengers in Rail or Ferry Services				Damages Due to Delay and/or Extra Travel Time and Miles for Passengers in Buses					
Damage Year (4-digit Year)	Known Recurrence Interval (Years)	Delay or Extra Travel Time (Hours)	Average Daily Number of Passengers	Duration of Loss or Reduction of Rail or Ferry Services (Days)	Loss of Services Damages (Rail or Ferry)	Additional Time per One-way Trip (Hours)	Additional Travel Miles	Duration of Loss or Reduction of Services (Days)	Number of One-way Traffic Trips Per Day (Buses)	Average Number of Passengers per Bus	Loss c Damag
2012	400.00	2.00	600000.00	10.00	$ 155,800,000	0.00	0.00	0.00	0.00	0.00	$

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

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Tab 3: Historic Damages, Part C (Known Recurrence Interval)

Historic Damages Part D (Known Recurrence Interval)

Cost of Loss of Transit Services for Passengers ($/Passenger/Hour):	$ 15.580
Current Federal Mileage Rate ($/Mile):	$ 0.560

		Damages Due to Delay and/or Extra Travel Time for Passengers in Rail or Ferry Services				Damages Due to Delay and/or Extra Travel Time and Miles for Passengers in Buses					
Damage Year (4-digit Year)	Known Recurrence Interval (Years)	Delay or Extra Travel Time (Hours)	Average Daily Number of Passengers	Duration of Loss or Reduction of Rail or Ferry Services (Days)	Loss of Services Damages (Rail or Ferry)	Additional Time per One-way Trip (Hours)	Additional Travel Miles	Duration of Loss or Reduction of Services (Days)	Number of One-way Traffic Trips Per Day (Buses)	Average Number of Passengers per Bus	Loss of S Damages
2012	400.00	2.00	500000.00	10.00	$ 155,800,000	0.00	0.00	0.00	0.00	0.00	$

Historic Damages Totals (Known Recurrence Interval)

Damage Year (4-digit Year)	Known Recurrence Interval (Years)	Total Part C Damages	Total Part D Damages	Total Historic Damages (Inflated to Analysis Year)	Error Check:
2012	400.00	$ 38,512,029	$ 155,800,000	$ 194,312,029	

Overall Historic Damages to be Used in BCR Calculation

Recurrence Interval (Years)	Total Historic Damages	Error Check:
36.00	$ 23,155,388	
85.00	$ 52,208,328	
400.00	$ 194,312,029	

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

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Tab 4: Post-Resilience Damages, Part A

Section II - Post-Resiliency Expected Damages												
Post-Resiliency Damages Part A												
	Physical Damages Costs				Response and Recovery Costs			Other Damage Costs				
	(includes permanent repairs to damaged fixed structures and rolling stock)				(includes costs of emergency protective measures and temporary repairs or measures that can be avoided by the proposed project)			(enter description of other damages below)				
Recurrence Interval (Years)	Physical Damage Costs for Fixed Structures ($)	Physical Damage Costs for Rolling Stock ($)	Base Year for Physical Damages Estimation (4-digit Year)	Physical Damages (Inflated to Analysis Year)	Response and Recovery Costs ($)	Base Year for Response and Recovery Estimation (4-digit Year)	Response and Recovery (Inflated to Analysis Year)	Other Damage Costs ($)	Base Year for Other Damages Estimation (4-digit Year)	Other Damages (Inflated to Analysis Year)	Total Part A Damages	
500.00	$ 35,000,000	$ 1,000,000	2012	$ 37,984,467	$ 500,000	2012	$ 527,562	$ -	2012	$ -	$ 38,512,029	

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

Ready 100%

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Tab 4: Post-Resilience Damages, Part B

Post-Resiliency Damages Part B

Cost of Loss of Transit Services for Passengers ($/Passenger/Hour):	$ 15.580
Current Federal Mileage Rate ($/Mile):	$ 0.560

	Damages Due to Delay and/or Extra Travel Time for Passengers in Rail or Ferry Services				Damages Due to Delay and/or Extra Travel Time and Miles for Passengers in Buses						
Recurrence Interval (Years)	Delay or Extra Travel Time (Hours)	Average Daily Number of Passengers	Duration of Loss or Reduction of Rail or Ferry Services (Days)	Loss of Services Damages (Rail or Ferry)	Additional Time per One-way Trip (Hours)	Additional Travel Miles	Duration of Loss or Reduction of Services (Days)	Number of One-way Traffic Trips Per Day (Buses)	Average Number of Passengers per Bus	Loss of Services Damages (Buses)	Total Part B Damages
500.00	2.00	500000.00	10.00	$ 155,800,000	0.00	0.00	0.00	0.00	0.00	$ -	$ 155,800,000

TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages | TAB 5 - Analysis Results

Ready 100%

Tab 5: Analysis Results

Analysis Results & Qualitative Benefits

Save Current Project | Print This Tab | Print Tabs 2 - 5

Click on a tab title to go directly to it:

- TAB 1 - Tool Information
- TAB 2 - Project Information & Cost Estimate
- TAB 3 - Pre-Resiliency Damages
- TAB 4 - Post-Resiliency Damages
- TAB 5 - Analysis Results & Qualitative Benefits

Present Value of Annual Damages:	$ 27,266,040	Present Value of Annual Damages:	$ 5,363,302

*Pre-Resiliency Damages are based on Historic Damages.

Section IV - Final Results of BCA

Reduction in Annual Damages:	$ 1,587,069	
Total Project Benefits:	$ 21,902,738	
Total BCA Project Costs:	$ 16,900,373	
Benefits Minus Costs:	$ 5,002,365	
Benefit-Cost Ratio (BCR):	1.30	BCR is greater than 1.0; the project is cost-effective based on the quantitative information provided.

Review of Unit Objectives

1) Understand documentation requirements for use of the FTA HMCE tool.
2) Understand the key inputs of the tool.
3) Identify the sources of documentation necessary to support key inputs.
4) Provide examples of “acceptable” and “unacceptable” documentation.
5) Successfully complete a FTA HMCE Tool BCA using a case study demonstration.

Course Conclusion - Purpose

The purpose of the course was to provide participants with an understanding of the Hazard Mitigation Cost Effectiveness (HMCE) methodology and tools necessary to assess the cost effectiveness of transit resilience projects for Competitive Resilience awards submitted under the FTA Public Transportation Emergency Relief Program.

Course Conclusion – Objectives

The course was intended to assist grantees with…

1) Estimating resilience project costs.
2) Computing resilience project benefits.
3) Understanding how to use FTA's HMCE Tool.
4) Identifying, gathering, and analyzing documentation required in the FTA Competitive Resilience grant application process.
5) Determining the benefit-cost ratio for a hypothetical resilience project using the FTA HMCE Tool.

Questions and Answers