FTA

FEDERAL TRANSIT ADMINISTRATION

Unit 3: Overview of the HMCE Tool

Hazard Mitigation Cost Effectiveness Analysis Course

January 2014

U.S. Department of Transportation
Federal Transit Administration

Unit Objectives

1) Understand how to use the FTA HMCE BCA Tool
2) Review tool data entry highlights
3) Discuss other hazards and how to find other hazard-specific data
4) Identify the data necessary to complete a successful BCA

Overview of the HMCE Tool

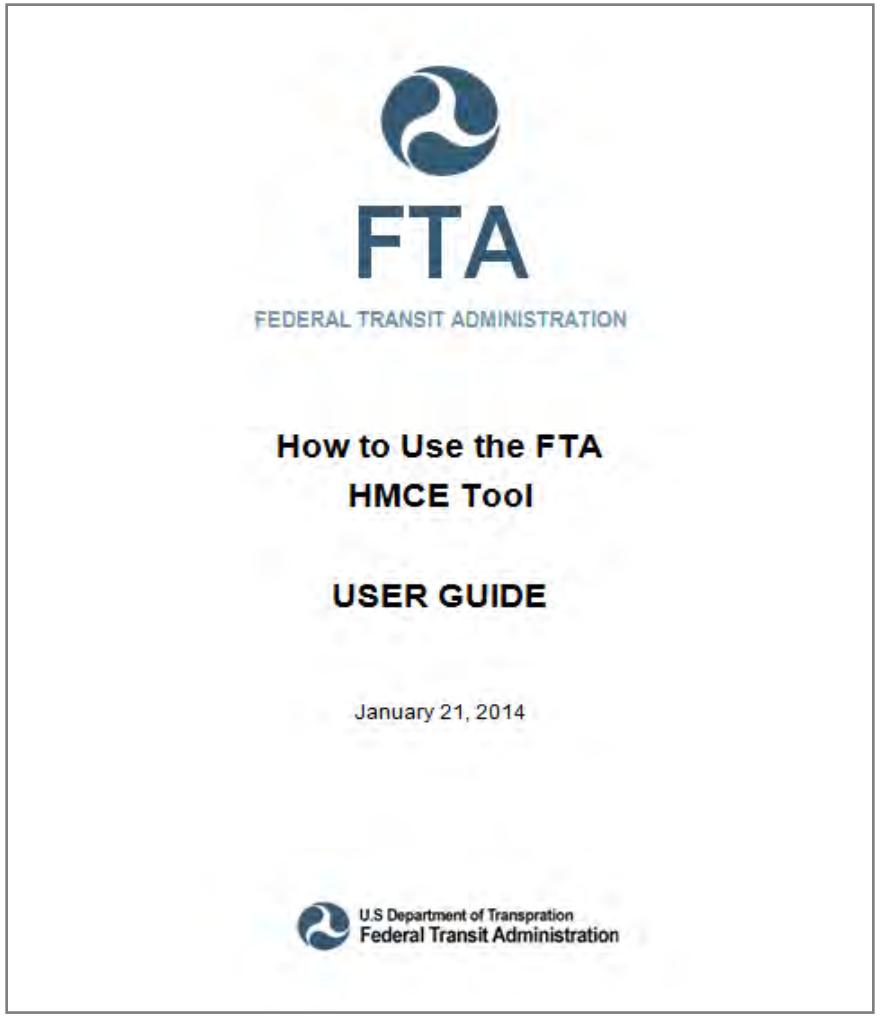
- The FTA Hazard Mitigation Cost Effectiveness Tool (HMCE Tool) is designed assess the potential cost-effectiveness of transit resilience project grant proposals.
- The HMCE Tool estimates resilience project costs and benefits in the same manner as FEMA's Benefit-Cost Analysis (BCA) software for evaluating hazard mitigation project grant proposals.
- The HMCE Tool may be run, saved and printed as a Microsoft Excel® macro-enabled workbook (.xlsm) or as an executable file (.exe), depending on which version you use.

Overview of the HMCE Tool
(continued)

- The HMCE Tool is divided into the following sections:
  - Introduction
  - TAB 1 - Tool Information
  - **TAB 2 – Project Information & Cost Estimate**
  - **TAB 3 – Pre-Resilience Damages**
  - **TAB 4 – Post-Resilience Damages**
  - TAB 5 – Benefit-Cost Analysis Results and Qualitative Benefits

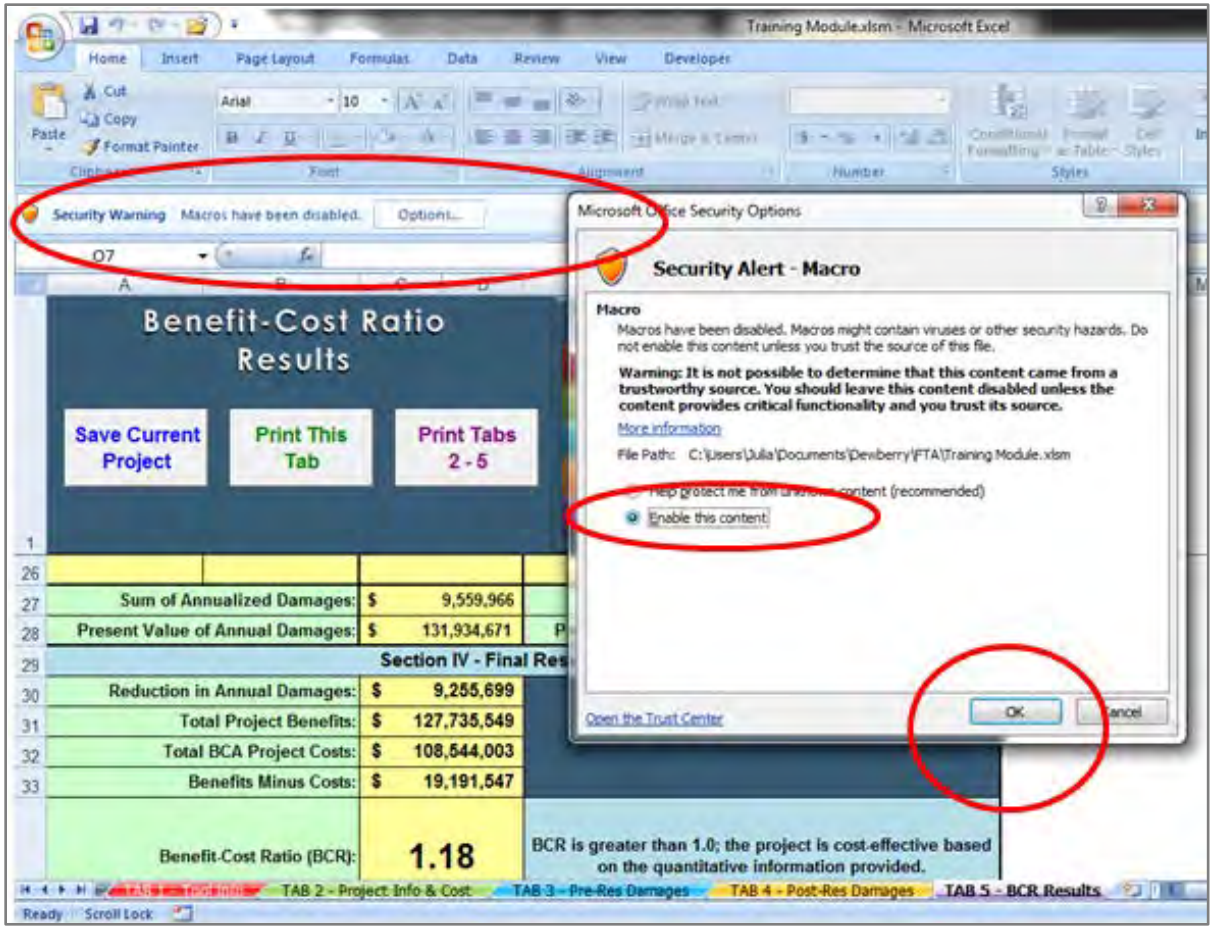
HMCE Tool User Guide

- Provides general information on tool navigation, saving and printing
- Features screen captures with specific information on each of the tool sections:
  - Actions/Inputs
  - Notes and Tips
- Includes appendices with summary guidance on Project Useful Life, Asset Useful Life, and Hurricane Sandy Flood Recurrence Intervals



Getting Started in the Tool - Macros

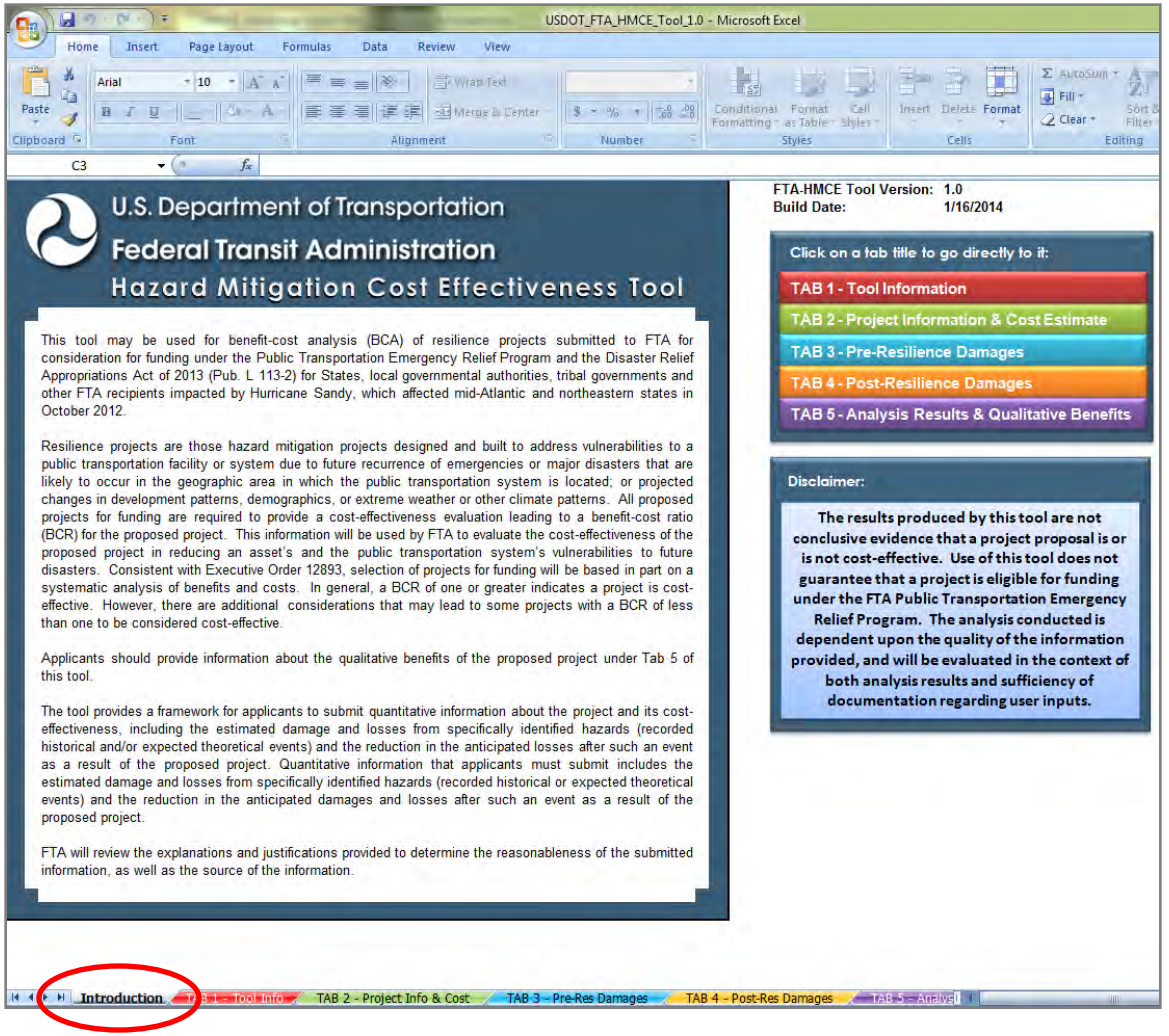
- When you first open the tool in Excel®, a warning may appear that macros have been disabled.
- Although not needed for calculations, the tool uses macros to facilitate navigation, saving and printing.
- To enable macros, click the **Options** button next to the warning and follow the directions.



Introduction – General Information

Introduction Tab

- This first tab in the HMCE Tool provides general information about the software, including
  - Tool Version
  - Build Date
  - Disclaimer
- Read this information before using the software for the first time.



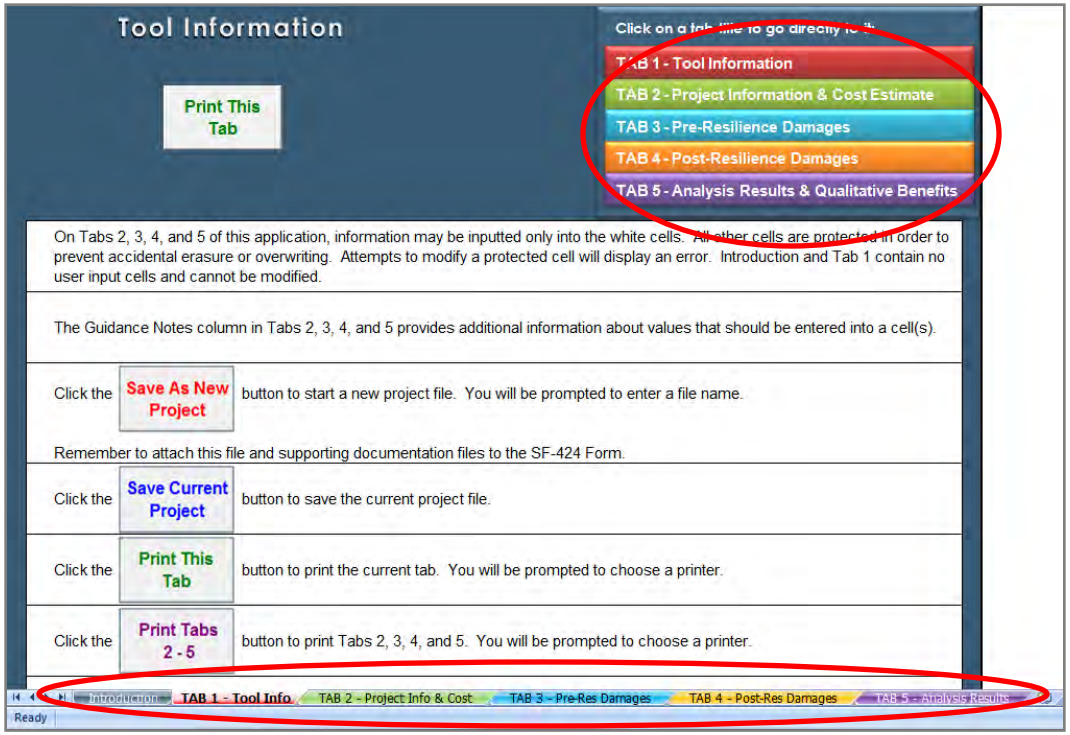
TAB 1 – Tool Information: Tool Navigation

TAB 1 – Tool Information

- Tab 1 in the HMCE Tool provides basic tool information on inputs, file saving and printing

Tool Navigation – Options:

- Click on a tab name to proceed directly to that tab, or…
- You can also navigate through the tool using the tabs at the bottom of the screen



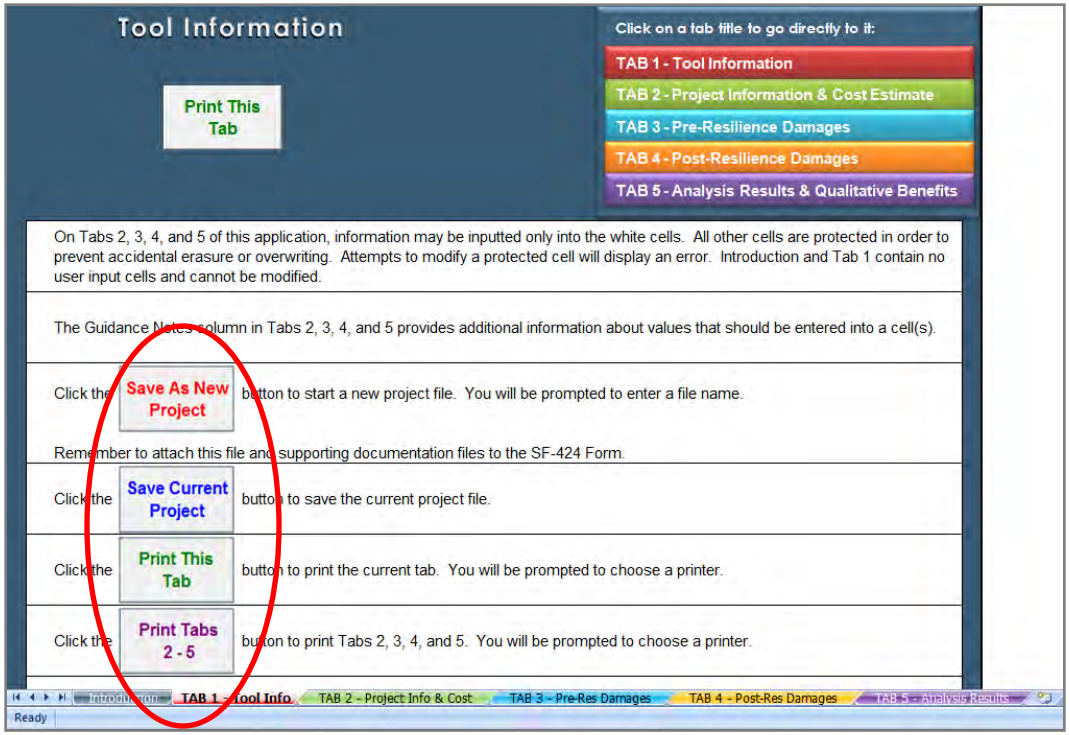
TAB 1 – Tool Information: Saving and Printing

Saving

- **Save as New Project** creates new project – appears only on Tab 2.
- **Save Current Project** saves your work – on Tabs 2-5.

Printing

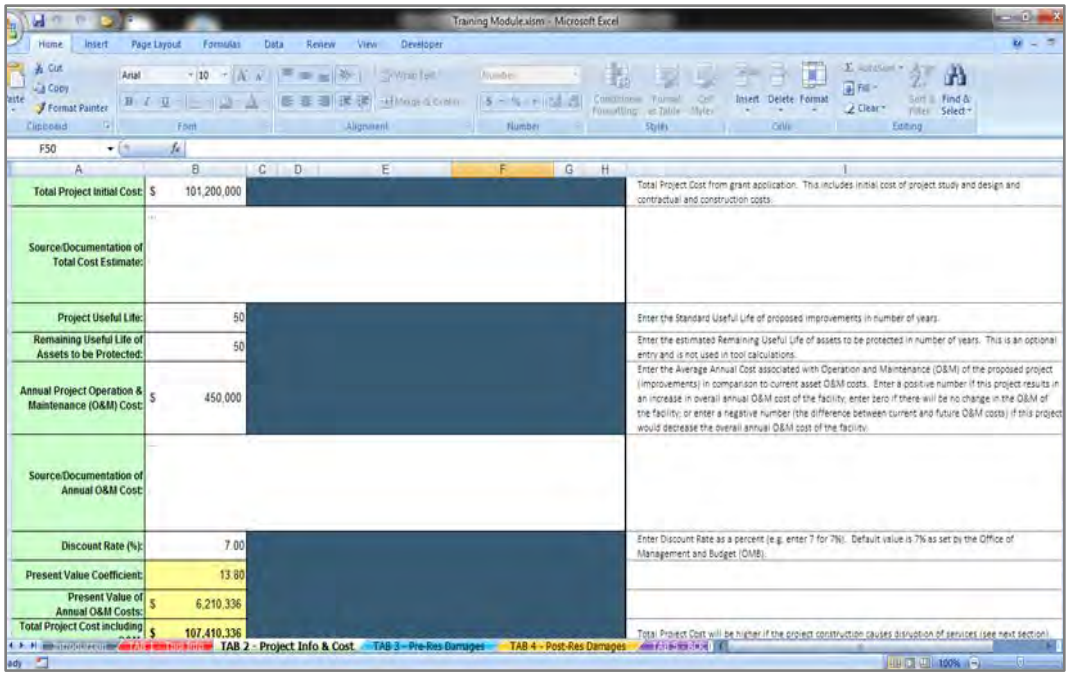
- **Print This Tab** prints the current tab – at top of each tab.
- **Print Tabs 2 -5** – appears only on Tab 5.



TAB 1 – Tool Information: General Information and Notes

General Information & Notes

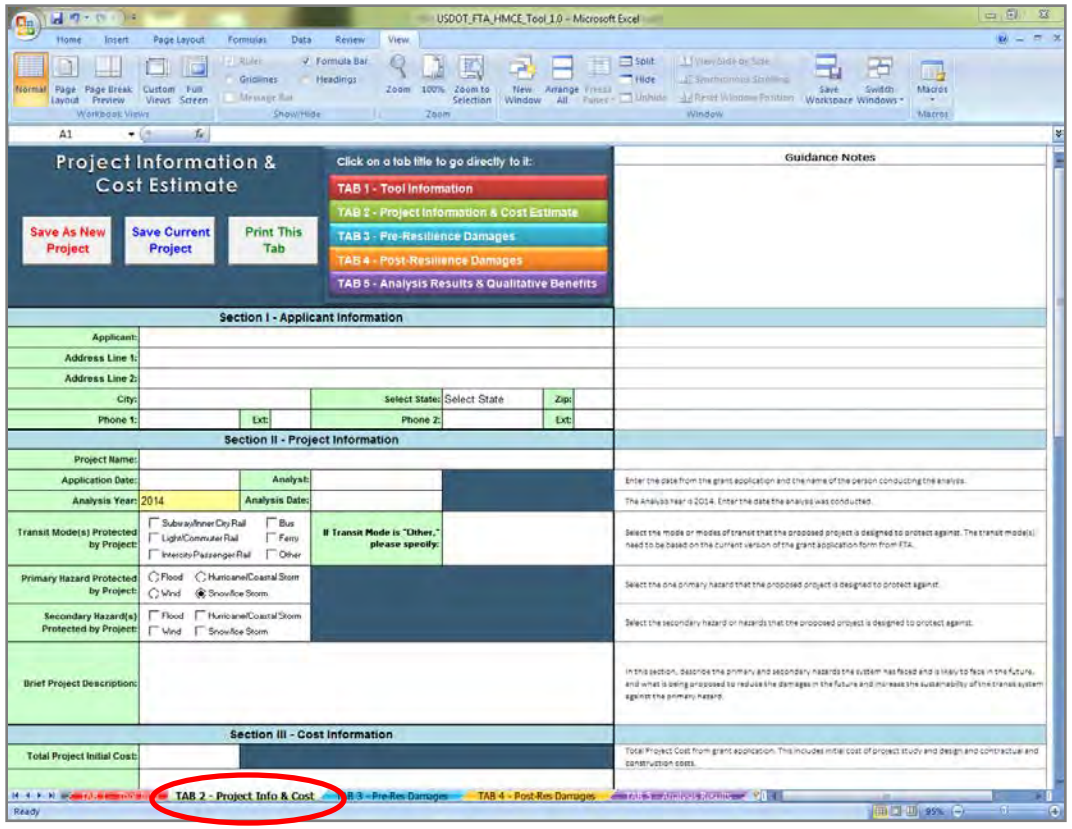
- White cells along the left-hand side of screen are typically input cells
- Green cells point to white input cells
- Yellow cells contain values calculated based on user inputs or carried over from previous tabs
- Guidance notes can be found along the right-hand side of the screen



TAB 2 – Project Information & Cost Estimate: Overview

TAB 2 – Project Information & Cost Estimate

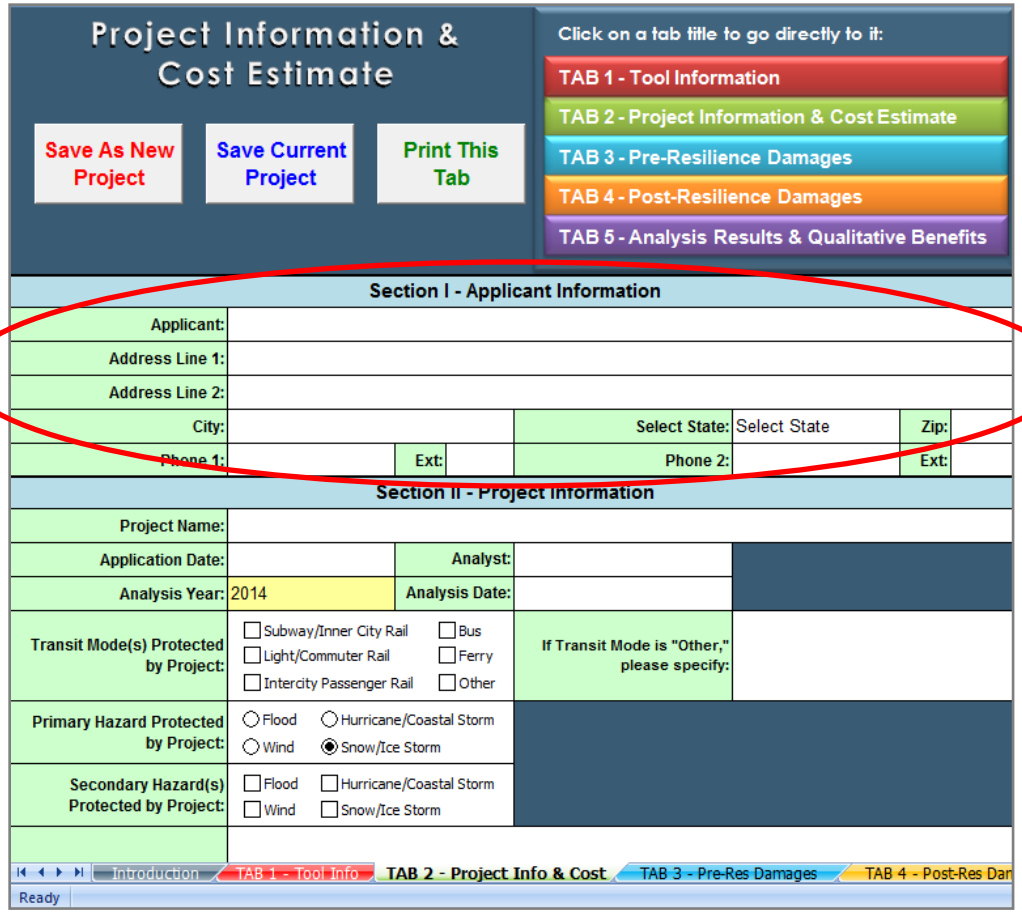
- Tab 2 in the HMCE Tool provides information that ties the HMCE analysis to the grant proposal
- Tab 2 also provides details regarding the resilience cost used in the analysis:
  - Initial Project Cost
  - O&M Costs
  - Project-Related Service Interruptions



TAB 2 - Section I: Applicant Information

Applicant Information

- This section must be completed to tie the HMCE analysis to the grant proposal.
- Enter name of the entity applying for the FTA grant in **Applicant** box
- Enter **Address**, **City**, **State**, **Zip** and contact **Phone** numbers, in the appropriate boxes.



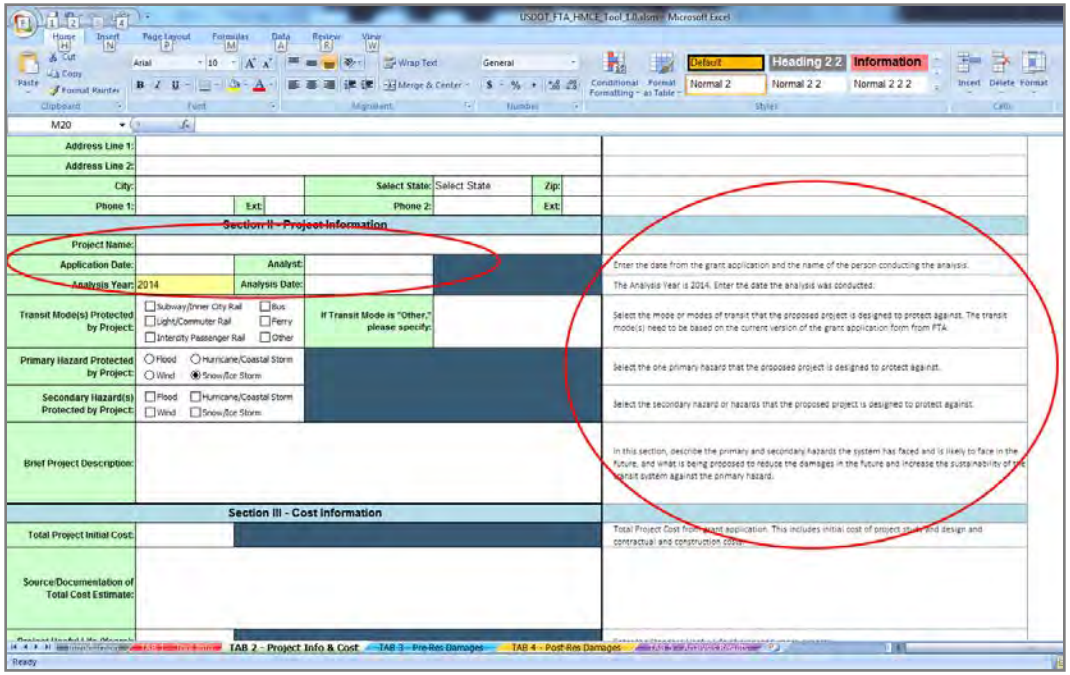
TAB 2 – Section II: Project Information and Analysis Details

Project Information

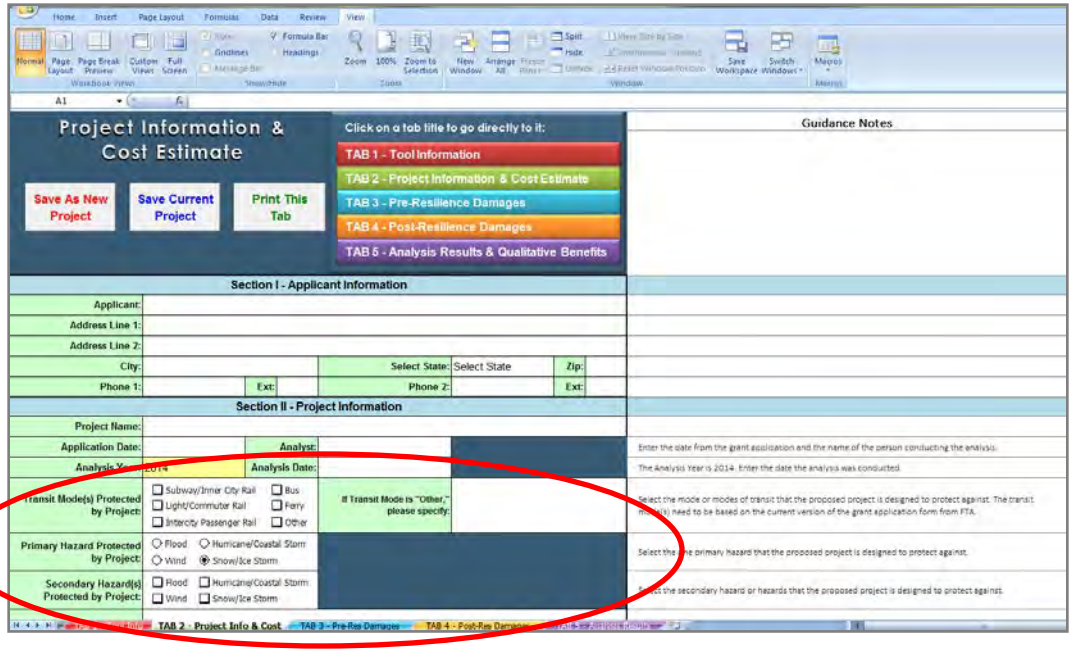
- Enter **Project Name**
- Enter the **Application Date** when you're submitting the application

Analysis Details

- No input required for Analysis Duration (2014 used for this FTA grant funding cycle)
- Enter **Analyst** and **Analysis Date**



TAB 2 – Section II: Transit Mode(s), Primary and Secondary Hazards



Transit Mode(s)

- Check **Transit Mode(s) Protected by Project**
  - If not listed, select "Other" and provide description.

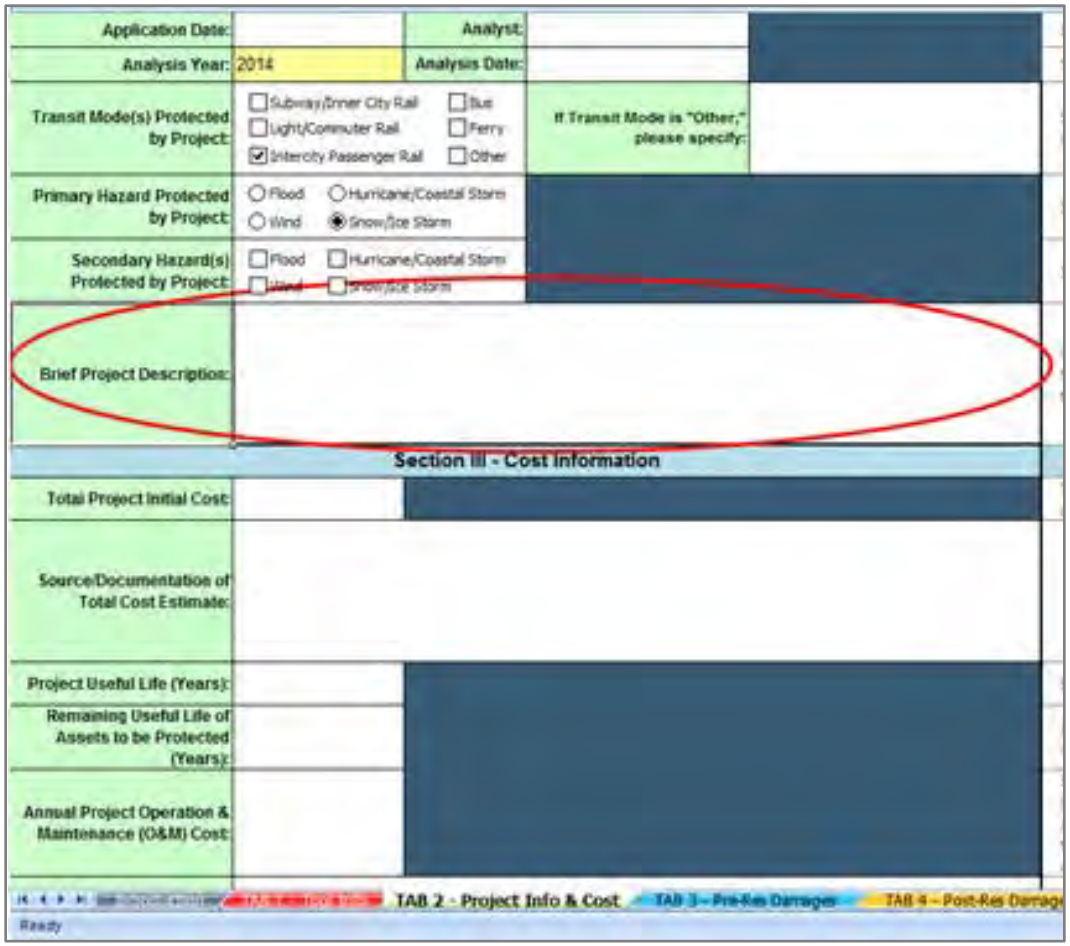
Primary and Secondary Hazards

- Select **Primary Hazard Protected by Project** used as basis for analysis
- Check any **Secondary Hazard(s) Protected by Project**

TAB 2 – Section II: Brief Project Description

Brief Project Description

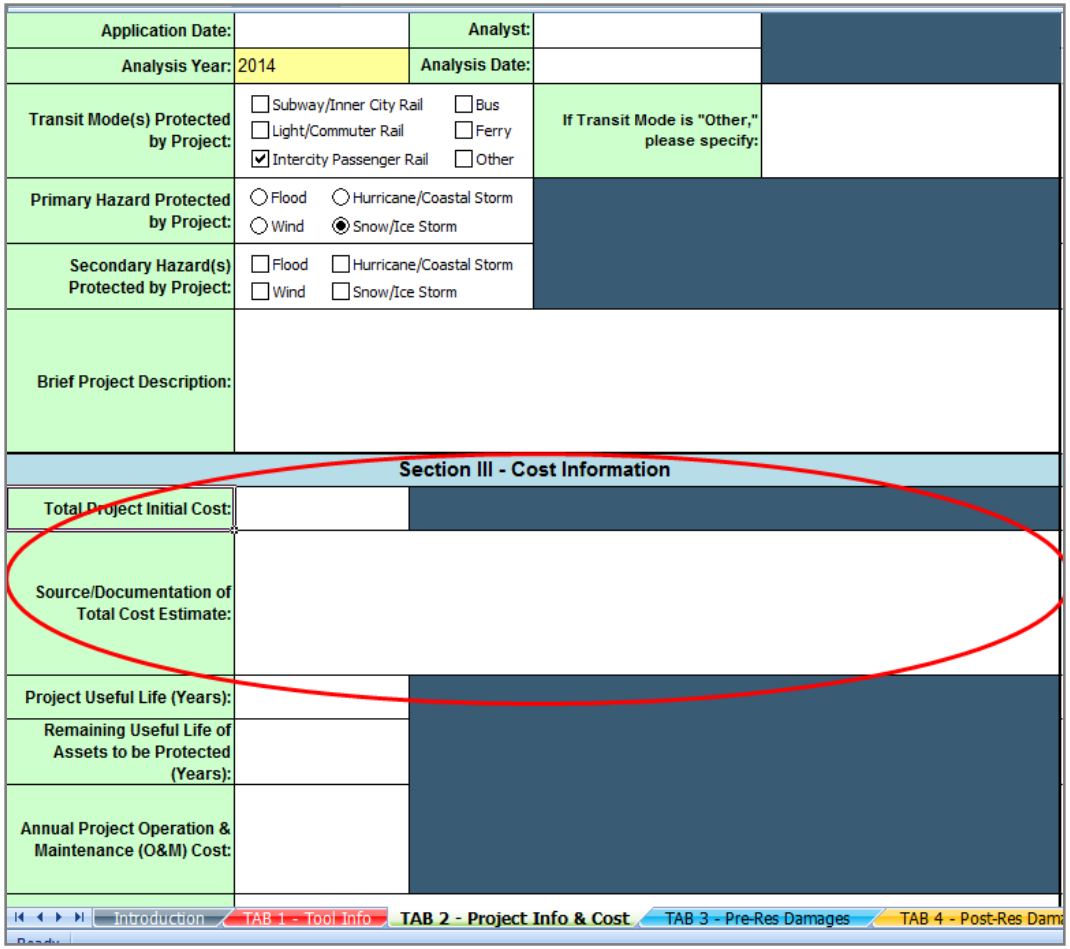
- Use **Brief Project Description** to describe the proposed project.
- This is an opportunity to describe your project qualitatively before you start entering numbers.
- If you like, you can copy and paste the description from the grant proposal.



TAB 2 – Section III: Project Cost Information

Cost Information

- Enter **Total Initial Project Cost** including pre-construction, construction, and ancillary costs (cost in the grant proposal form)
- Briefly describe where estimate came from (i.e., local historic costs, current contractor bids, published unit costs) in the **Source/ Documentation of Total Cost Estimate**



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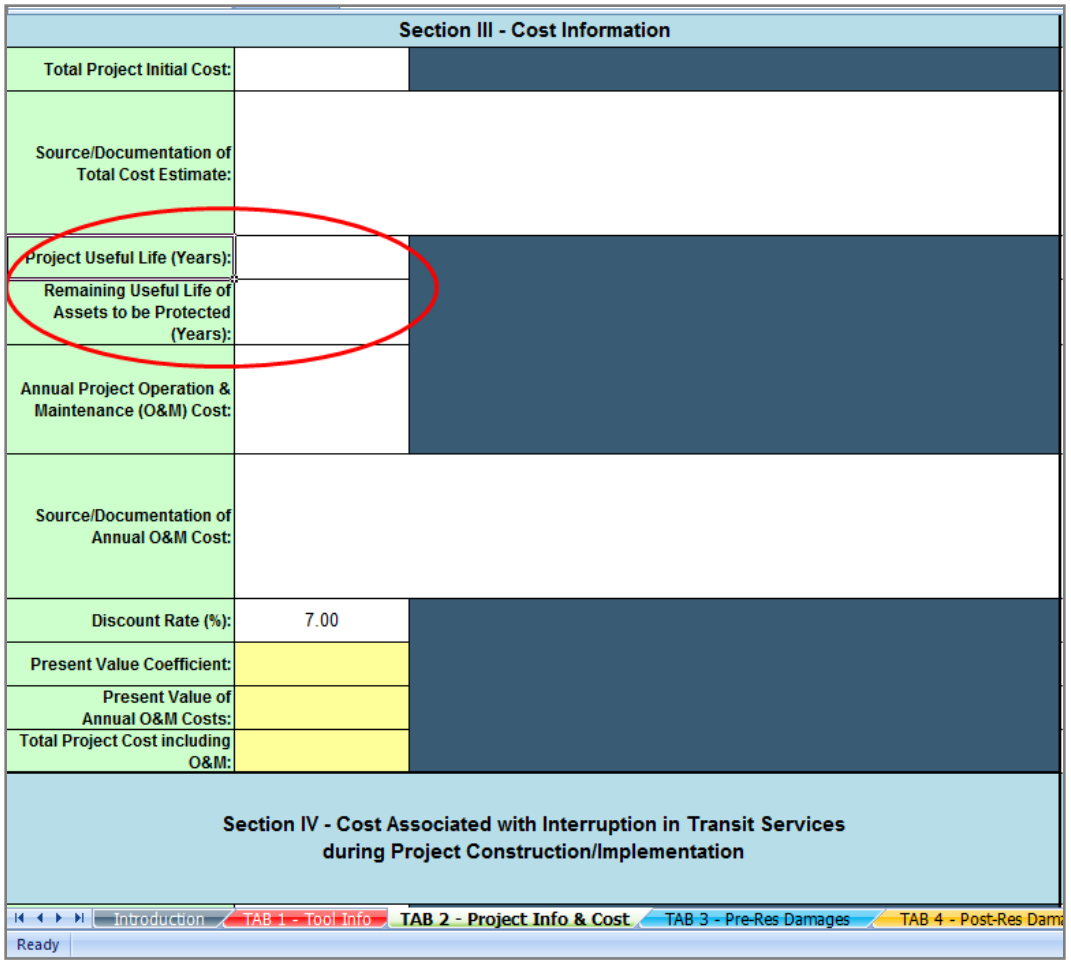
TAB 2 – Section III: Project Useful Life and Remaining Useful Life of Asset



Section III - Cost Information	
Total Project Initial Cost:	
Source/Documentation of Total Cost Estimate:	
Project Useful Life (Years):	
Remaining Useful Life of Assets to be Protected (Years):	
Annual Project Operation & Maintenance (O&M) Cost:	
Source/Documentation of Annual O&M Cost:	
Discount Rate (%):	7.00
Present Value Coefficient:	
Present Value of Annual O&M Costs:	
Total Project Cost including O&M:	
Section IV - Cost Associated with Interruption in Transit Services during Project Construction/Implementation	

Project Useful Life

- Enter **Project Useful Life**, in years, over which the project will protect the asset(s).
- Additional guidance in Appendix A of User Guide

Remaining Asset Useful Life

- Enter **Remaining Useful Life of Asset(s) to be Protected**, in years. If unknown, leave it blank
- Additional guidance in Appendix B of User Guide

TAB 2 – Section III: Project Useful Life and Remaining Useful Life of Asset (continued)

Project Useful Life (Appendix A)

Project Type	Standard Project Useful Life (years)	Acceptable Limits (years)	Comments
Acquisition	100	100	None
Elevation – Non-Residential, Public, and/or Historic Building or Transit Facility	50	50-100	None
Non-Residential Building Retrofit	25	25-50	None
Public and/or Historic Building/Transit Facility Retrofit	50	50-100	None
Roof Diaphragm Retrofit	30	30	Roof hardening and roof clips
Non-Structural Building/Facility Elements	30	30	Ceilings, electrical cabinets, generators, parapets, chimneys
Non-Structural Major Equipment	15	15-30	Elevators, HVAC, sprinklers
Non-Structural Minor Equipment	5	5-20	Generic contents, racks, shelves
Major Infrastructure (minor localized flood reduction projects)	50	35-100	None
Concrete Infrastructure, Flood Walls, Roads, Bridges, Major Drainage Systems	50	35-50	None
Culverts (concrete, PVC, CMP, HDPE, etc.) with end treatments	30	25-50	End treatment (wing walls, end sections, head walls, etc.)
Culverts (concrete, PVC, CMP, HDPE, etc.) without end treatments	10	5-20	End treatment (wing walls, end sections, head walls, etc.)
Pump Stations, Substations, Wastewater Systems, or Equipment such as Generators	50	50	Structures
Pump Stations, Substations, Wastewater Systems, or Equipment Such as Generators	5	5-30	Equipment
Hurricane Storm Shutters	15	15-30	Depends on type of storm shutter
Utility Mitigation/Resilience Projects	50	50-100	Major (e.g., power lines, cable, hardening gas, water, sewer lines, etc.)
Utility Mitigation/Resilience Projects	5	5-30	Minor (e.g., backflow valves, downspout disconnect, etc.)
Equipment Purchases	2	2-10	Small, portable equipment (e.g., computer)
Equipment Purchases	30	5-30	Heavy equipment

Asset Useful Life (Appendix B)

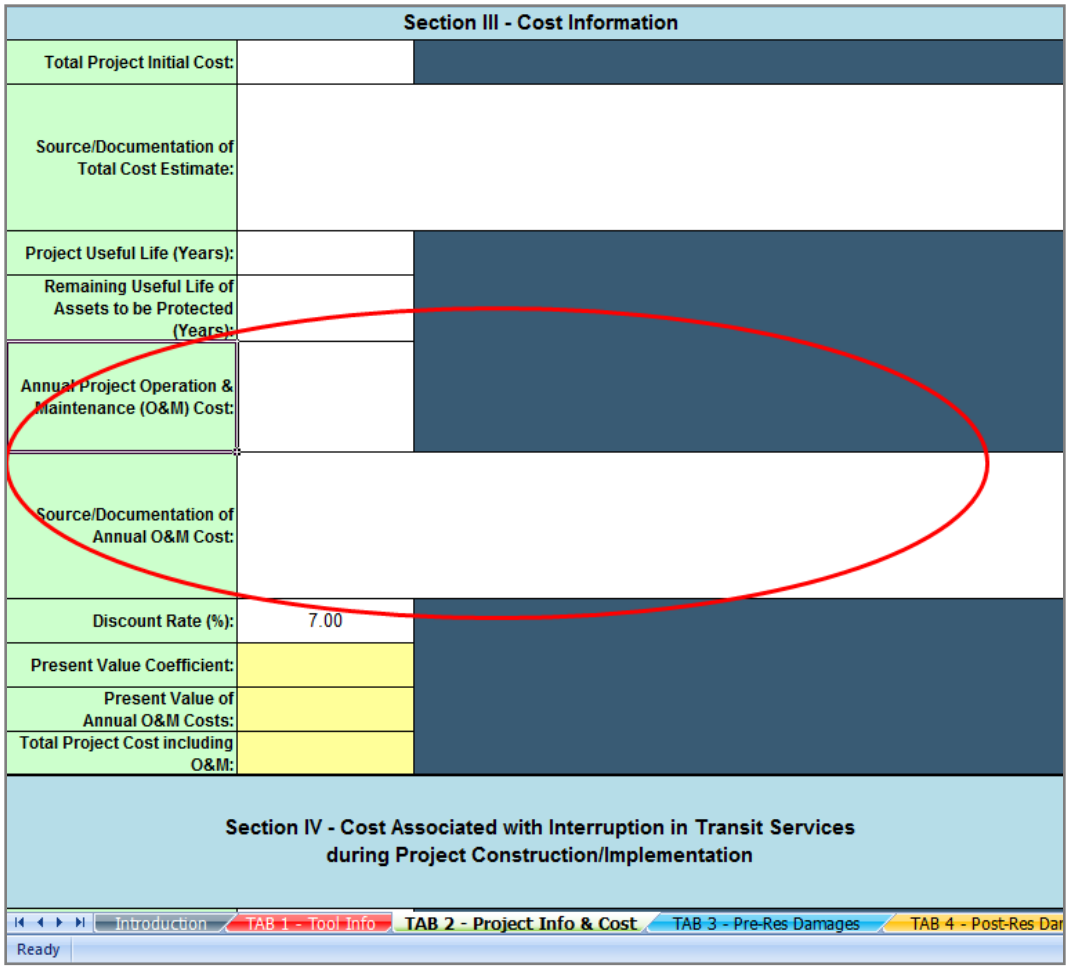
Asset Type	Minimum Useful Life (years)	Comments
Buses		
Large, heavy-duty transit buses including over the road buses	12	Approximately 35'–40', and articulated buses
Small size, heavy-duty transit buses	10	Approximately 30'
Medium-size, medium-duty transit buses	7	Approximately 25'–35'
Medium-size, light-duty transit buses	5	Approximately 25'–35'
Light Duty Vehicles		
Other light-duty vehicles	4	Other light-duty vehicles used as equipment and in transport of passengers (revenue service) such as regular and specialized vans, sedans, and light-duty buses including all bus models exempt from testing in the current 49 CFR part 665
Trolleys		
Fixed guideway steel-wheeled "trolley"	25	Streetcar or other light rail vehicle
Fixed guideway electric trolley-bus with rubber tires obtaining power from overhead catenary	15	
Simulated trolleys, with rubber tires and internal combustion engine	Refer to criteria for buses	Often termed "trolley-replica buses"
Rail Vehicles		
All rail vehicles	25	At time of grant application, the grantee may propose alternative useful life to be reviewed by FTA
Ferries		
Passenger Ferries	25	
Other Ferries (without refurbishment)	30	
Other Ferries (with refurbishment)	60	
Other Facilities		
Railroad or highway structure	50	
Other buildings and facilities	40	Concrete, steel, and frame construction

NOTE: Per FTA Circular 5010, grantees should identify the method used to determine the asset useful life. Acceptable methods life include, but are not limited to: 1) Generally accepted accounting principles; 2) Independent evaluation; 3) Manufacturer's estimated useful life; 4) Internal Revenue Service guidelines; 5) Industry standards; 6) Grantee experience; 7) The grantee's independent auditor who needs to concur that the useful life is reasonable for depreciation purposes; or 8) Proven useful life developed at a Federal test facility.

TAB 2 – Section III: Operation & Maintenance (O&M) Costs

O&M Costs

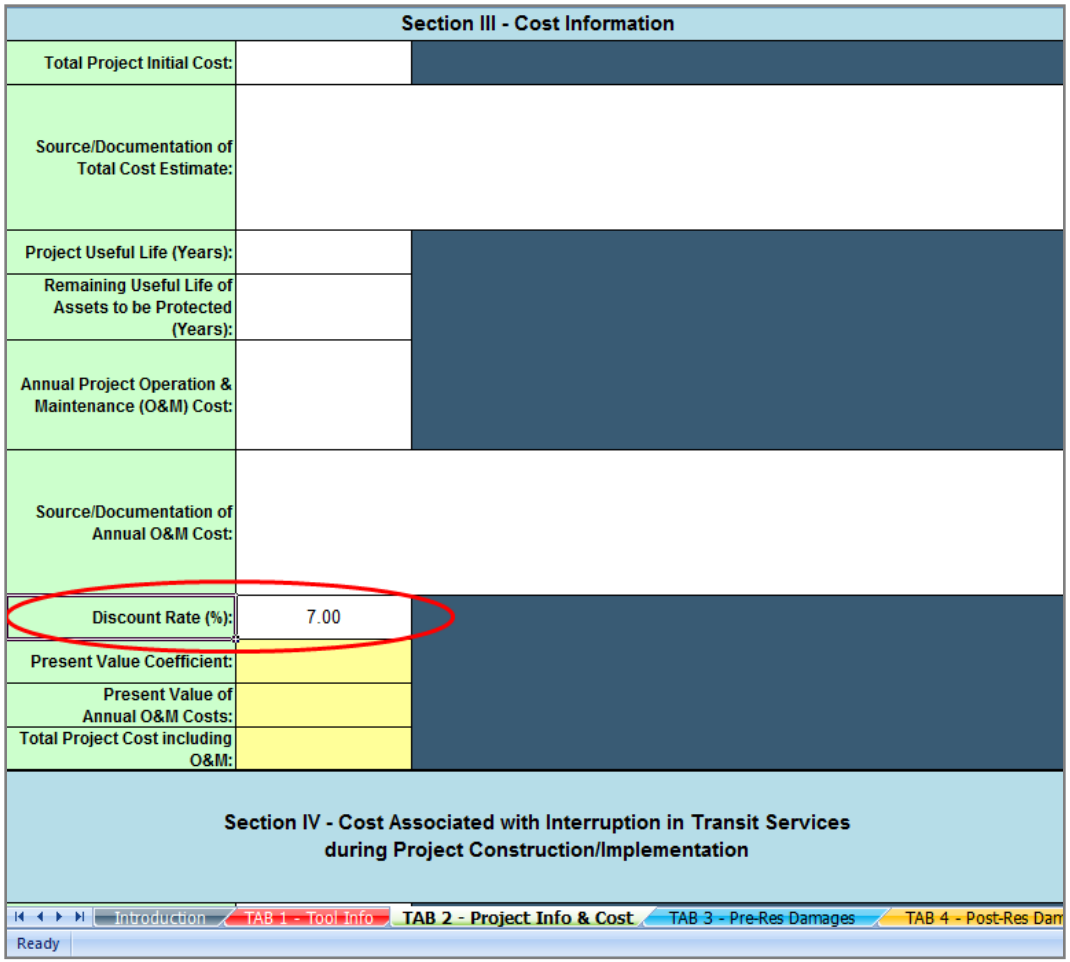
- Enter **Annual O&M Cost** based on the difference between average annual O&M costs associated with proposed project and current average annual O&M costs for asset(s) to be protected by project.
  - Value can be positive, zero, or negative, depending on the project
- Briefly describe the **Source/Documentation of Annual O&M Cost**



TAB 2 – Section III: Discount Rate

Discount Rate

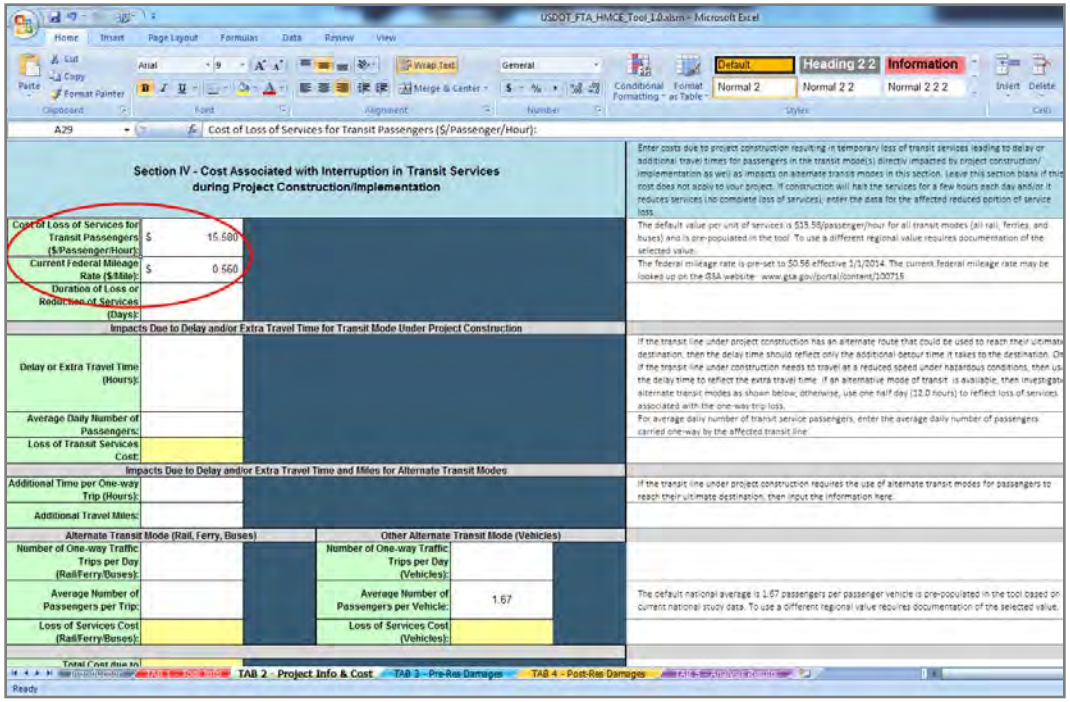
- No input is required for the Discount Rate. For this FTA funding cycle, the discount rate is pre-populated at 7 percent (7.00%) per OMB Circular A-94 guidance.
- As discussed in Unit 2, the discount rate accounts for the time value of money.



TAB 2 – Section IV: Interruption of Transit Service Costs

Interruption of Service Costs

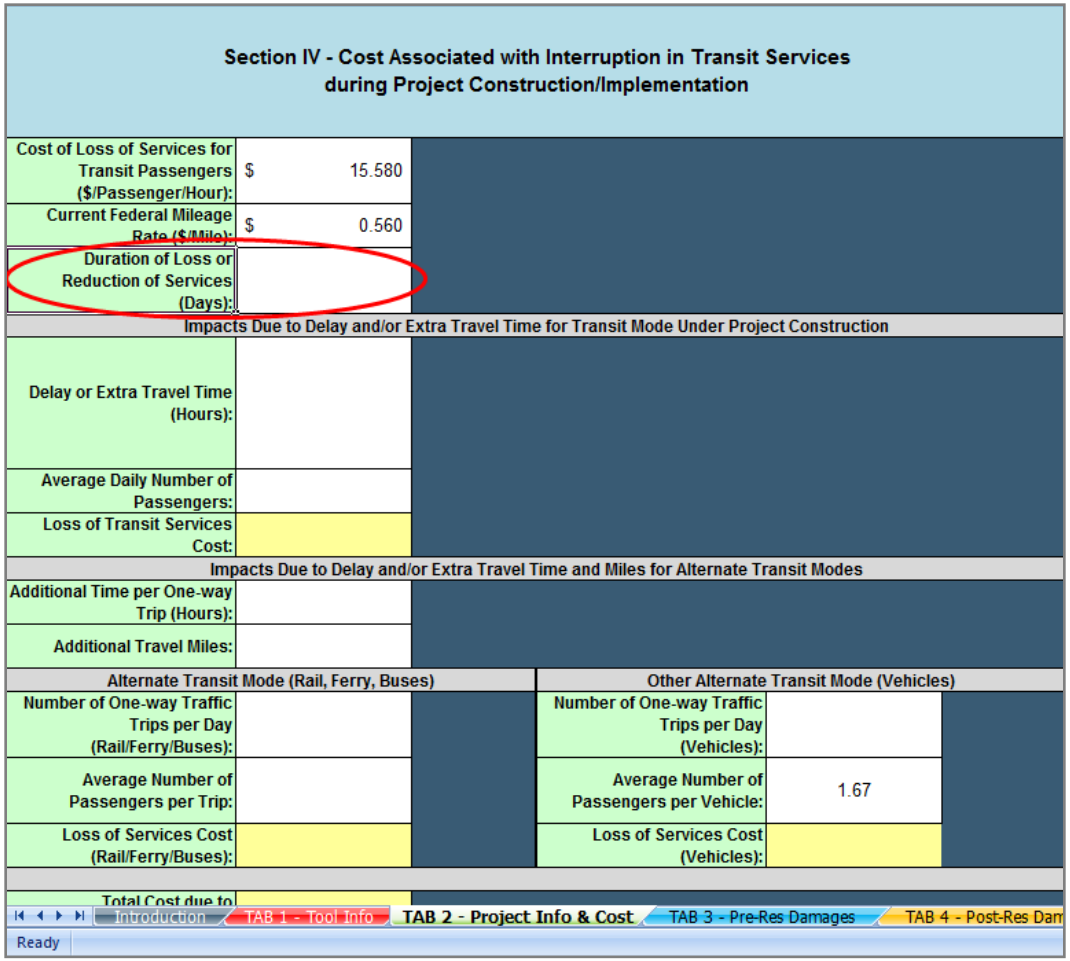
- Section allows input of costs to interruption of transit service associated with construction or implementation of the proposed project.
- Enter **Cost of Loss of Services for Transit Passengers** if different from default value.
- Enter **Current Federal Mileage Rate** if different from default value.



TAB 2 – Section IV: Duration of Transit Service Interruption

Duration of Transit Service Interruption

- Enter **Duration of Loss or Reduction of Services** in days, defined as the **length of time during resilience project construction or implementation that passenger travel will be impacted**.



Section IV - Cost Associated with Interruption in Transit Services during Project Construction/Implementation

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

Impacts Due to Delay and/or Extra Travel Time for Transit Mode Under Project Construction

Delay or Extra Travel Time (Hours):	
Average Daily Number of Passengers:	
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):	
Additional Travel Miles:	

Alternate Transit Mode (Rail, Ferry, Buses)		Other Alternate Transit Mode (Vehicles)	
Number of One-way Traffic Trips per Day (Rail/Ferry/Buses):		Number of One-way Traffic Trips per Day (Vehicles):	
Average Number of Passengers per Trip:		Average Number of Passengers per Vehicle:	1.67
Loss of Services Cost (Rail/Ferry/Buses):		Loss of Services Cost (Vehicles):	

Total Cost due to

Introduction | TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Dam

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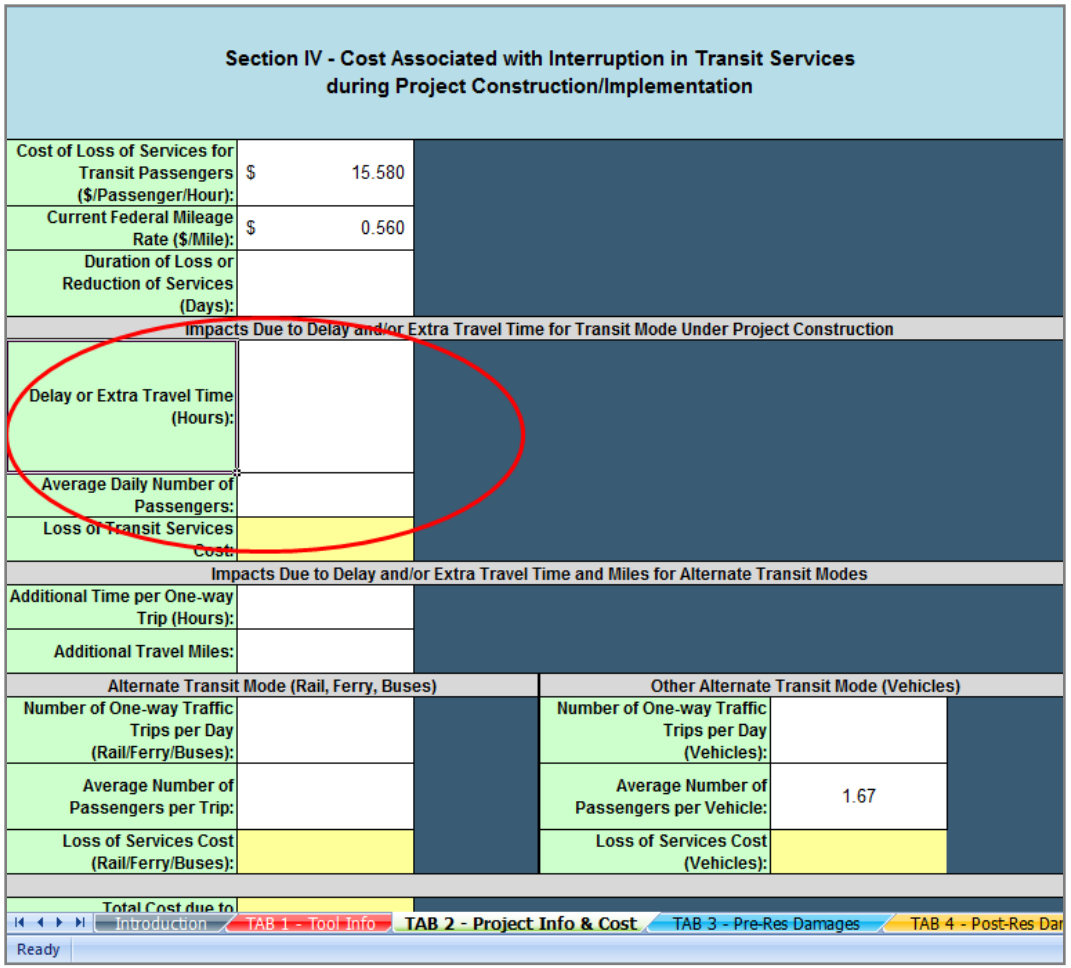
TAB 2 – Section IV: Interruption of Transit Mode Under Project Constriction

Interruption of Transit Mode Under Project Construction

- Enter estimated **Delay or Extra Travel Time** in hours and **Average Daily Number of Passengers** using transit line during project construction
- Applicable for service interruptions involving an alternate route on the same transit mode or reduced transit speeds during construction.



Section IV - Cost Associated with Interruption in Transit Services during Project Construction/Implementation

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

Impacts Due to Delay and/or Extra Travel Time for Transit Mode Under Project Construction

Delay or Extra Travel Time (Hours):	
Average Daily Number of Passengers:	
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):	
Additional Travel Miles:	

Alternate Transit Mode (Rail, Ferry, Buses)		Other Alternate Transit Mode (Vehicles)	
Number of One-way Traffic Trips per Day (Rail/Ferry/Buses):		Number of One-way Traffic Trips per Day (Vehicles):	
Average Number of Passengers per Trip:		Average Number of Passengers per Vehicle:	1.67
Loss of Services Cost (Rail/Ferry/Buses):		Loss of Services Cost (Vehicles):	

Total Cost due to

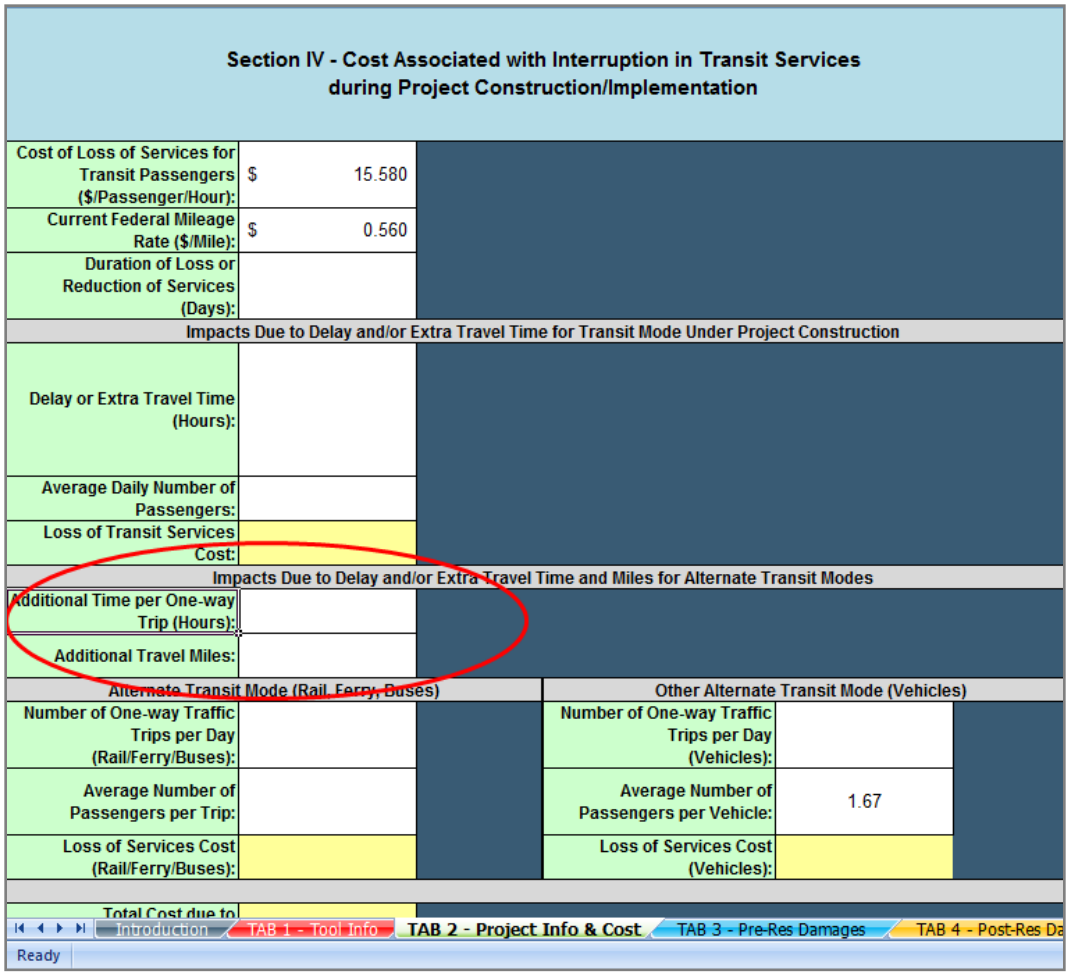
Introduction | TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Dar

Ready

TAB 2 – Section IV: Extra Travel Time and Miles on Alternate Transit Modes

Project Impacts on Alternate Transit Modes

- Enter the **Additional Time per One-Way Trip** in hours for the alternative transit mode and **Additional Travel Miles** per one way trip in miles for passenger vehicles
- Applicable for projects impacting an alternative mode of transit including passenger vehicle traffic.



Section IV - Cost Associated with Interruption in Transit Services during Project Construction/Implementation

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

Impacts Due to Delay and/or Extra Travel Time for Transit Mode Under Project Construction

Delay or Extra Travel Time (Hours):	
Average Daily Number of Passengers:	
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):	
Additional Travel Miles:	

Alternate Transit Mode (Rail, Ferry, Buses)		Other Alternate Transit Mode (Vehicles)	
Number of One-way Traffic Trips per Day (Rail/Ferry/Buses):		Number of One-way Traffic Trips per Day (Vehicles):	
Average Number of Passengers per Trip:		Average Number of Passengers per Vehicle:	1.67
Loss of Services Cost (Rail/Ferry/Buses):		Loss of Services Cost (Vehicles):	

Total Cost due to

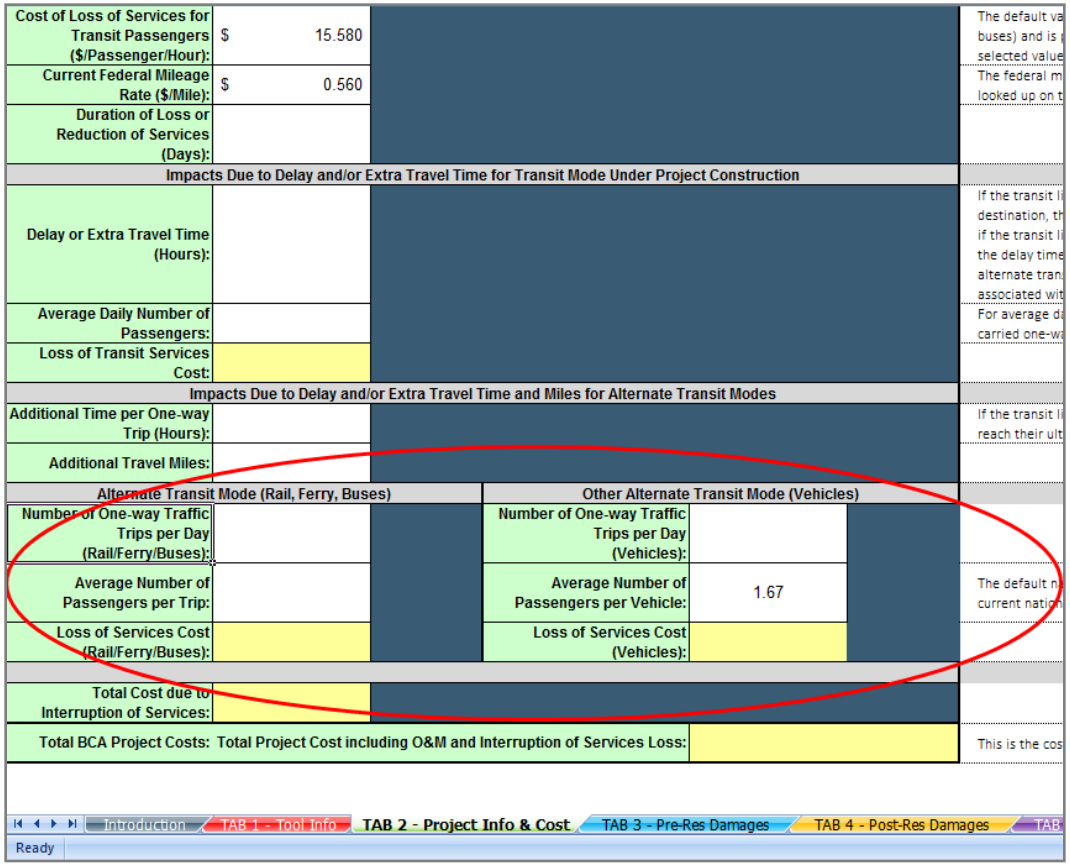
Introduction | TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Da

Ready

TAB 2 – Section IV: Interruption of Alternative Transit Modes

Interruption of Alternate Transit Modes

- Enter **Number of One-way Traffic Trips per Day (Rail/Ferry/Buses)** and **Average Number of Passengers per Trip** If alternative transit modes will be impacted
- Enter **Number of one-way Traffic Trips per Day (Vehicles)** if passenger vehicles will be impacted



Cost of Loss of Services for Transit Passengers ($/Passenger/Hour):	$ 15.580			The default va buses) and is selected value
Current Federal Mileage Rate ($/Mile):	$ 0.560			The federal m looked up on t
Duration of Loss or Reduction of Services (Days):				
Impacts Due to Delay and/or Extra Travel Time for Transit Mode Under Project Construction				
Delay or Extra Travel Time (Hours):				If the transit l destination, th if the transit l the delay time alternate tran associated wit
Average Daily Number of Passengers:				For average d carried one-w
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):				If the transit l reach their ult
Additional Travel Miles:				
Alternate Transit Mode (Rail, Ferry, Buses)		Other Alternate Transit Mode (Vehicles)		
Number of One-way Traffic Trips per Day (Rail/Ferry/Buses):		Number of One-way Traffic Trips per Day (Vehicles):		
Average Number of Passengers per Trip:		Average Number of Passengers per Vehicle:	1.67	The default n current natio
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:				This is the cos

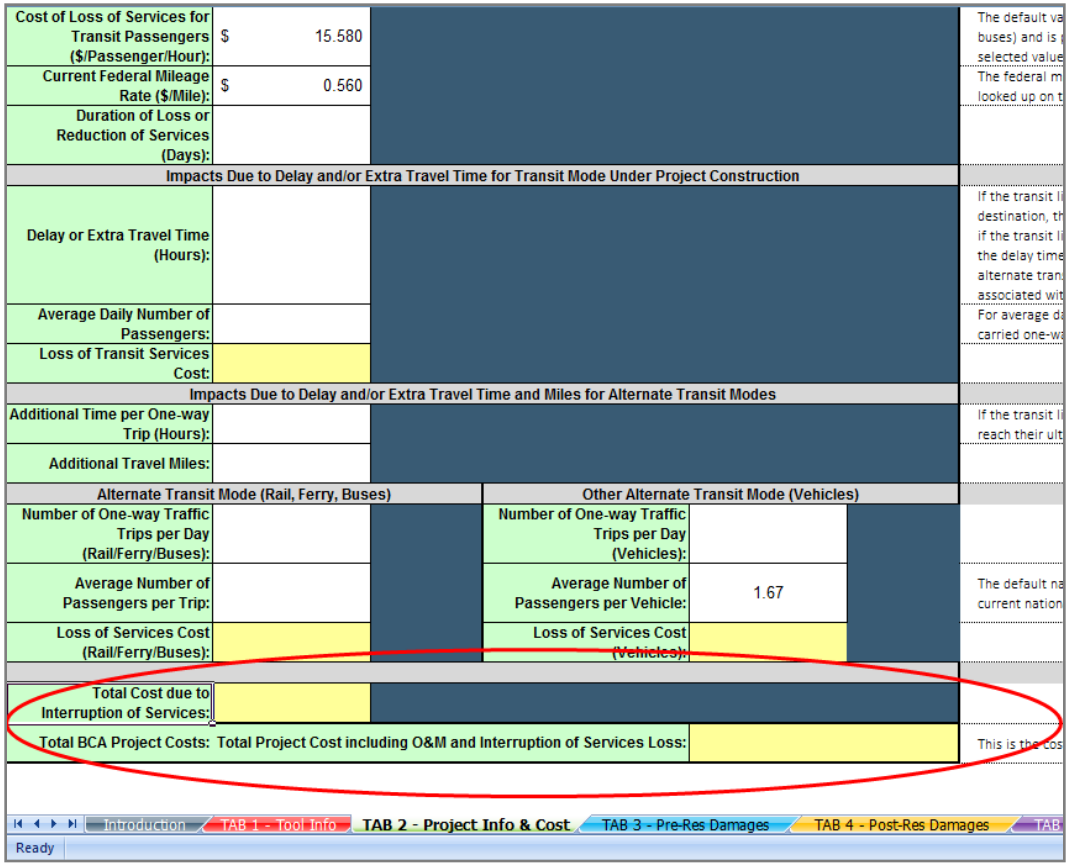
Introduction | TAB 1 - Tool Info | TAB 2 - Project Info & Cost | TAB 3 - Pre-Res Damages | TAB 4 - Post-Res Damages

Ready

TAB 2 – Section IV: Project Cost Summary

Project Cost Summary

- The Total BCA Project Costs will be displayed at the bottom of Tab 2 and be used in the evaluation of the benefit-cost ratio (BCR).
- No additional inputs are required for Tab 2.
- Remember to **Save As New Project** (if you have not done so) before proceeding to Tab 3.



TABs 3 and 4 - General Notes: Entering Damage Information

TAB 3 – Pre-Resilience Damage: the current (as-is) situation

- Two basic options for inputting damage:
  1) Historic Damages, based on records from actual past disaster events
     - Need a minimum of one known RI event or three unknown RI events occurring in different years
  2) Expected Damages, based on damages predicted from a theoretical model or engineering analysis.
     - Need a minimum of one or more events with known RIs

TAB 4 – Post-Resilience Damage: residual damage (project effectiveness)

- Input damages based Expected Damages only

TABs 3 and 4 - General Notes: Entering Damage Information (continued)

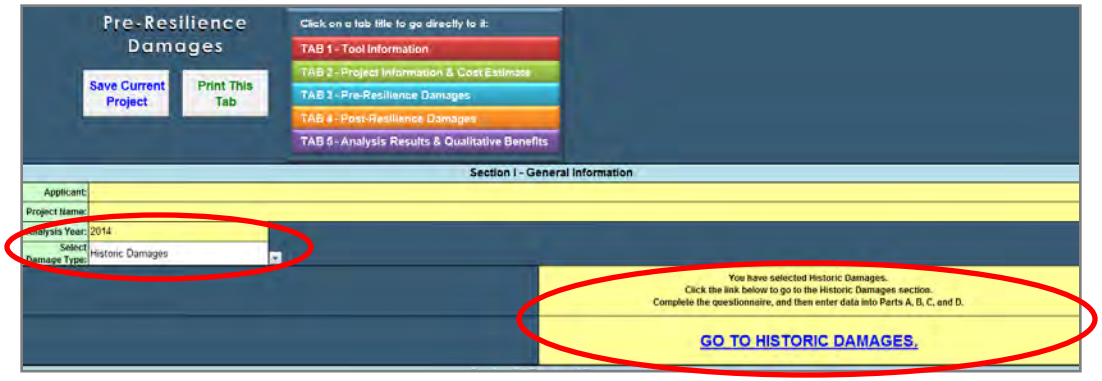
Tabs 3 and 4 Both Allow Input of the Following Damages (Unit 2):

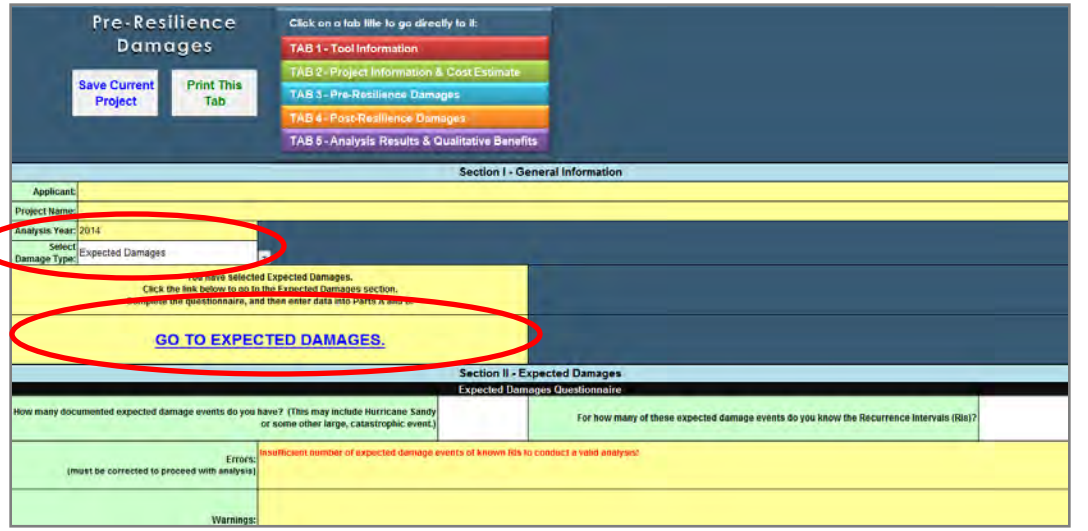
- Physical Damages Costs – permanent repair/replacement
  - Fixed Structures - transit stations, tracks, maintenance facilities, substations
  - Rolling Stock – rail cars, buses, ferries
- Response and Recovery Costs – emergency repairs and other temporary measures
- Other Damage Costs – miscellaneous costs (debris, cleanup)
- Economic Impacts of Lost Transit Service (Non-Physical Damages) – service losses/delays, alternate transit, additional mileage

General Notes: Expected vs. Historic Damages

Historic vs. Expected Damage (Pre-Resilience)

- In **TAB 3, Section I**, select Expected Damages or Historic Damages from the drop-down menu.
- If you select "Historic Damages", click the **GO TO HISTORIC DAMAGES** button to skip to the appropriate section. Otherwise, proceed with the Expected Damages questionnaire below.

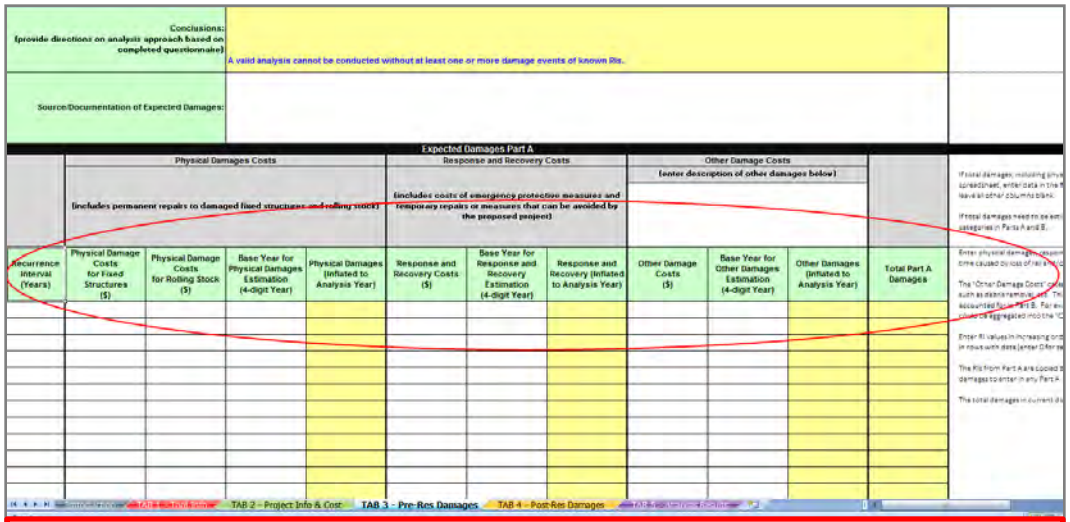




General Notes: Rules on Entering Damages

Rules on Entering Damages

- Use one row for each damage event. If there are more rows in the table than you have damage events, leave the extra rows blank
- If you enter a value in the first cell of a row (recurrence interval or year), you must enter a value in every other white input cell in that row, even if the value is “0”

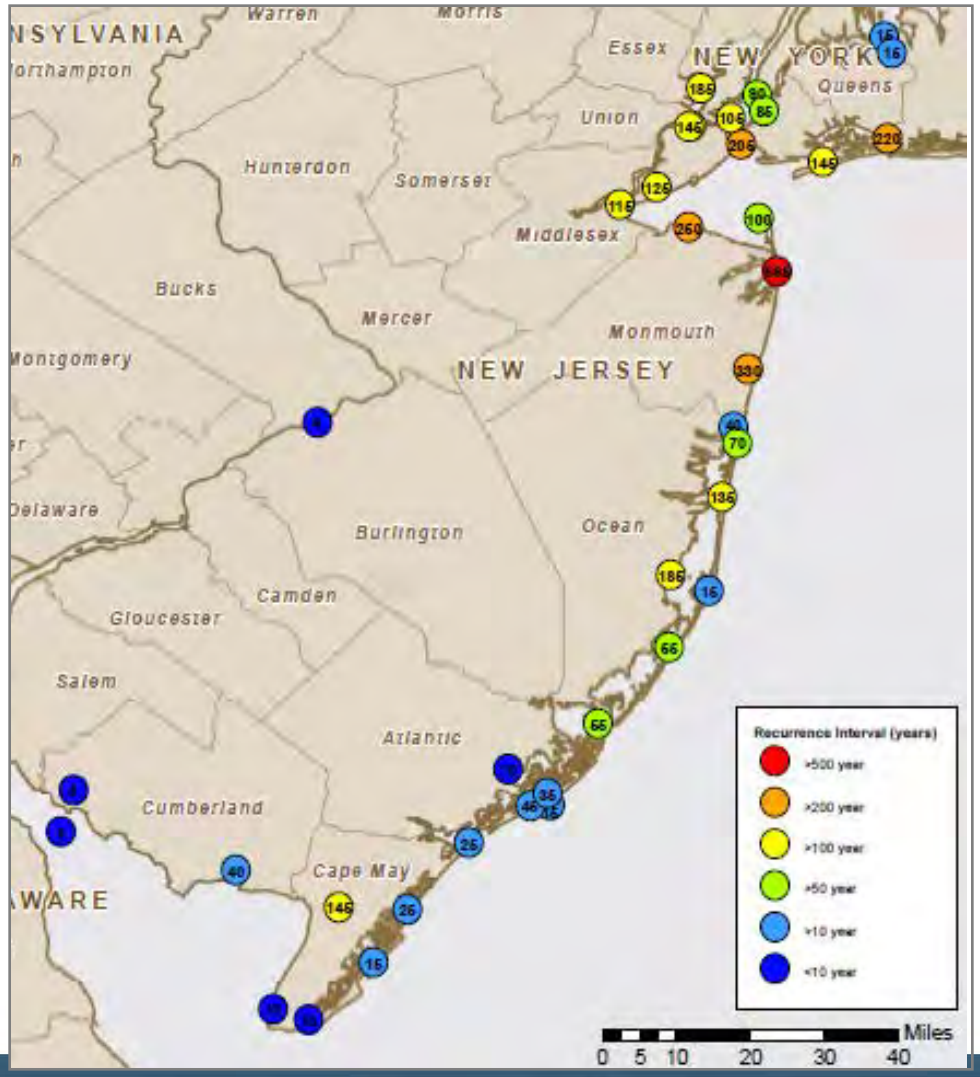


General Notes apply to Expected and Historical Damages in Tab 3 and Post-Resilience Damages in Tab 4

General Notes: Additional Guidance on Entering Recurrence Intervals (RIs)

Guidance on Entering RIs

- You cannot repeat a RI (for example, you cannot enter two 25-year RI events)
- Total damages must increase with increasing RIs; for example, you cannot have a 500-year event with lower damages than a 100-year event
- Summary guidance on estimating Hurricane Sandy Flood RIs in NJ and NY is given in Appendix C of the User Guide



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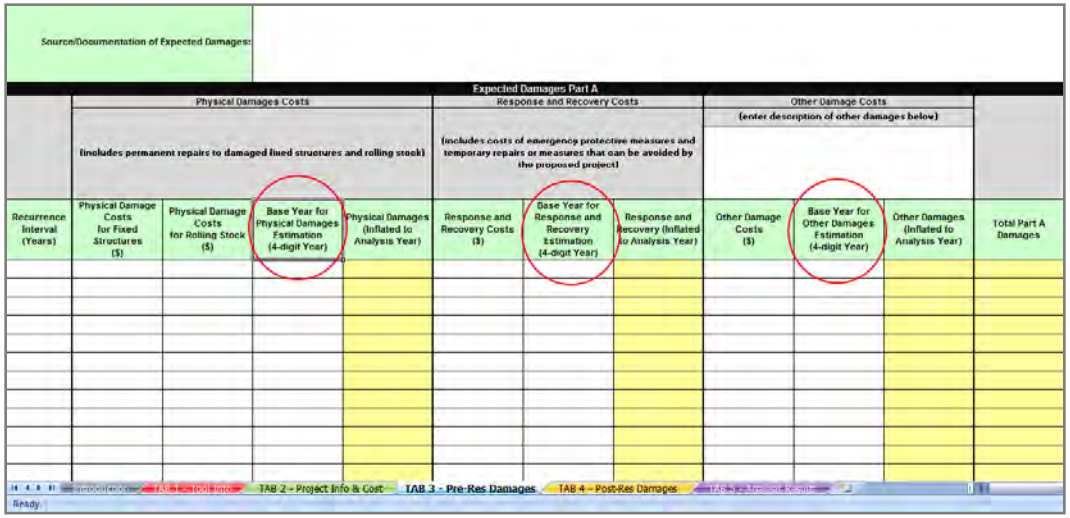
General Notes: Base Year for Damage Estimates

Base Year for Damage Estimates

The **Base Year** is the year that the damages were estimated, and is used as the basis to inflate old estimates to analysis year (2014) dollars.

- For Expected Damages, the Base Year will be the year in which the estimate was made.
- For Historic Damages, the Base Year will be the year in which the damage was estimated, not necessarily the year in which the damage occurred.
- If damage values are adjusted to a certain year's dollars prior to entry in the tool, the Base Bear should be that year.

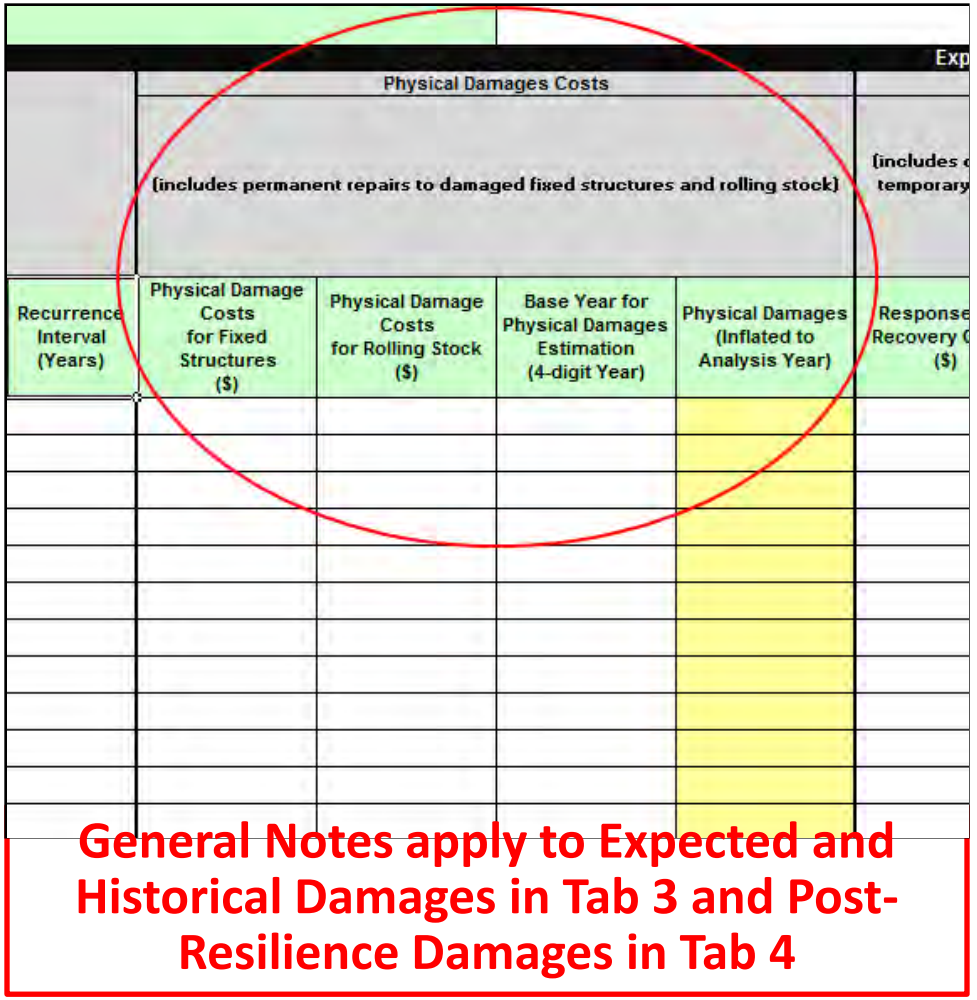


General Notes apply to Expected and Historical Damages in Tab 3 and Post-Resilience Damages in Tab 4

General Notes: Physical Damages

Physical Damages Costs

- Enter **Physical Damage Costs for Fixed Structures** and **Physical Damage Costs for Rolling Stock** for each event
  - Can be approximated as the cost to repair the element to pre-disaster condition
- Enter the four-digit in year which damages were calculated in **Base Year for Physical Damages Estimation** .



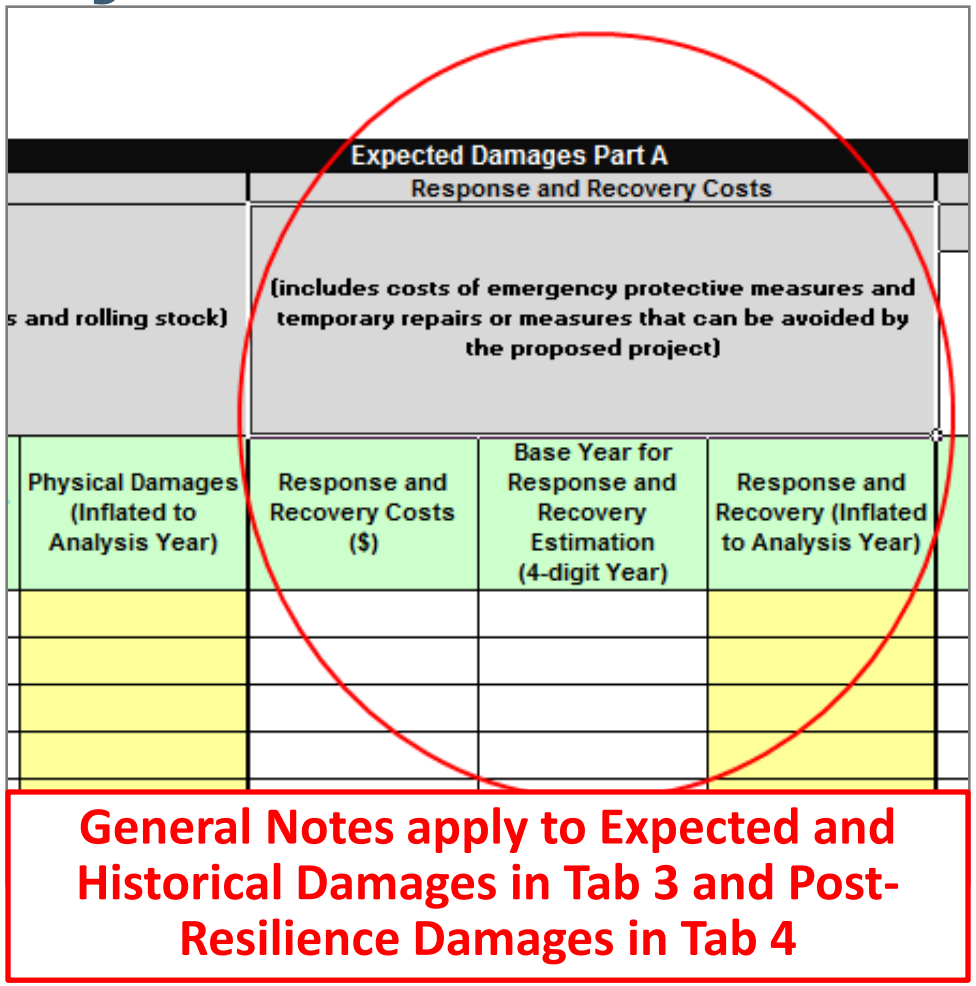
	Physical Damages Costs (includes permanent repairs to damaged fixed structures and rolling stock)				Exp (includes temporary
Recurrence Interval (Years)	Physical Damage Costs for Fixed Structures ($)	Physical Damage Costs for Rolling Stock ($)	Base Year for Physical Damages Estimation (4-digit Year)	Physical Damages (Inflated to Analysis Year)	Response Recovery ($)

General Notes apply to Expected and Historical Damages in Tab 3 and Post-Resilience Damages in Tab 4

General Notes: Response and Recovery Costs

Response and Recovery Costs

- Enter the **Response and Recovery Costs** for each event.
  - Can include emergency protective measures (such as sandbags) and temporary repairs that can be avoided by the proposed project.
- Enter the four-digit year in which damages were calculated in **Base Year for Response and Recovery Estimation**.

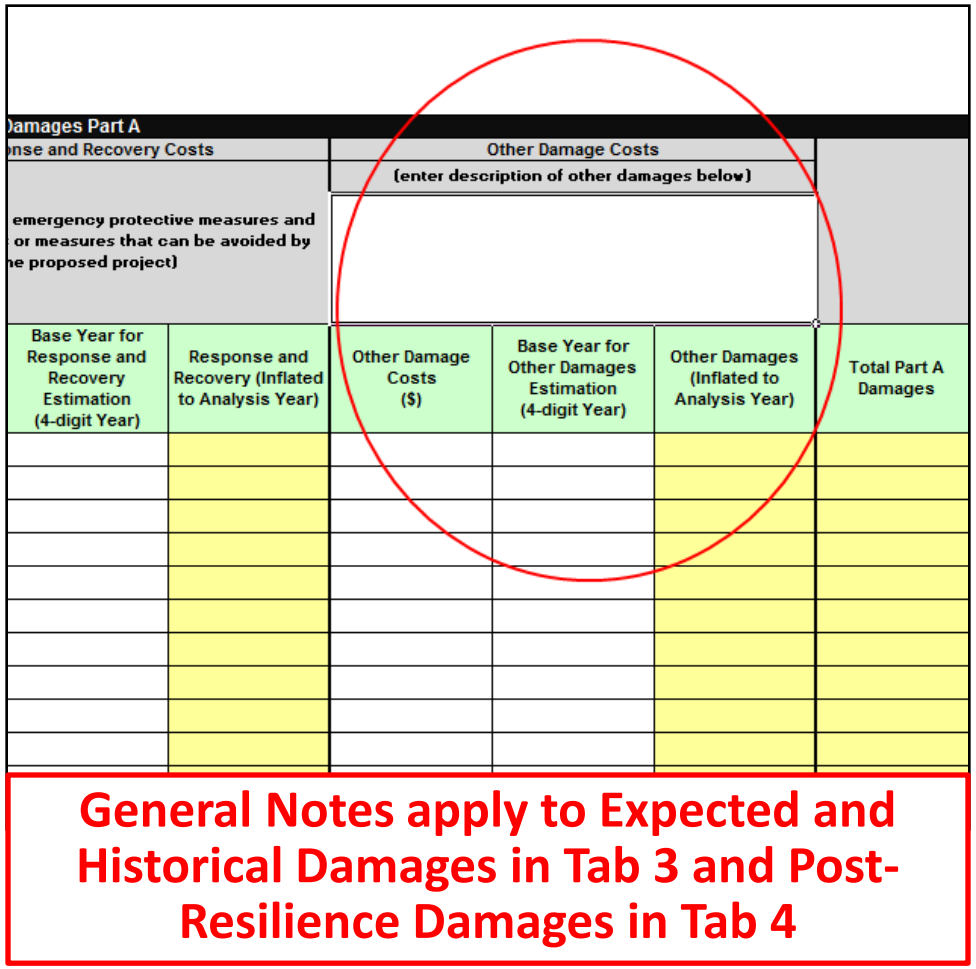


General Notes apply to Expected and Historical Damages in Tab 3 and Post-Resilience Damages in Tab 4

General Notes: Other Damage Costs

Other Damage Costs

- Enter a brief **Description of Other Damages** you are claiming.
- Enter the **Other Damage Costs** for each event (i.e., damage costs not captured by Physical Damage Costs and/or Response and Recovery Costs.)
- Enter the four-digit year in which damages were calculated in **Base Year for Other Damages** Estimation.



Damages Part A					
nse and Recovery Costs		Other Damage Costs (enter description of other damages below)			
emergency protective measures and or measures that can be avoided by he proposed project)					
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

General Notes apply to Expected and Historical Damages in Tab 3 and Post-Resilience Damages in Tab 4

General Notes: Damages Due to Delay/ Extra Travel Time in Rail or Ferry Services

Damages due to Delay and/or Extra Travel Time – Rail or Ferry

- Enter **Delay or Extra Travel Time** in hours, **Average Daily Number of Passengers**, and **Duration of Loss or Reduction of Rail Services** in days for each event.
- **Be sure to enter the average daily passengers for the year in which the damage occurred (for Historic Damages) or was estimated (for Expected Damages).**

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

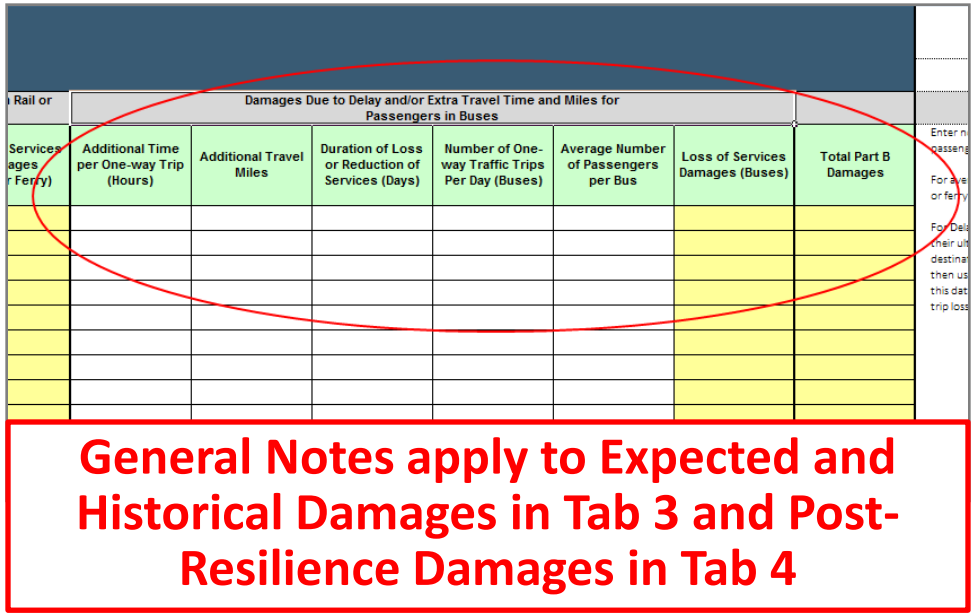
Damages Due to Delay and/or Extra Travel Time for Passengers in Rail or Ferry Services					
Recurrence Interval (Years)	Delay or Extra Travel Time (Hours)	Average Daily Number of Passengers	Duration of Loss or Reduction of Rail or Ferry Services (Days)	Loss of Services Damages (Rail or Ferry)	Addit per Or (

General Notes apply to Expected and Historical Damages in Tab 3 and Post-Resilience Damages in Tab 4

General Notes: Damages Due to Delay/ Extra Travel Time for Bus Passengers

Damages due to Delay and/or Extra Travel Time – Buses

- Enter **Additional Time per One-Way Trip** in hours, **Additional Travel Miles**, and **Duration of Loss or Reduction of Rail Services** in days, **Number of One-way Traffic Trips per Day (Buses)**, and **Average Number of Passengers** in each Bus for each event.
- **Be sure to enter the average daily passengers for the year in which the damage occurred (for Historic Damages) or was estimated (for Expected Damages).**

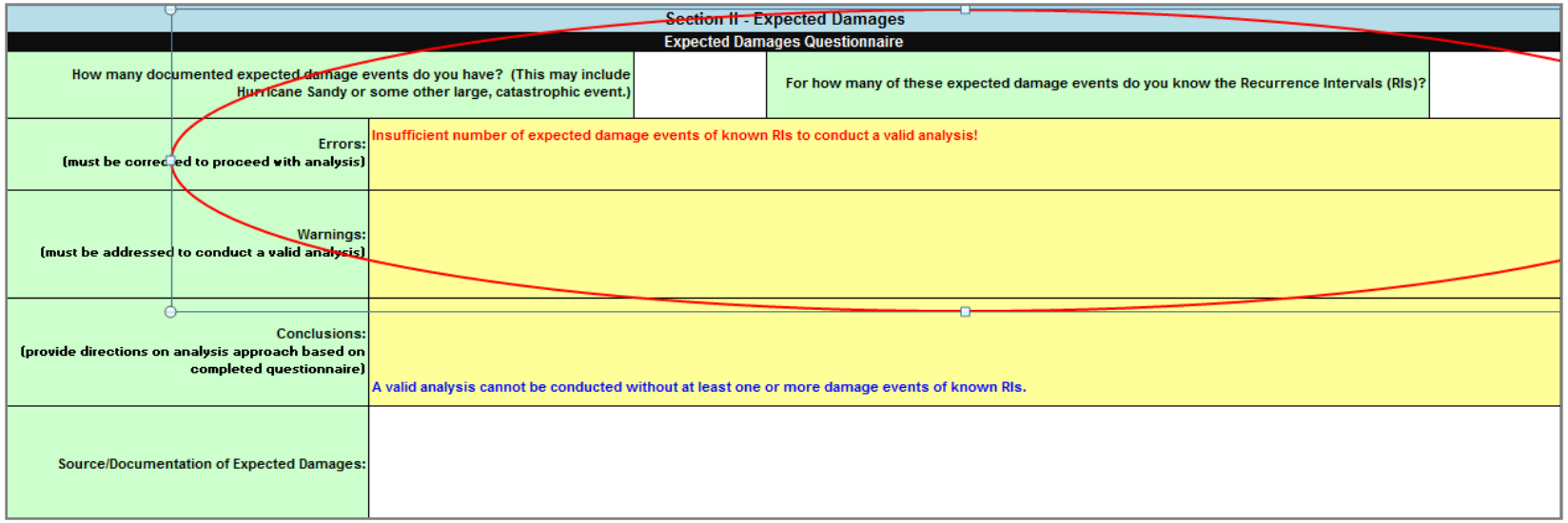


General Notes apply to Expected and Historical Damages in Tab 3 and Post-Resilience Damages in Tab 4

TAB 3 – Section II: Pre-Resilience Expected Damages Questionnaire

Expected Damages Questionnaire – Number of Events, RIs

- After selecting Expected Damages in Section I, begin Section II by entering **How many documented expected damage events your have?** (This may include one or more catastrophic events of known RI) and **For how many of these expected damage events do you know the RIs?**



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.)		For how many of these expected damage events do you know the Recurrence Intervals (RIs)?	
Errors: (must be corrected to proceed with analysis)	Insufficient number of expected damage events of known RIs to conduct a valid analysis!		
Warnings: (must be addressed to conduct a valid analysis)			
Conclusions: (provide directions on analysis approach based on completed questionnaire)	A valid analysis cannot be conducted without at least one or more damage events of known RIs.		
Source/Documentation of Expected Damages:			

TAB 3 – Section II: Expected Damages Questionnaire (continued)

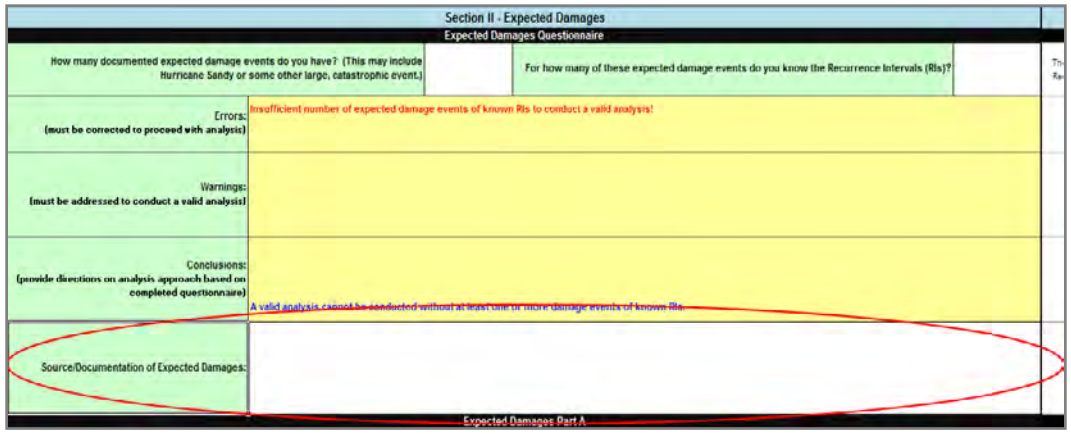
Expected Damages Questionnaire – Rules on Number of Events, RIs

- You need between 1 and 12 expected damage events, and you must know the RI for each event to be included in your analysis.
- If your entries do not meet the criteria, then Errors, Warnings and/or Conclusions will appear.
  - **Errors** must be corrected to proceed with analysis
  - **Warnings** must be addressed to conduct a valid analysis
  - **Conclusions** provide directions on analysis approach
- Analyses based on one damage event of known RI are of limited accuracy and are not recommended.
- Analyses based on two or more expected damage events of known RIs are preferred, especially if one or more are based on Hurricane Sandy or some other large, catastrophic event

TAB 3 – Section II: Source of Expected Damages

Source/Documentation of Expected Damages

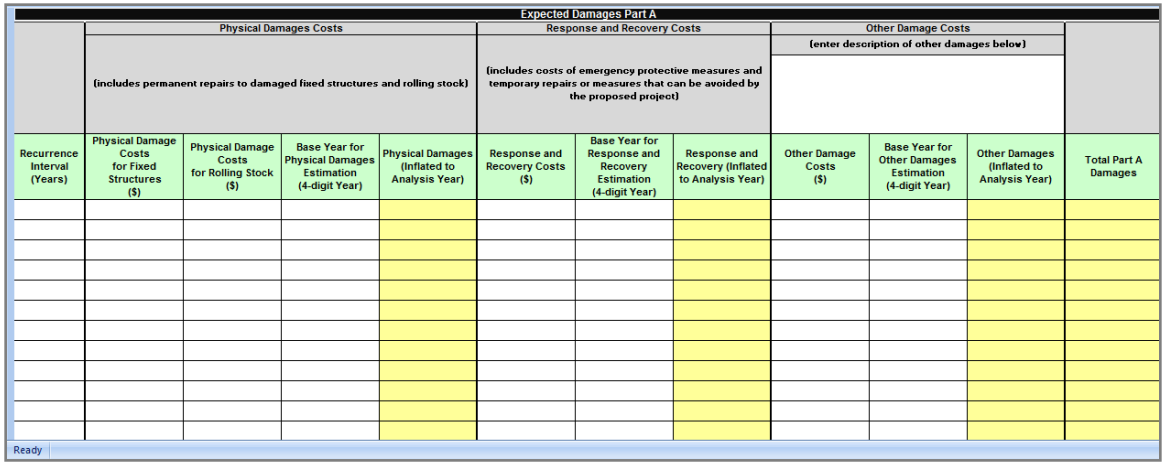
- Describe or list the **Source/Documentation of Expected Damages**
- Expected damages (including service losses) and event RIs may be documented using transit agency studies, DOT traffic studies, engineering reports or other sources (building damage functions from FEMA BCA or HAZUS-MH, FEMA flood hazard RI data, ASCE 7 wind RI data)
- Include copies of studies or reports with the source and methodology used to determine expected damages as separate attachments.



TAB 3 – Section II: Expected Damages and Service Losses

Expected Damages and Service Losses

- Follow the General Notes on Entering Damages to complete Expected Damages Part A (damages) and Part B (service losses)
- Remember if you start a row in Part A, you must enter a value in every white cell in that row in Parts A and B, even if the value is 0.



Expected Damages Part A

	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)			
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

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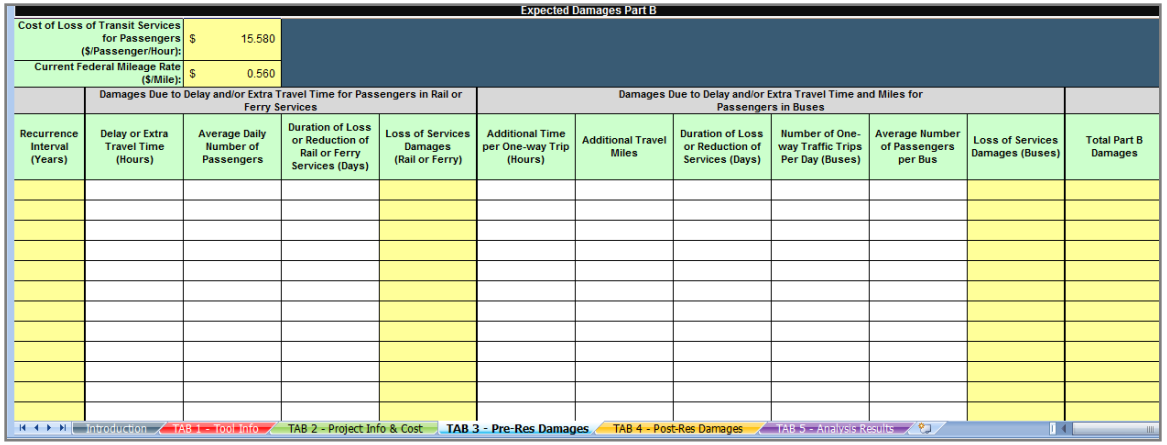


Expected Damages Part B

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)	Total Part B Damages

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

TAB 3 – Section III: Pre-Resilience Historic Damages – Analysis Duration

Historic Damages – Analysis Duration

- After selecting Historic Damages in Section I, begin Section III by entering the 4-digit **Year Built** of the facility being protected to determine the Analysis Duration.
- Regardless of you entry for the Year Built, the Analysis Duration does not go back before 1908, and the calculations will use a Analysis Duration is 10 years.

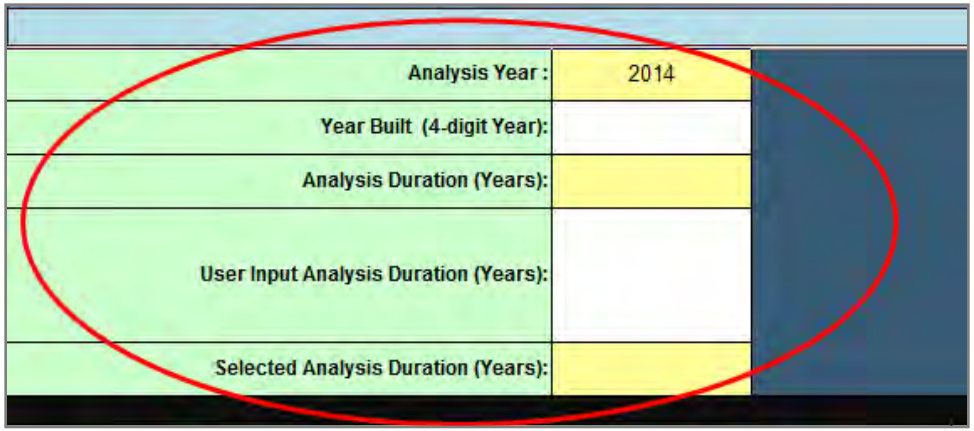
Section III - Historic Damages			
Analysis Year :	2014		
Year Built (4-digit Year):			
Analysis Duration (Years):			
User Input Analysis Duration (Years):			
Selected Analysis Duration (Years):			
Historic Damages Questionnaire			
How many documented historic damage events do you have? (This may include Hurricane Sandy or some other large, catastrophic event.)		For how many of these historic damage events do you know the Recurrence Intervals (RIs)?	
Errors: (must be corrected to proceed with analysis)	Insufficient number of historic damage events of known RIs to conduct a valid analysis!		
Warnings: (must be addressed to conduct a valid analysis)			
Conclusions: (provide directions on analysis approach based on completed questionnaire)	A minimum of one historic event of known RI or three historic events of unknown RI are needed to conduct a valid analysis.		
Source/Documentation of Historic Damages:			

TAB 3 – Section III: Historic Damages – Analysis Duration Adjustments

Historic Damages – Number of Events, RIs

- Enter a **User Input Analysis Duration** in years if you choose to adjust the Analysis Duration from the duration based on the Year Built.
- User Input Analysis Duration may be used with supporting documentation for the following situations:

1) Discontinuities in damage records
2) Replacement of facility
3) Change in local flow conditions
4) Structure age is old or hard to determine (use 50 years)



NOTE: Significant documentation requirements apply for User Input Analysis Durations of less than 30 years

TAB 3 – Section III: Historic Damages Questionnaire

Historic Damages Questionnaire – Number of Events, RIs

- After selecting Historic Damages in Section I and determining the Analysis Duration, continue Section III by entering **How many documented historic damage events your have?** (This may include one or more catastrophic events of known RI) and **For how many of these historic damage events do you know the RIs?**

Section III - Historic Damages			
Analysis Year :	2014		
Year Built (4-digit Year):			
Analysis Duration (Years):			
User Input Analysis Duration (Years):			
Selected Analysis Duration (Years):			
Historic Damages Questionnaire			
How many documented historic damage events do you have? (This may include Hurricane Sandy or some other large, catastrophic event.)		For how many of these historic damage events do you know the Recurrence Intervals (RIs)?	
Errors: (must be corrected to proceed with analysis)	Insufficient number of historic damage events of known RIs to conduct a valid analysis!		
Warnings: (must be addressed to conduct a valid analysis)			
Conclusions: (provide directions on analysis approach based on completed questionnaire)	A minimum of one historic event of known RI or three historic events of unknown RI are needed to conduct a valid analysis.		
Source/Documentation of Historic Damages:			

TAB 3 – Section III: Historic Damages Questionnaire (continued)

Historic Damages Questionnaire – Rules on Number of Events, RIs

- You must have between 1 and 12 historic damage events that meet one of the following situations.
  1) At least 3 historic events with unknown RIs occurring in different years
  2) At least 1 (no more than 2) historic events with known RIs
  3) A combination of historic events with known and unknown RIs as described in situations 1) and 2), where the total values of the known RI events exceed the values of all unknown RI events
- Entries that do not meet the criteria will generate Errors, Warnings and/or Conclusions
  - **Errors** must be corrected to proceed with analysis
  - **Warnings** must be addressed to conduct a valid analysis
  - **Conclusions** provide directions on analysis approach

TAB 3 – Section III: Historic Damages Questionnaire (continued)

Historic Damages Questionnaire – Preferred Approaches

- As with expected damages, analyses based on one historic damage event of known RI are of limited accuracy and are not recommended.
- Analyses based on two historic events of known RIs are better, especially if one of the known historic event RIs is for Hurricane Sandy (or some other large, catastrophic event) and the other known historic event RI is based on a more frequently occurring event.
- Analyses based on three or more historic events with a combination of up to two known RIs are preferred, especially if one or more of the known historic event RIs is for Hurricane Sandy or some other large, catastrophic event and the other historic event RIs are based on more frequently occurring events.

TAB 3 – Section III: Source of Historic Damages

Source/Documentation of Historic Damages

- Describe or list the **Source/Documentation of Historic Damages**
  - Historic damages – including service losses - may be documented using disaster damage worksheets, insurance claims, repair records, news articles citing credible sources, transit agency statistics, maps, or annual reports
  - Historic event RIs may be documented using stream or tide gage data, FEMA FIS data, agency/expert determination, climatological data, rain gauge data, FEMA BCA information, or ASCE data
- Include copies of studies or reports with the source and methodology used to determine historic damages as separate attachments.

Historic Damages Questionnaire			
How many documented historic damage events do you have? (This may include Hurricane Sandy or some other large, catastrophic event.)		For how many of these historic damage events do you know the Recurrence Intervals (RIs)?	
Errors: (must be corrected to proceed with analysis)	Insufficient number of historic damage events of known RIs to conduct a valid analysis!		
Warnings: (must be addressed to conduct a valid analysis)			
Conclusions: (provide directions on analysis approach based on completed questionnaire)	A minimum of one historic event of known RI or three historic events of unknown RI are needed to conduct a valid analysis.		
Source/Documentation of Historic Damages:			
Historic Damages Part A (Unknown Recurrence Interval)			

TAB 3 – Section III: Historic Damages and Service Losses with Unknown RIs

Historic Damages & Service Losses (Unknown RIs)

- Follow General Notes on Entering Damages to complete Historic Damages Part A (damages) and Part B (service losses)
- Remember if you start a row in Part A, you must enter values in every white cell in that row in Parts A and B, even if the value is 0.

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)	Total Part A Damages

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)	Total Part B Damages

TAB 3 – Section III: Historic Damages and Service Losses with Known RIs

Historic Damages & Service Losses (Known RIs)

- Follow General Notes on Entering Damages to complete Historic Damages Part C (damages) and Part D (service losses)
- Remember if you start a row in Part C, you must enter values in every white cell in that row in Parts C and D, even if the value is 0.

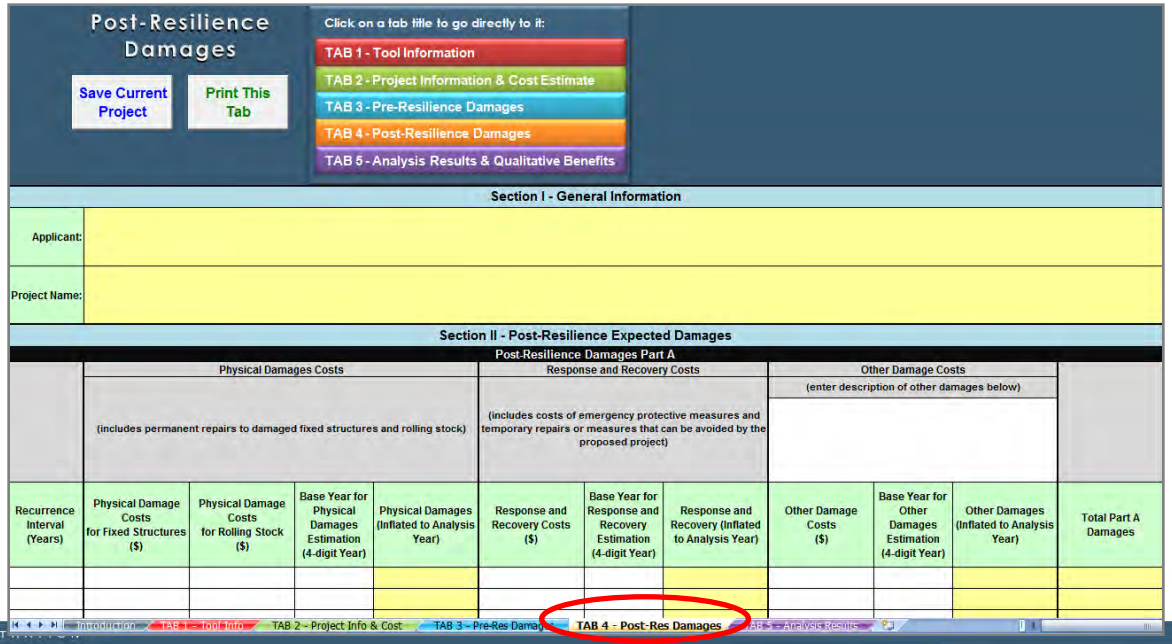
Historic Damages Part C (Known Recurrence Interval)											
		Physical Damages Costs (includes permanent repairs to damaged fixed structures and rolling stock)				Response and Recovery Costs (includes costs of emergency protective measures and temporary repairs or measures that can be avoided by the proposed project)			Other Damage Costs (enter description of other damages below)		
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 Damages (Inflated to Current Year)

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 Services Damages (Buses)

TAB 4: Post-Resilience Damages

TAB 4 – Post-Resilience Damages

- Tab 4 in the HMCE Tool provides data on post-resilience damages
- Post-resilience damages are damages expected to occur after the resilience project design level of effectiveness been reached. For instance, if a project is designed to protect up to the 500-year event, there should be some post-resilience damages beginning at the 500-year event



TAB 4: Post-Resilience Damages – Basic Guidance Assumptions

Post-resilience damages estimation guidance assumptions based on project type, design level of effectiveness, and pre-resilience damages:

- Acquisition/Relocation: Zero post-resilience damages
- Elevation: No post-resilience damages until design level of effectiveness is reached, then use minimum pre-resilience damages beginning at design level of effectiveness
- Flood barriers/Dry floodproofing: No pre-resilience damages until design level of effectiveness is reached, then apply pre-resilience damages that would occur at that flood level
- Wet floodproofing: Reduce pre-resilience damages to reflect reduced cleanup or downtime costs until design level of effectiveness is reached, then apply maximum pre-resilience damages that would occur for that flood level
- Other projects: Generally use no post-resilience damages until design level of effectiveness if reached, then either conservatively assume the maximum pre-resilience damages once the design level of effectiveness is reached or incrementally increase pre-resilience damages as RIs increase.

TAB 4: Post-Resilience Damages and Service Losses

Post-Resilience Damages and Service Losses

- Follow the General Notes on Entering Damages to complete Post-Resilience Damages Part A (damages) and Part B (service losses)
- Remember if you start a row in Part A, you must enter a value in every white cell in that row in Parts A and B, even if the value is 0.

Section II - Post-Resilience Expected Damages

Post-Resilience Damages Part A

	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)			
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

Post-Resilience Damages Part B

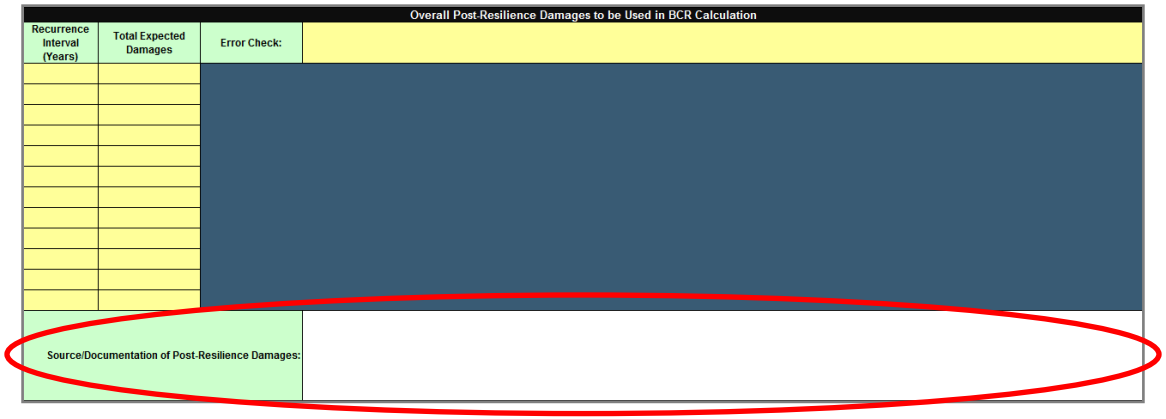
Cost of Loss of Transit Services for Passengers ($/Passenger/Hour):	$	15.580
Current Federal Mileage Rate ($/Mile):	$	0.560

	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	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

TAB 4: Source of Post-Resilience Damages

Source/Documentation of Post-Resilience

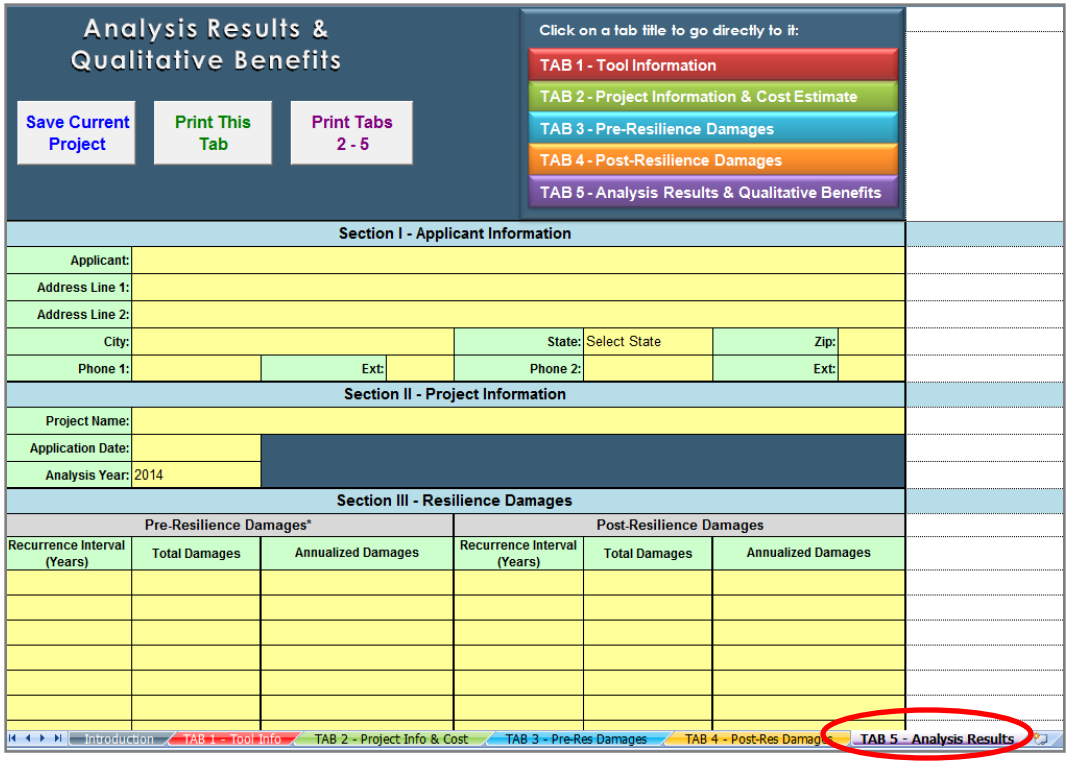
- At the bottom of Tab 4, describe or list the **Source/Documentation of Post-Resilience Damages**
- Post-resilience damages (including service losses) may be documented using engineering or technical reports, detailed project scopes with plans and specifications
- Include copies of studies or reports with the source and methodology used to determine post-resilience damages as separate attachments.



TAB 5 – Analysis Results & Qualitative Benefits: Overview

TAB 5 – Analysis Results & Qualitative Benefits

- Tab 5 - Sections I-IV review project benefits and costs calculated by the HMCE Tool and provide a Benefit-Cost Ratio (BCR) as the final output
- Tab 5 – Section V allows users to input other qualitative project benefits that may not be reflected in the HMCE Tool BCR

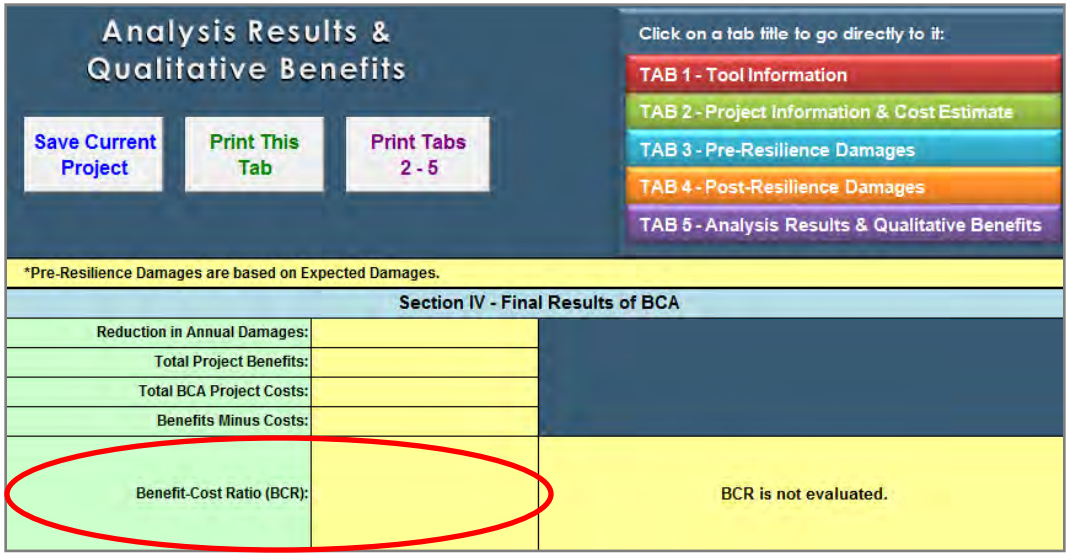


TAB 5 – Section IV: Final Results of BCA (Benefit-Cost Ratio)

Final Results of BCA: Expressed as a Benefit-Cost Ratio (BCR)

- BCR > 1.0 indicates the project is cost-effective
- BCR < 1.0 indicates that 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.
- A negative BCR (< 0.0) indicates the project is not effective at reducing damages and losses.

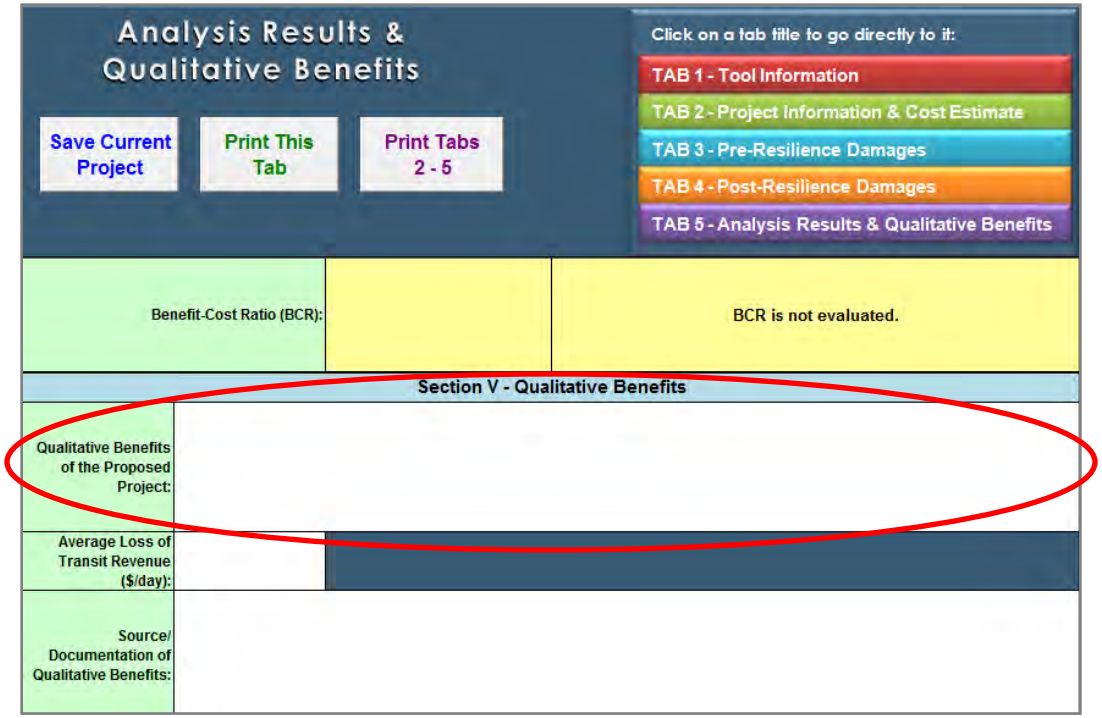
Remember: The BCR is one of seven factors that will be considered in grant proposal reviews; so a BCR less than 1.0 will not automatically remove a proposal from consideration



TAB 5 – Section V: Qualitative Benefits

Qualitative Benefits

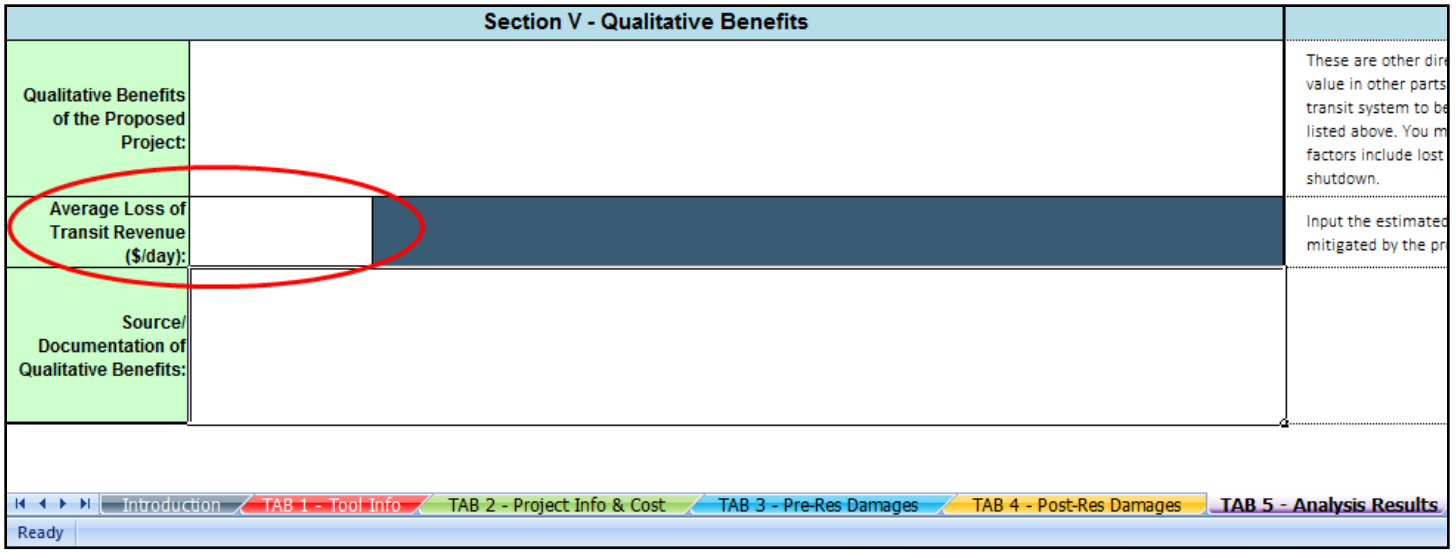
- Input **Qualitative Benefits of the Proposed Project** that are not reflected in the qualitative analysis portions of the tool
- Qualitative Benefits are other direct or indirect project benefits that cannot or have not been quantified in dollar value in other parts of the BCA, but would contribute to the general goal of sustainability of the facility or transit system to be protected.



TAB 5 – Section V: Average Daily Loss of Transit Revenue

Average Daily Loss of Transit Revenue

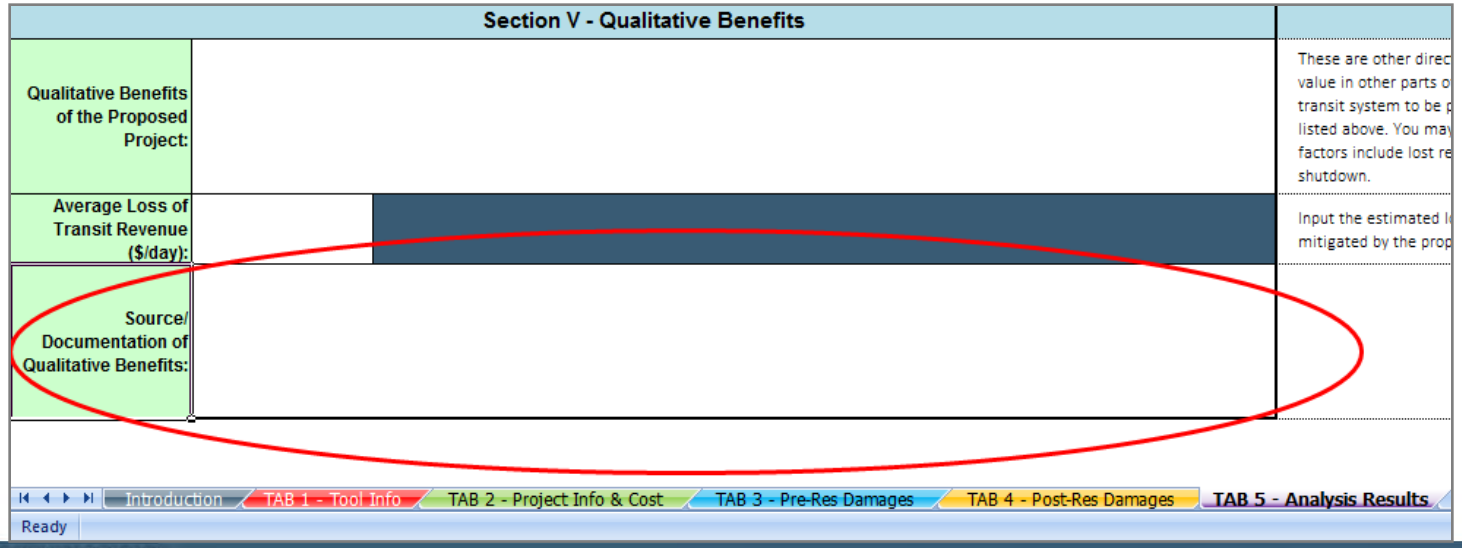
- Enter the estimated **Average Loss of Transit Revenue** to the transit agency in dollars per day due to a shutdown of the transit line or asset to be mitigated by the proposed resilience project.
- This input allows for accounting of lost revenue to the transit line and associated businesses due to a transit line shutdown.



TAB 5 – Section V: Source of Qualitative Benefits

Source/Documentation of Qualitative Benefits

- Describe or list the **Source/Documentation of Qualitative Benefits**
  - Qualitative benefits may be documented using many of the sources listed for other damages and losses in the HMCE Tool, as well as non-engineering studies of societal and economic impacts
- Include copies of studies or reports with the source and methodology used to determine historic damages as separate attachments.



Questions and Answers