

# Performing a Hazus Level 2 Analysis

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**Stantec**

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# Overview

- Level 1 – Default hazard, inventory and damage information
- Level 2 – Includes local and default hazard, inventory and damage data
- Level 3 – Includes hazard specific data

User effort and data requirements increase with levels

# Flood Analysis Level 2 - UDDG

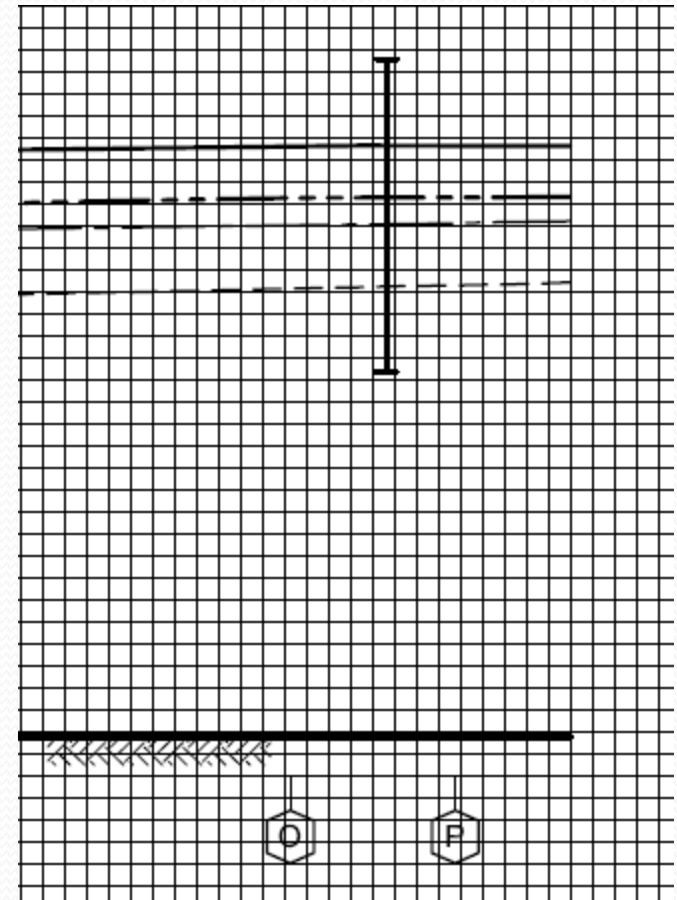
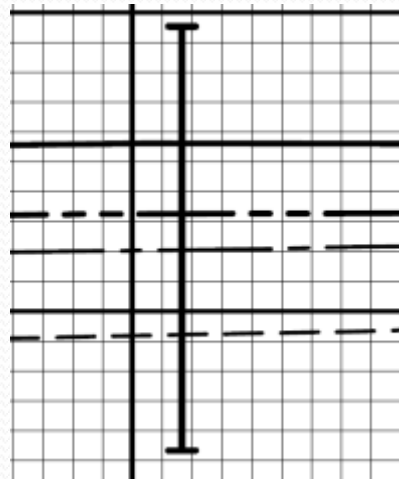
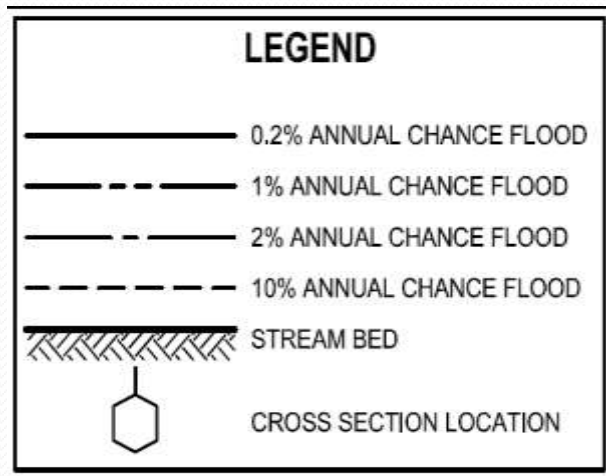
- Gather 10, 25, 50, 100, & 500 recurrence intervals
- Create UDDG for each recurrence interval
- Import each UDDG through the User-Defined datasets
- Create Annualized Scenario and Delineate Floodplain
- Run the Analysis on all intervals and Annualized Loss.
- Interpret Results.

**FLOOD  
INSURANCE  
STUDY**



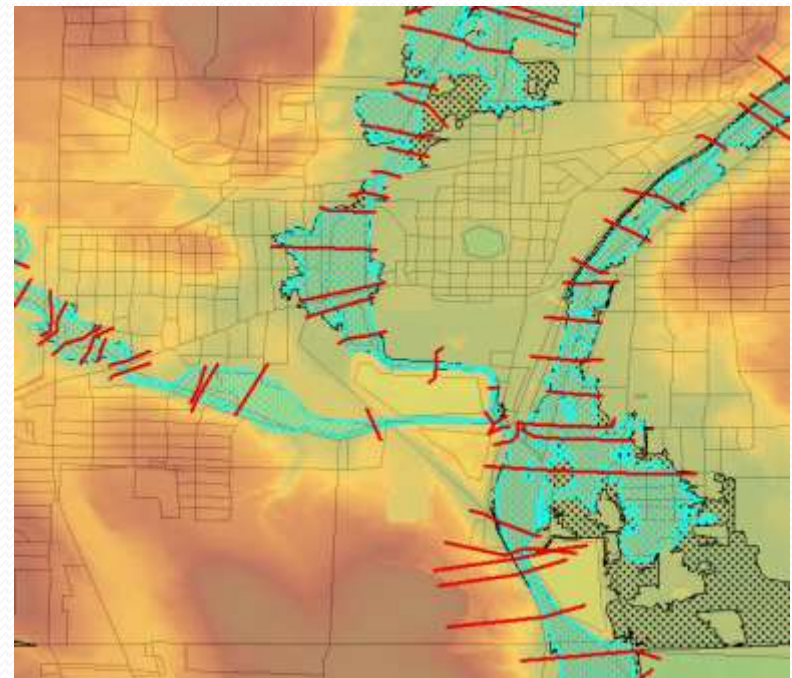
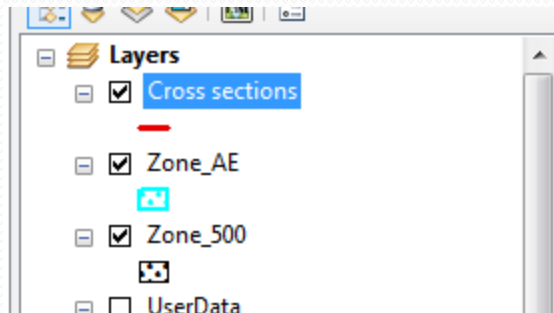
# Gathering the Recurrence Interval Elevations

- FEMA Cross Section Elevations from a Flood Insurance Study (FIS), Stream Profiles contain the 10, 50, 100, & 500 year intervals.



# Gathering the Recurrence Interval – Populating Elevations

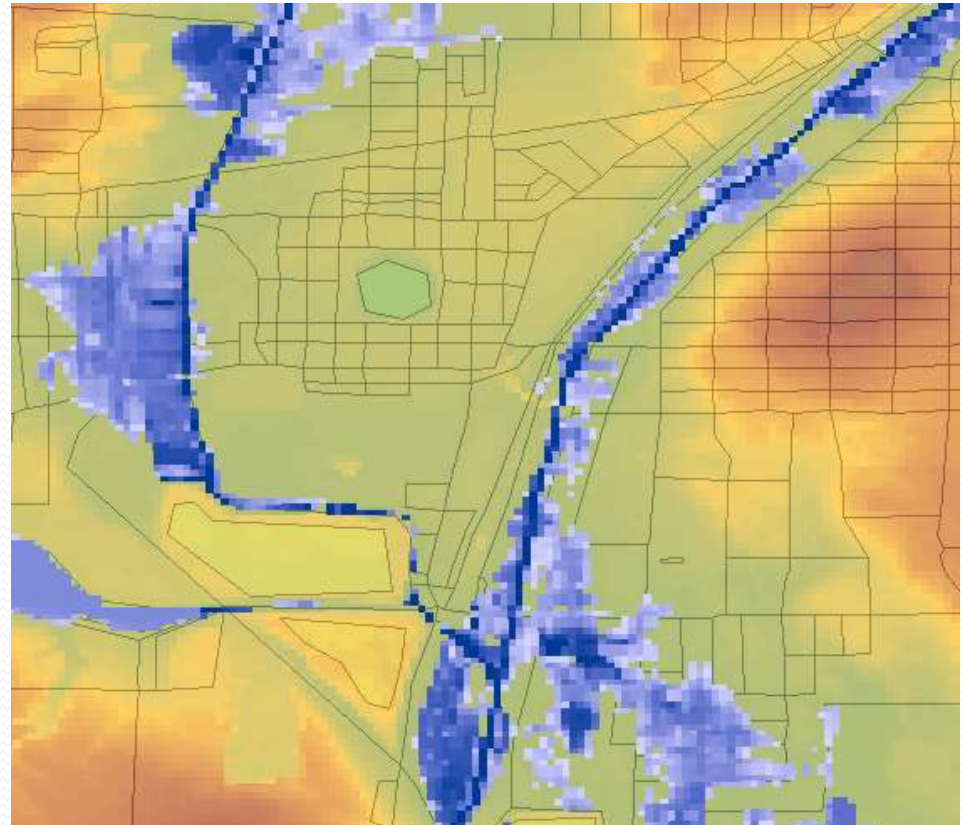
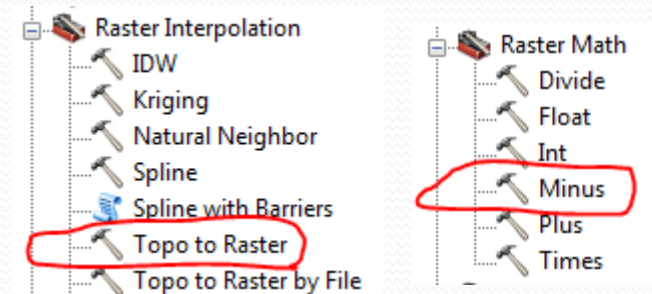
ten_year	year_25	year_50	year_100	year_500	Station
967.2	967.9	968.6	969	969.6	4.2
967.7	968.15	968.6	969	969.6	4.1
967	967.7	968.4	968.7	969.5	4
966.9	967.6	968.3	968.7	969.4	3.9
966.4	967.9	969.4	970.7	972.5	7139
965.9	966.65	967.4	967.9	969.1	20370
966.4	967.85	969.3	970.5	972.3	6696
965.9	966.6	967.3	967.8	969	19580
966.8	967.5	968.2	968.6	969.3	3.7
966.4	967.8	969.2	970.5	972.3	6300
966	967.45	968.9	970.3	972	5940





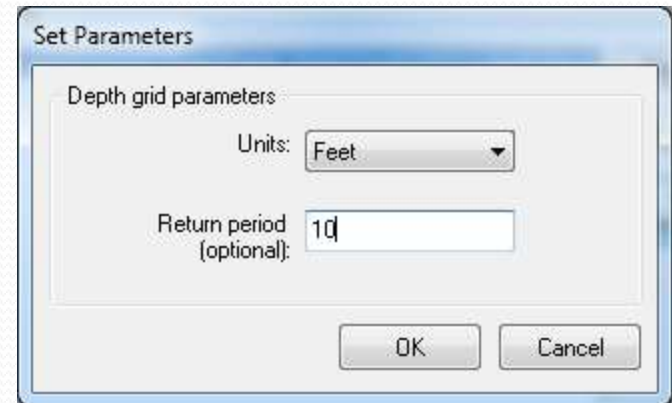
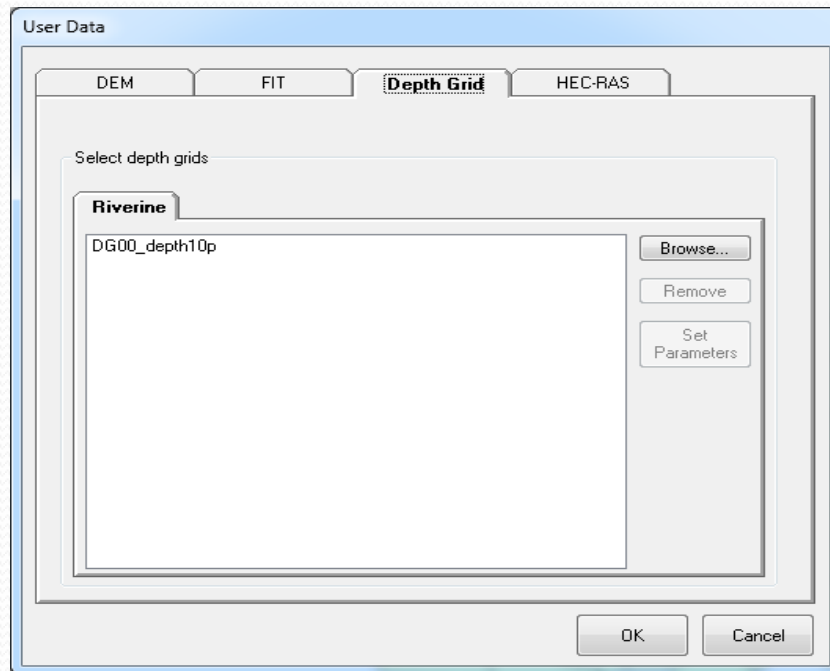
# Create UDDG for each Recurrence Interval

- User-Defined Depth Grids (UDDG) created in ESRI ArcMap software.
- Create a Water Surface Terrain from the cross sections
- Perform a Minus Function to get the change in elevation from BFE to Terrain/Topography
- Clip UDDG within FEMA digital Floodplains to limit UDDG to regulatory floodplains.



# Import UDDGs into HAZUS User Supplied Data

- Import into the User Data Depth Grid tab and set Parameters for each recurrence interval.
- Use the USGS One - Arc second as the DEM user data to run scenario and process floodplain





# Create Scenario and Delineate Floodplain

- Create an Annualized scenario using the UDDGs for floodplain creation
- Select all User Data depth grids and delineate Riverine floodplain running hydraulic analysis on all Return Periods

Select map features to be included in the scenario. A single scenario may contain more than one object type.

Map layer type

☐ River reaches

☐ Coastal shorelines

☐ FIT analysis areas

☒ User-defined depth grids


Map layer selection

Add to selection

Remove from selection

Clear selection

Save selection

 Riverine Hydraulic Analysis

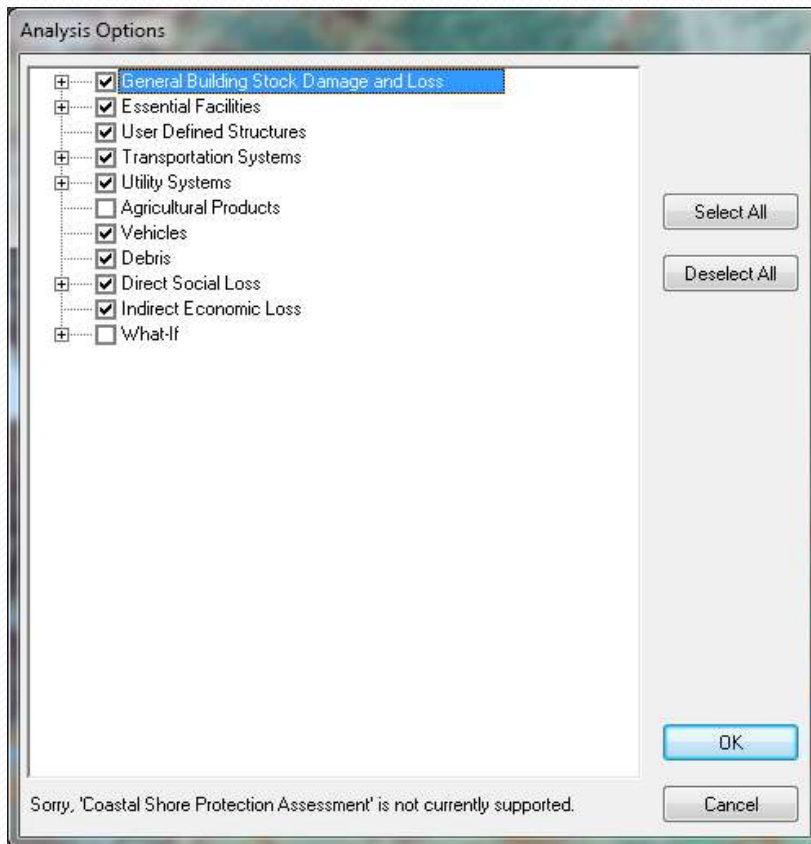
Analysis type:

Output cell size:

Riverine depth grids

DG ID	Period(s) to Analyze	Available Periods
1	10	10

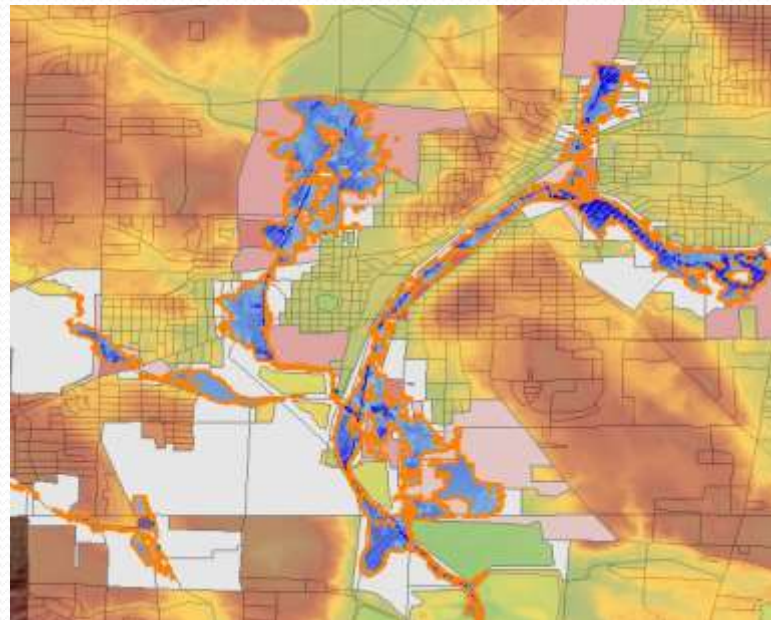
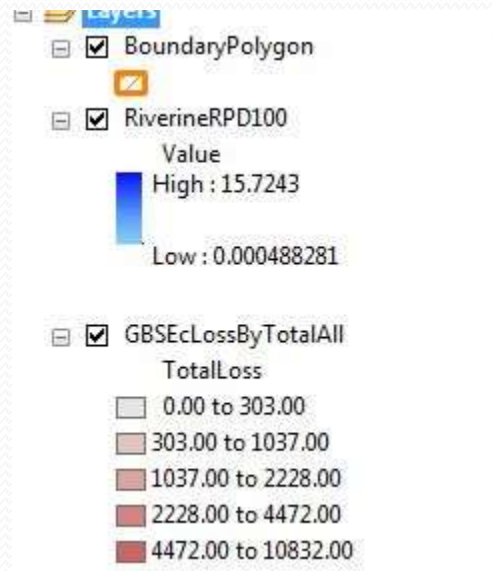
# Run Analysis & Review Results



- Run the standard Analysis options and then run the Annualized option.
- Review Results for each return period.

# Interpret Results

- Hazard maps including flood depth grid and flood boundary
- Damage estimates for inventory such as general building stock for a specific return period
- Tables and reports can be mapped and exported



# Incorporating into Hazard Mitigation Plan (HMP)

- The Summary Report as well as the Census Block level damages will be used in the Hazard Analysis portion of an HMP.
- The Level Two Analysis will help to refine a communities flooding mitigation efforts by location and resources.
- The Annualized Loss option will provide estimated annual damages.

# Incorporating into HMP – Summary Table

The total economic loss estimated for the flood is 5.85 million dollars, which represents 0.63 % of the total replacement value of the scenario buildings.

## **Building-Related Losses**

The building losses are broken into two categories : direct building losses and business interruption losses . The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood . Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 5.84 million dollars . 0% of the estimated losses were related to the business interruption of the region . The residential occupancies made up 19.21% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

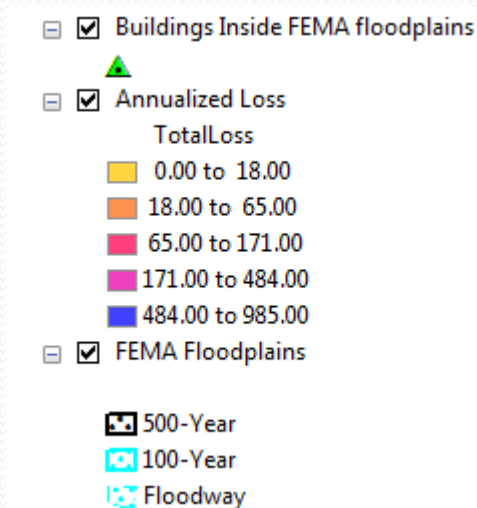
**Table 6: Building-Related Economic Loss Estimates**  
(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<b><u>Building Loss</u></b>						
	Building	0.73	0.33	0.68	0.05	1.77
	Content	0.40	1.19	1.72	0.32	3.62
	Inventory	0.00	0.04	0.41	0.01	0.45
	<b>Subtotal</b>	<b>1.12</b>	<b>1.56</b>	<b>2.78</b>	<b>0.38</b>	<b>5.84</b>
<b><u>Business Interruption</u></b>						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.01	0.00	0.00	0.01
	<b>Subtotal</b>	<b>0.00</b>	<b>0.01</b>	<b>0.00</b>	<b>0.00</b>	<b>0.01</b>
<b>ALL</b>	<b>Total</b>	<b>1.12</b>	<b>1.56</b>	<b>2.78</b>	<b>0.38</b>	<b>5.85</b>



# Incorporating into HMP – Estimated Damages

- The General Building Stock by Full Replacement will help guide a community on areas more susceptible to flooding loss.

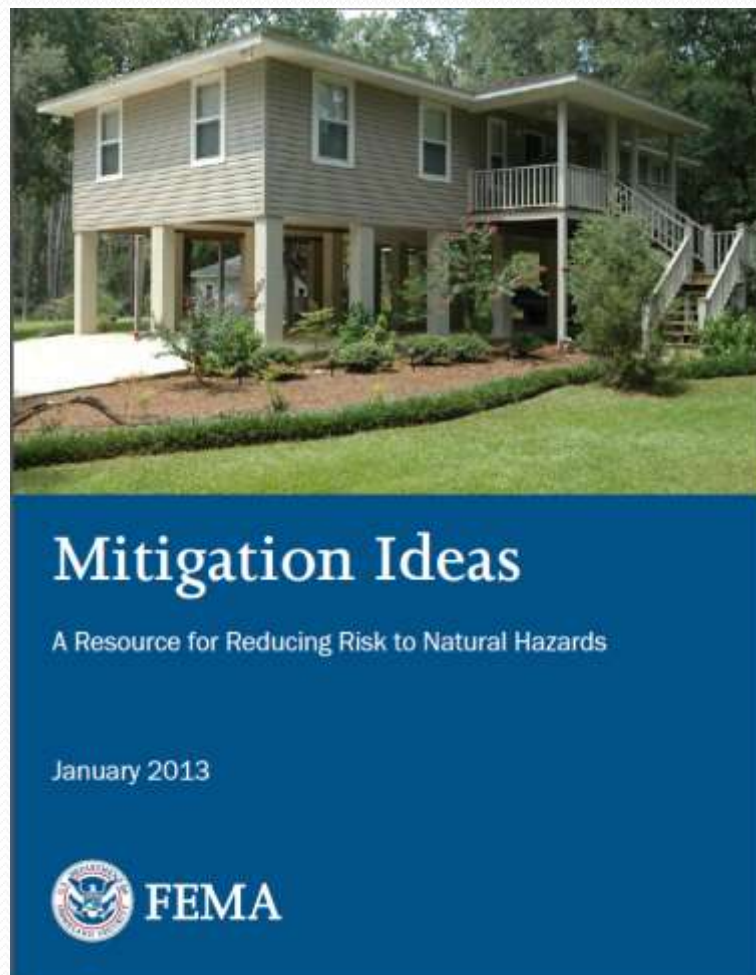




# Incorporating into HMP – Potential Flooding Mitigation Efforts

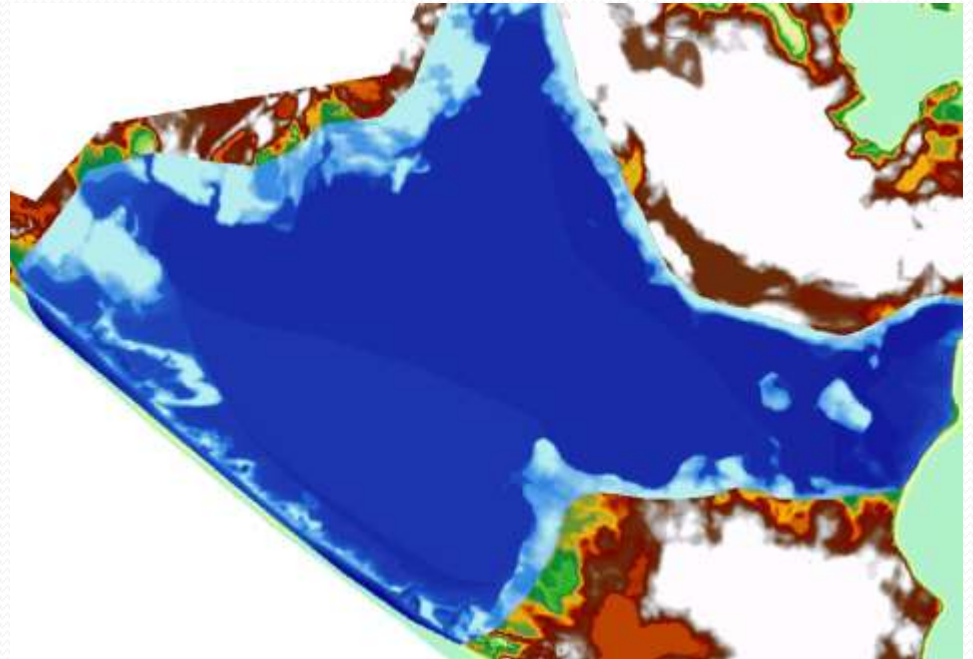
- The level 2 Analysis can Improve a communities Flood Risk Assessment.
- The structures at higher risk can be mitigated by a variety of projects (Source: FEMA Mitigation Ideas);
  - Home/Structure Buy-outs
  - Relocating Structures
  - Elevating/Retrofit Structures and Utilities

<http://www.fema.gov/resource-document-library>



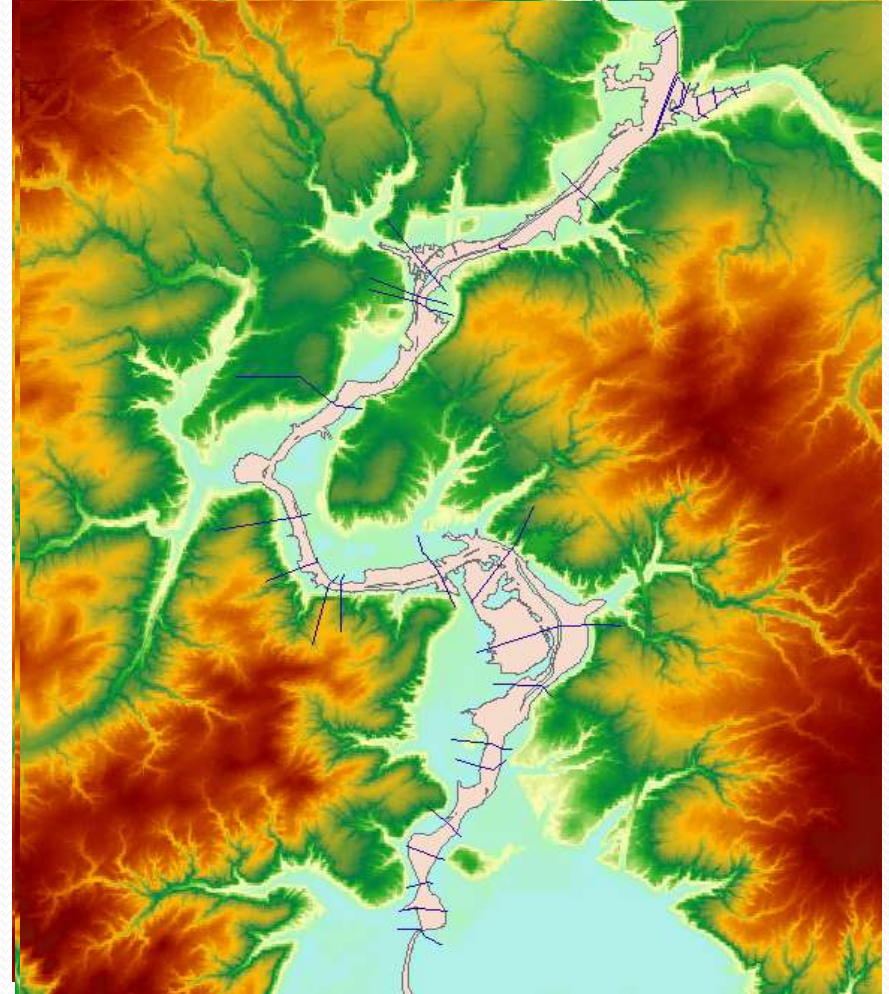
# Flood Information Tool

- Incorporate floodplains, cross sections and DEM for more refined analysis
- FIT processing is done in ARC GIS
- Used for both coastal and riverine

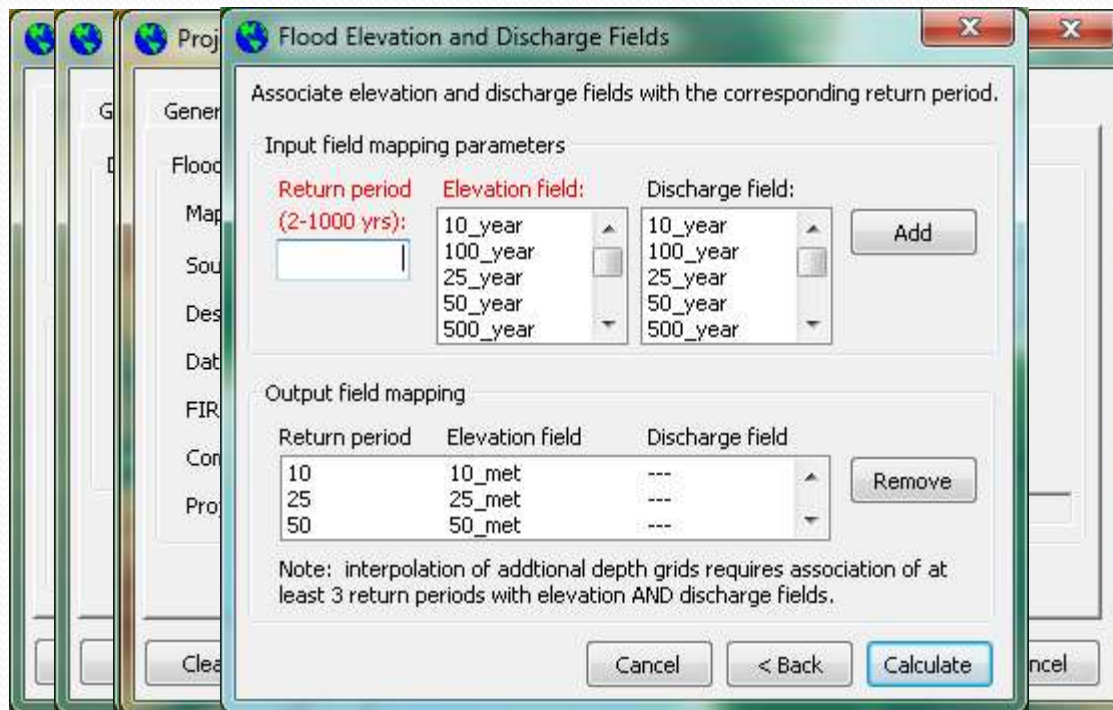


# FIT – Inputs

- DEM
- Floodplains
- Cross sections

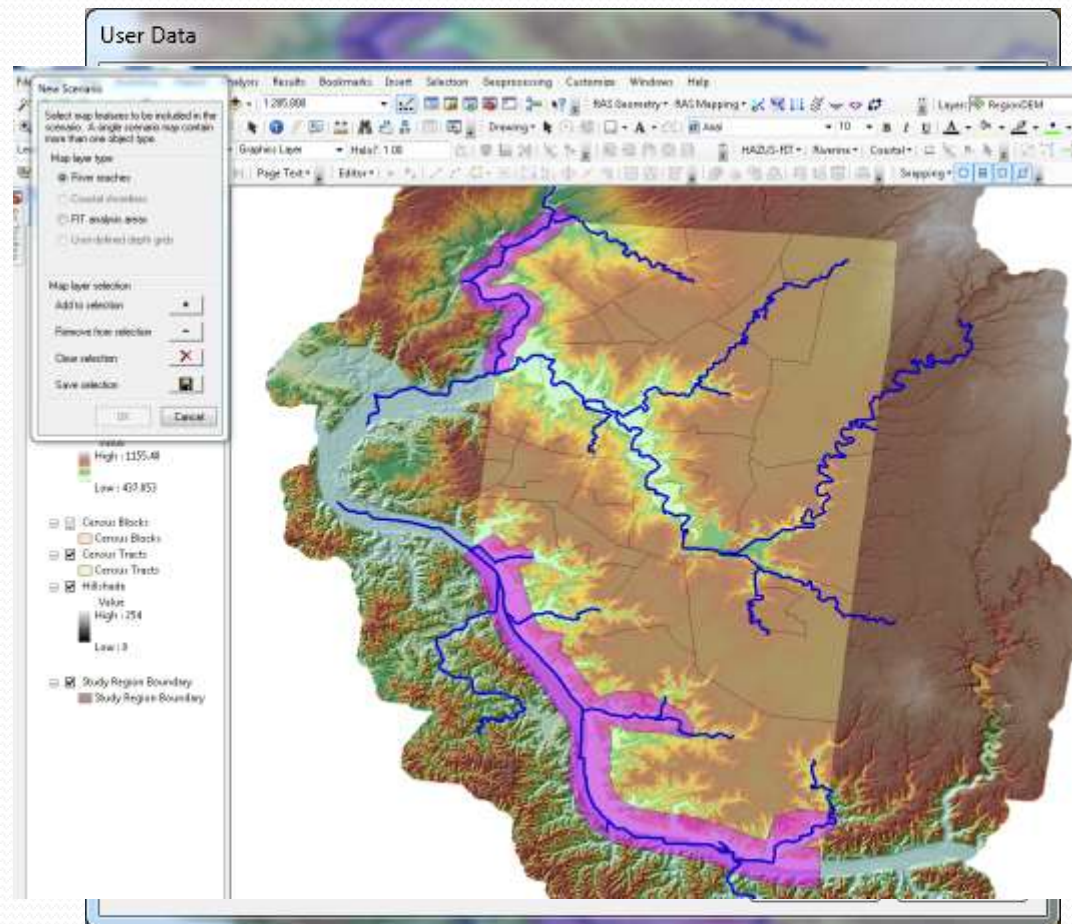


# FIT – Project set up



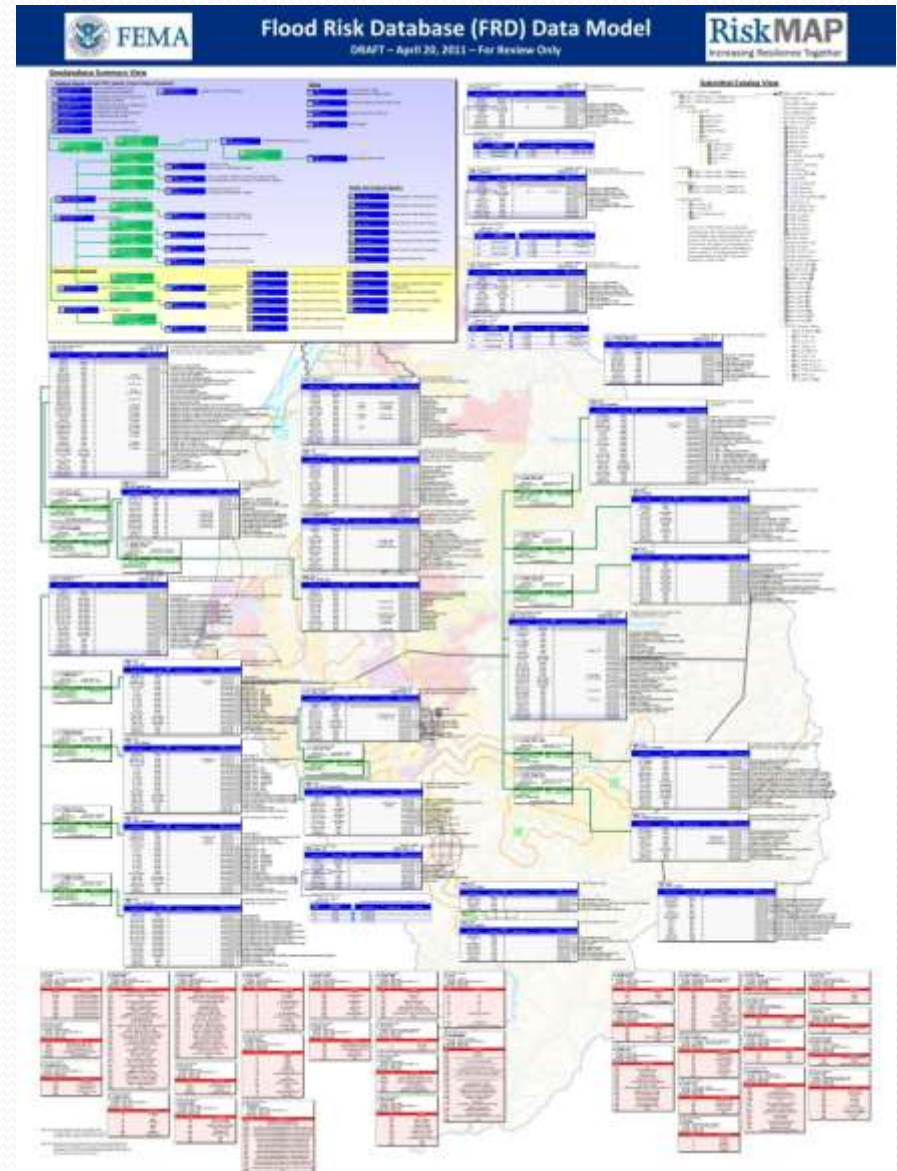


# FIT – Import in Hazus



# The FRD

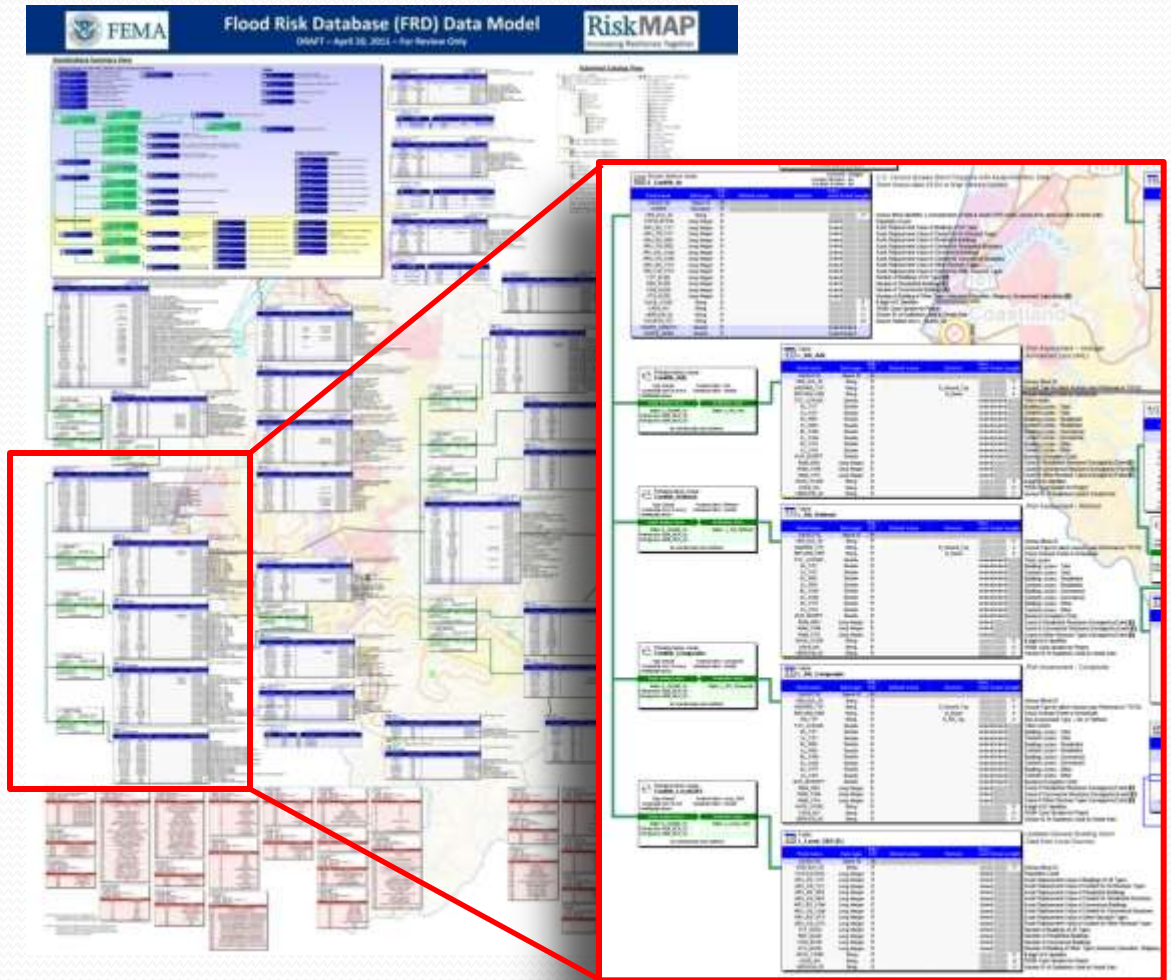
- Flood Risk Database
- Backbone of the new FEMA RiskMap products





# HAZUS components of the FRD

- AAL Analysis
- Refined Analysis
- Composite Table
- Community Summary
- All Hazus components tie into Census Block data



# HAZUS Data within the FRD

Table L_RA_Composite							Risk Assessment - Composite	
Field name	Data type	R/A / O/E	Default value	Domain	Precision Scale		Length	
OBJECTID	Object ID	R						
CEN_BLK_ID	String	R					17	Census Block ID
HAZARD_TYP	String	R		D_Hazard_Typ			4	Hazard Type for which Analysis was Performed or 'TOTAL'
RETURN_PER	String	R		D_Event			6	Hazus Analysis Event or Annualized
RA_TYP	String	R		D_RA_Typ			3	Risk Assessment Type – AAL or Refined
TOT_LOSSES	Double	R			Default	Default		Total Losses
BL_TOT	Double	R			Default	Default		Building Losses - Total
CL_TOT	Double	R			Default	Default		Content Losses - Total
BL_RES	Double	R			Default	Default		Building Losses - Residential
CL_RES	Double	R			Default	Default		Content Losses - Residential
BL_COM	Double	R			Default	Default		Building Losses - Commercial
CL_COM	Double	R			Default	Default		Content Losses - Commercial
BL_OTH	Double	R			Default	Default		Building Losses - Other
CL_OTH	Double	R			Default	Default		Content Losses - Other
BUS_DISRUPT	Double	R			Default	Default		Business Disruption Costs
NUM_RES	Long Integer	E			Default			Count of Residential Structures Damaged by Event [E]
NUM_COM	Long Integer	E			Default			Count of Commercial Structures Damaged by Event [E]
NUM_OTH	Long Integer	E			Default			Count of Other Structure Types Damaged by Event [E]
HUC8_CODE	String	R					8	8-digit HUC Identifier
CASE_NO	String	R					12	FEMA Case Number for Project
VERSION_ID	String	R					11	Version ID of Guidelines Used to Create Data

# Data Development

- Data is generated in Hazus, then applicable tables are exported according to census block and imported into the database using GIS.

Direct Economic Losses For Full Replacement Value

By General Occupancy | By Specific Occupancy | By General Building Type | Total

Results for: Scenario: New100 Return period: 100

Pre/Post File: Total

Economic Losses (Thous. dollars)

	CensusBlock	TotalLoss	BuildingLoss	ContentLoss	InventoryLoss	RelocationC
1	391517002004023	0	0	0	0	0
2	391517002004028	0	0	0	0	0
3	391517002004029	0	0	0	0	0
4	391517002004030	0	0	0	0	0
5	391517002004031	15	4	12	0	0
6	391517002004071	25	14	0	0	0
7	391517002004072	204	52	136	16	0
8	391517002004073	15	5	7	0	0
9	391517002004074	285	57	224	0	0
10	391517002004075	1083	366	629	80	0
11	391517002004076	342	75	241	20	0
12	391517002004077	57	10	33	1	0
13	391517002004078	0	0	0	0	0
14	391517002004079	424	134	266	19	0
15	391517002004080	0	0	0	0	0

Close Map Print

Table	CEN_BLK_ID *	HAZARD_TYP	RETURN_PER
L_RA_Composi	391517132011023	Riverine	0.2% Chance Event (500-yr)
	391517132011023	Riverine	1% Chance Event (100-yr)
	391517132011023	Riverine	2% Chance Event (50-yr)
	391517132011023	Riverine	4% Chance Event (25-yr)
	391517132011023	Riverine	10% Chance Event (10-yr)
	391517132011023	Riverine	Average Annual
Field name	391517132011027	Riverine	0.2% Chance Event (500-yr)
OBJECTID	391517132011027	Riverine	1% Chance Event (100-yr)
CEN_BLK_ID	391517132011027	Riverine	2% Chance Event (50-yr)
HAZARD_TYP	391517132011027	Riverine	4% Chance Event (25-yr)
RETURN_PER	391517132011027	Riverine	10% Chance Event (10-yr)
RA_TYP			
TOT_LOSSES			
BL_TOT	Double	R	Default Default
CL_TOT	Double	R	Default Default
BL_RES	Double	R	Default Default
CL_RES	Double	R	Default Default
BL_COM	Double	R	Default Default
CL_COM	Double	R	Default Default
BL_OTH	Double	R	Default Default
CL_OTH	Double	R	Default Default
BUS_DISRUPT	Double	R	Default Default
NUM_RES	Long Integer	E	Default
NUM_COM	Long Integer	E	Default
NUM_OTH	Long Integer	E	Default
HUC8_CODE	String	R	8
CASE_NO	String	R	12
VERSION_ID	String	R	11

# Flood Map Desktop

**Create/Add Project**

Project Type:  Database Format: Access Created By: bschattschneider

Spatial Reference:

☒ New Project ☐ Existing Project

File name without extension:

**Table Of Contents**

- Project Management
  - Workspace: FRD
    - Flood Risk: FRD
      - Data
        - County
        - FRD\_Model\_Info
        - FRD\_STUDY\_INFO
        - FRR\_Custom
        - FRR\_Images
        - FRR\_Project
        - L\_AOMI\_Summary
        - L\_Claims
        - L\_CSLF\_Summary
        - L\_Exposure
        - L\_Local\_GBS
        - L\_RA\_AAL
        - L\_RA\_Composite
        - L\_RA\_Refined
        - L\_RA\_Summary
        - L\_RA\_UDF\_Refined
        - L\_Source\_Cit
        - S\_AOMI\_Pt
        - S\_Carto\_Ar
        - S\_Carto\_Ln
        - S\_Carto\_Pt
        - S\_CenBlk\_Ar
        - S\_CSLF\_Ar
        - S\_FRD\_Pol\_Ar
        - S\_FRD\_Proj\_Ar
        - S\_FRM\_Callout\_Ln
        - S\_HUC\_Ar

# Average Annualized Loss (AAL)

- Level 1 HAZUS flood analysis – Run once, nationwide
- Run for 5 return periods (10, 4, 2, 1, and 0.2% annual chance flood events) in addition to Annualized result
- Only details Total Loss estimates for the events, not a detailed breakdown of damages

CEN_BLK_ID *	HAZARD_TYP	RETURN_PER	TOT_LOSSES	BL_TOT	CL_TOT	BL_RES	CL_RES	BL_COM	CL
391570201003022	Riverine	Average Annual	0	0	0	0	0	0	
391570201003023	Riverine	Average Annual	138000	0	0	0	0	0	
391570201003024	Riverine	Average Annual	5000	0	0	0	0	0	
391570201003025	Riverine	Average Annual	375000	0	0	0	0	0	
391570201003026	Riverine	Average Annual	162000	0	0	0	0	0	
391570201003027	Riverine	Average Annual	1000	0	0	0	0	0	
391570201003028	Riverine	Average Annual	2000	0	0	0	0	0	
391570201003029	Riverine	Average Annual	10000	0	0	0	0	0	
391570201003030	Riverine	Average Annual	1000	0	0	0	0	0	
391570201003031	Riverine	Average Annual	0	0	0	0	0	0	
391570201003032	Riverine	Average Annual	11000	0	0	0	0	0	

# Refined

- Level 2 Hazus flood analysis, where data is available
- Run for 5 return periods (10, 4, 2, 1, and 0.2% annual chance flood events) in addition to Annualized result
- Generated from enhanced local data for specifics on local area flooding events

[illegible]



# Composite

- A combination dataset which compiles the best available data for each census block
- Usually Refined results take precedence over AAL results
- This data shown on the Flood Risk Map

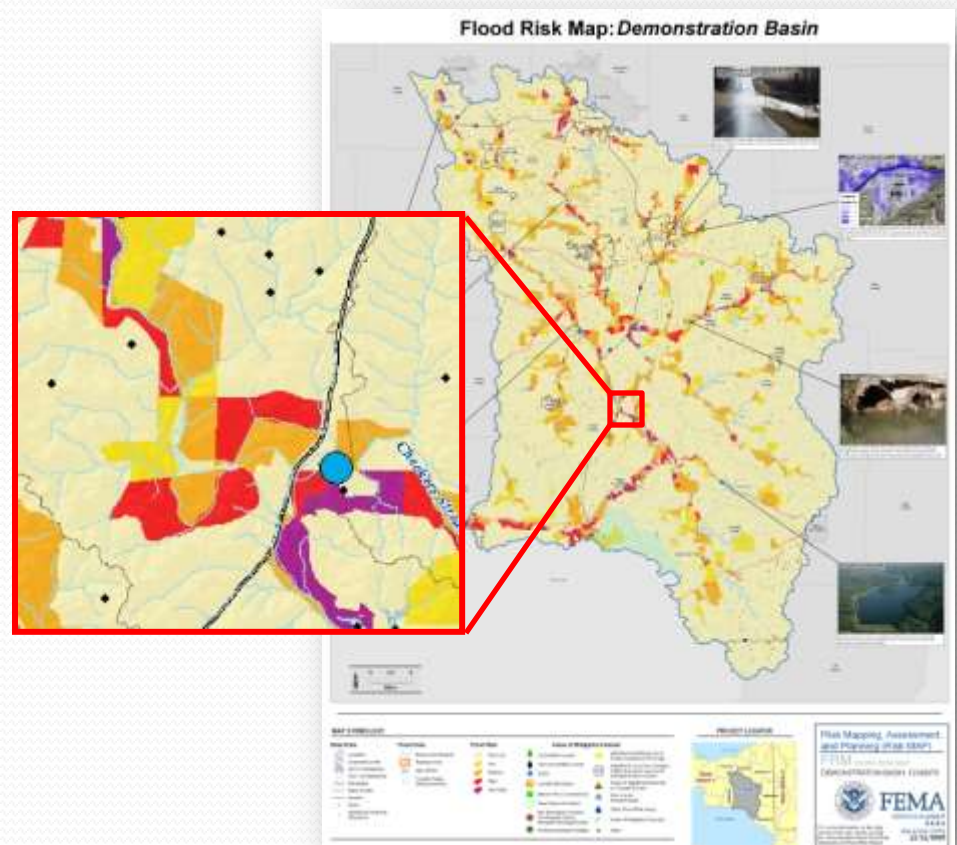
# Community Summary

- Table details the totals of this information
- Sums up the loss estimates for each return period within each municipality in the study area

POL_NAME1	RETURN_PER
GREEN, CITY OF	20% Chance Event (5-yr)
GREEN, CITY OF	50% Chance Event (2-yr)
GREEN, CITY OF	Average Annual
GUERNSEY COUNTY	0.2% Chance Event (500-yr)
GUERNSEY COUNTY	0.5% Chance Event (200-yr)
GUERNSEY COUNTY	1% Chance Event (100-yr)
GUERNSEY COUNTY	2% Chance Event (50-yr)
GUERNSEY COUNTY	4% Chance Event (25-yr)
GUERNSEY COUNTY	10% Chance Event (10-yr)
GUERNSEY COUNTY	20% Chance Event (5-yr)
GUERNSEY COUNTY	50% Chance Event (2-yr)
GUERNSEY COUNTY	Average Annual
HANOVERTON, VILLAGE OF	0.2% Chance Event (500-yr)
HANOVERTON, VILLAGE OF	0.5% Chance Event (200-yr)
HANOVERTON, VILLAGE OF	1% Chance Event (100-yr)
HANOVERTON, VILLAGE OF	2% Chance Event (50-yr)
HANOVERTON, VILLAGE OF	4% Chance Event (25-yr)
HANOVERTON, VILLAGE OF	10% Chance Event (10-yr)
HANOVERTON, VILLAGE OF	20% Chance Event (5-yr)
HANOVERTON, VILLAGE OF	50% Chance Event (2-yr)
HANOVERTON, VILLAGE OF	Average Annual
HARRISON COUNTY	0.2% Chance Event (500-yr)
HARRISON COUNTY	0.5% Chance Event (200-yr)
HARRISON COUNTY	1% Chance Event (100-yr)
HARRISON COUNTY	2% Chance Event (50-yr)
HARRISON COUNTY	4% Chance Event (25-yr)
HARRISON COUNTY	10% Chance Event (10-yr)
HARRISON COUNTY	20% Chance Event (5-yr)

# The Flood Risk Map (FRM)

- Details flood risk factors within HUC-8 watershed
- Hazus composite analysis average annualized loss estimates shown on basemap
- Displays basic information in conjunction with other factors for ease of risk identification



# Flood Risk Report

- Companion to FRD/FRM



	Estimated Potential Losses for Flood Event Scenarios											
	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized (5/yr)	
	Estimated Value	% of Total	Dollar Losses	Loss Ratio	Dollar Losses	Loss Ratio	Dollar Losses	Loss Ratio	Dollar Losses	Loss Ratio	Dollar Losses	Loss Ratio
Residential Building/Contents	\$989,989,000	92%	\$72,487,000	7%	\$64,210,000	10%	\$133,795,000	14%	\$228,382,000	23%	\$1,813,000	0%
Commercial Building/Contents	\$64,564,000	8%	\$2,131,000	3%	\$3,169,000	5%	\$7,202,000	11%	\$14,405,000	22%	\$921,000	1%
Other Building/Contents	\$215,214,000	2%	\$1,152,000	1%	\$4,110,000	2%	\$6,338,000	3%	\$12,158,000	6%	<\$250,000	0%
Total Building/Contents	\$1,269,764,000	100%	\$75,770,000	7%	\$101,489,000	9%	\$147,335,000	14%	\$255,145,000	24%	\$2,649,000	0%
Business Disruption	N/A	N/A	\$5,301,000	N/A	\$8,755,000	N/A	\$13,944,000	N/A	\$28,291,000	N/A	<\$250,000	N/A
TOTAL	\$1,269,764,000	N/A	\$81,071,000	N/A	\$110,247,000	N/A	\$161,279,000	N/A	\$283,436,000	N/A	\$2,821,000	N/A

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

<sup>1</sup>Loss ratio = Dollar Losses / Estimated Value

<sup>2</sup>Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.

<sup>3</sup>Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.

<sup>4</sup>Total Loss = Total Building/Contents + Business Disruption

<sup>5</sup>Losses shown are rounded to nearest \$10,000 for values under \$100,000 and to the nearest \$100,000 for values over \$100,000.

<sup>6</sup>Loss Ratios rounded to nearest integer percent.

- Details listed by community



Questions/Comments?