

Risk MAP CDS
Hazus 4.2
User Release Notes

Version 1.0

January 29, 2018

Document Management History

Revision History

Version Number	Date	Summary of Changes	Team/Author
1.0	01/29/2018	Initial version	Risk MAP CDS

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1. Introduction

Hazus Release 4.2 is a full versioned software release, implementing compatibility with ArcGIS 10.5.1, state database updates, as well as defect fixes and major enhancements, detailed below. Hazus 4.2 also contains the release contents for Hazus 4.1, which was not released in anticipation of compatibility with ArcGIS 10.5.1. Hazus 4.2 is compatible with ArcGIS 10.5.1 and is supported for 64-bit Windows 7 and Windows 8.1, and Windows 10 operating systems.

Hazus 4.2 will be released via the [FEMA Flood Map Service Center \(MSC\) Hazus download webpage](#) for free public download. Updated state databases will also be available for download. The scheduled release date is January 29, 2018.

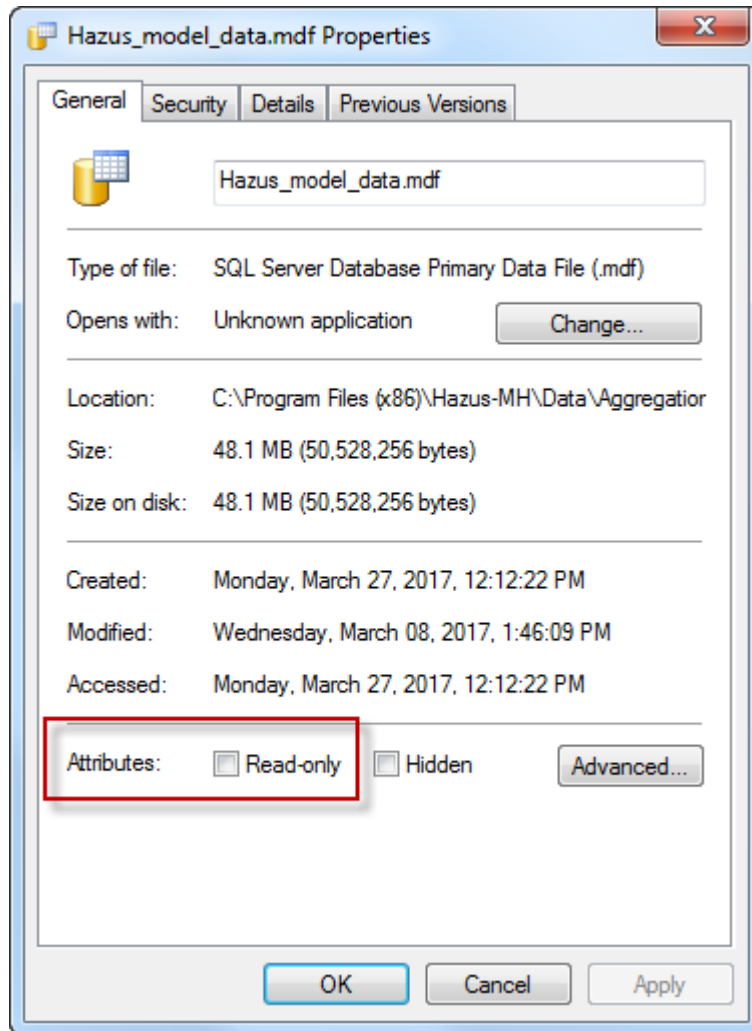
The purpose of this document is to describe the functional changes and known issues found in the Hazus 4.1 and Hazus 4.2 release packages and associated data, installation, and compatibility updates.

2. Contents of the Release

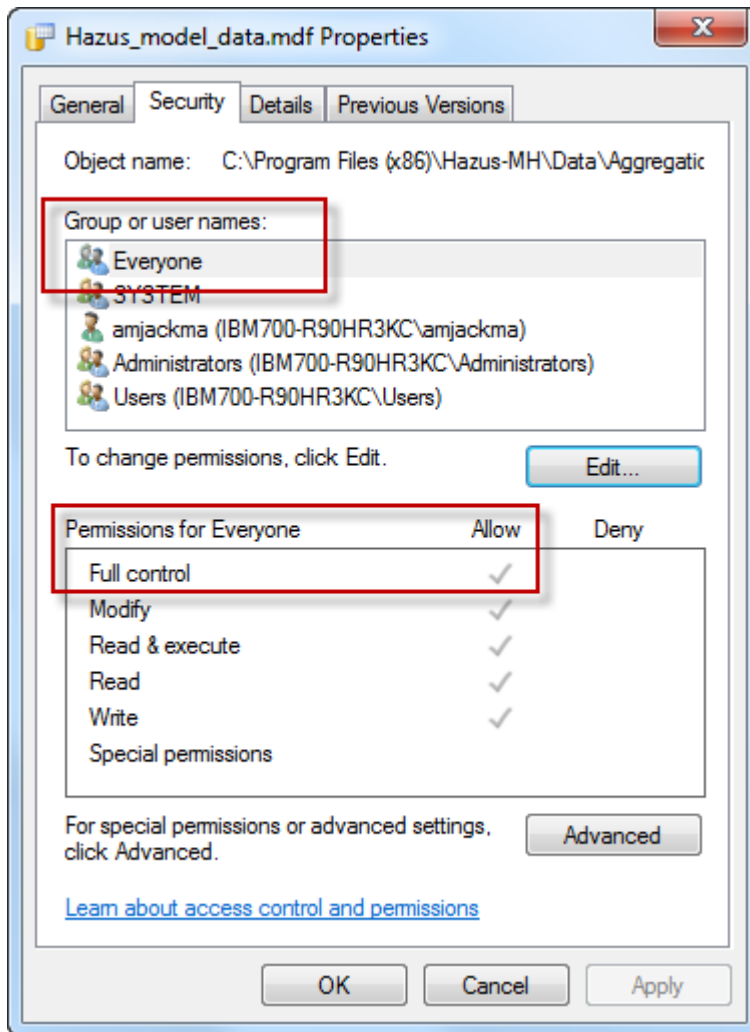
Installation:

- The password for the Hazus SQL instance has changed. If you connect directly to our databases using SQL, please contact the Help Desk for the new login: hazus-support@riskmapcds.com
- As a best practice, please use the following sequence of steps when uninstalling/re-installing Hazus:
 1. Using Control Panel → Uninstall a Program, uninstall Hazus
 2. Using Control Panel → Uninstall a Program, uninstall all SQL Server components
 3. Reboot the machine
 4. Install your new version of Hazus using the normal InstallHazus file
- Please note, if you have SQL Management Studio installed on your machine, you do not need to uninstall the program but you **MUST** reboot your machine after uninstalling Hazus and all SQL Server components provided by Hazus
- When installing Hazus 4.0 or 4.2, a security issue may arise if users attempt to launch Hazus for the first time and encounter an error reading “Thread Not Started.” If this occurs, follow these steps:
 - Go to the folder C:\Program Files (x86)\Hazus-MH\Data\Aggregation
 - Right click on the file called Hazus_model_data.mdf and select "Properties"

- On the General tab, make sure "Read-Only" is unchecked



- On the Security tab, make sure Group or User Names is set to "Everyone"
- Also on the Security tab, make sure Permissions for Everyone is set to Full Control -> Allow (see screen shot)
- Re-launch Hazus and see if the Thread error is gone



- Users should use a location other than the root C:\ drive for extracting the HAZUS_APP zip. When extracting the zip file, extract the files to an existing folder, or a new folder such as C:\HazusApp.

Shell and Utility Items:

- **The default datum and projections system for all of Hazus, including all program and State database feature classes, were changed from NAD83 to WGS84 to cover the entire globe. Input user data must now be in WGS84 to be used in Hazus; imported depth grids will be converted automatically by Hazus.**
- Upgrades were completed to windows and views to avoid text or scroll bars being cut off, or windows not displaying properly. If you continue to experience display issues, please check your monitor settings. Recommended screen resolution and text size values for Hazus are as follows:
 - **Resolutions: 1680 x 1050 or 1920 x 1080**

- **Text size: 100% or 125%**
- HPRs will now preserve data links in the ArcMap Table of Contents.
- All hard-coded state abbreviations (eg. CA, PA) were removed to enable easier use of imported non-US geographies.
- A series of steps are now available for unlocking/changing SQL security permissions on individual machines. See Appendix C.
- Multi-state aggregation for Alaska, Oregon, and Washington no longer fails.

Flood Model:

- **Overall processing times for depth grids and all levels of flood analysis were significantly reduced. Users should expect to experience hydrology and hydraulics (H&H) processing times similar to Hazus 3.2 and significant data storage and processing improvement times when using a user-supplied depth grid.**
- **Import process for user-defined depth grids now support the following file formats: GRID (as before), IMAGINE (IMG), HEC-RAS (FLT), TAGGED IMAGE FILE (TIF), and fGDB. Hazus will also automatically re-project any user-defined depth grids which are not in WGS84.**
- With the conversion to WGS84, the FIT module still operates and provides results in NAD83. Importing a FIT depth grid into Hazus will result in Hazus automatically re-projecting to WGS84.
- Coastal analysis now completes successfully on the first attempt, and should no longer throw the error message “Analysis has not been completed.” Similarly, users do not need to restart Hazus to complete the analysis.
- An existing defect in Essential Facilities results was fixed where improper results displayed. Correct results will now display according to the EF methodology described in the Flood Technical Manual.
- The Shelter Parameters window was updated to disable features which have no impact on the flood results, and to prevent users from entering invalid values into fields that do impact results.
- Coastal GBS results will now generate correctly on the first attempt for both Level 1 and Level 2 analysis.
- An enhancement was made to the number of stories field for RES1 structures in UDF imports to limit the number of stories handled by Hazus. Users can enter up to 255 with 255 reserved to indicate a split-level structure, however, Hazus will treat it as no higher than five stories. Users are not advised to enter a RES1 UDF with more than five stories, as these types of structures are rare for single-family dwellings. RES3A and RES3B occupancies with more than 2 stories can now be modeled too.
- Please note, most Hazus Flood Depth Damage Functions do not extent beyond flood depths of 24 feet. Importing or creating depth grids with flood depths greater than 24 feet may not produce reliable results.
- An existing defect where the dasymetric data crashed the flood model within the state of Oklahoma was fixed that included repairing geometries for all State Census Blocks.
- An erroneous multiplier was removed from the Business Interruption calculations that will significantly increase Business Interruption losses in future analyses, however an existing methodology issue still remains in this module and is outlined

in Appendix A.

- An issue was resolved in UDF Inventory loss calculations where square footage was not taken into account per the Flood Technical Manual. The calculation now matches the correct methodology from the manual.
- A UDF without an assigned DDF by the user will now use Coastal DDFs for Coastal hazards using a type of depth approach similar to Hazus GBS. For structures at a depth greater than 2 feet, a Coastal V DDF is used and for structures in 2 feet or less of flood depth, a Coastal A DDF is used. For Content and Inventory, 4 feet is the boundary between using Coastal A and V DDFs.
- An existing defect where blank cells appeared in the Essential Facilities results for Coastal hazard type analysis has been resolved.
- An analysis using the full suite of return periods and a user-supplied depth grid no longer crashes Hazus Flood.
- Total building damage counts can now be mapped rather than just subsets by building or occupancy types.
- Formatting changes were made to the Global Summary Report to provide more clarity in results reporting and consistency with results tables.
- A check within Hazus depth grid boundaries was found to no longer work, and was repaired. When running a county-wide, Level 1 analysis on the full suite of return periods, smaller return period boundaries were occasionally extending horizontally beyond the boundaries of higher return periods. Similarly, the flood depths of lower return periods were occasionally higher, especially in backwater areas, than those of higher return periods for the same raster cell. The check within Hazus was restored and enhanced to ensure all depth grid boundaries snap to one another where appropriate, and no horizontal or vertical extension of a smaller return period beyond a higher return period occurs for Level 1 analysis. **Please note: users may still see horizontal shifting of the depth grid boundary, and this can be resolved by re-running Hydraulics. Similarly, users may still find that losses in some instances are higher for smaller return periods. This is caused by the methodology issue discovered in the Business Interruption calculations, and is detailed in Appendix A.**

Earthquake Model:

- **The simplified Fire Following Earthquake (FFE) module has been re-enabled, with existing defects resolved. Testing has validated reasonable performance in comparison to recent earthquakes (eg. Loma Prieta and Northridge) for county wide or greater study regions. Care should be given to reporting tract level results. Please see Appendix B for additional information on the FFE methodology.**
- If using a high resolution dataset for hazard characteristics (e.g. soils), it is recommended that users dissolve the dataset on the Type field before using in Hazus. Undissolved hi-res data may result in maps not correctly applying hazard type values.
- The ShakeMap processing component within Hazus was updated to better handle the new high-resolution ShakeMap data file formats and to optimize analysis.
- Results are now available for liquefaction damages to railways and roads, when the ShakeMap hazard is used.

- In the 2010 Census Data updates, pipeline lengths were found to be overestimated. This has been corrected to a more reasonable estimation of pipeline length for potable water, sewer and natural gas distribution size based on a ratio of road length in each Census Tract using the original Hazus approach from 2000 for all State Databases.
- Electric power system performance now populates with correct analysis results.
- Building categories not selected for analysis now display as “N/A” in results, which is consistent with the other hazard models and avoids confusion about which categories should return results.
- The distance calculation was fixed for Arbitrary and Historic scenarios. Now Arbitrary and Historical scenarios with identical parameters return comparable results.
- Total building damage counts can now be mapped, as well as total casualties for peak day, night and commute times, rather than only being able to map damage or casualties by building or occupancy type.
- Formatting changes were made to the Global Summary Report to provide more clarity in results reporting and consistency with results tables.

Hurricane Model:

- A restriction was removed from the storm data table where users were unable to enter storms in different hemispheres using the Latitude and Longitude fields. The restrictions have been adjusted, including warning messages, such that users can now place a hurricane into any hemispherical quadrant on the globe. Hurricanes cannot physically cross the equator, and instances of hurricanes crossing the 180-degree meridian through the Pacific Ocean and then impacting land should be extremely rare. Please note: Hawaii remains the only Pacific location selectable in the Hazus user interface. Users who wish to use the wind model for the Pacific territories should still expect to perform significant data preparation, including inventory preparation and development of associated wind field hazard layers. This enhancement was intended as a first step toward easier use of the wind model in the Pacific, and not as a full solution.
- The Hurrevac download portal was updated to reflect the new download site and format used by Hurrevac.
- Hazus will now automatically generate an error message when there are zeros in the storm data table that appear under Radius to Max Winds. Hazus will automatically overwrite any fields with zeros with a default value of 30, provided peak gusts are 50 mph or less. Previously, these zeros could occur in Hurrevac imports for parts of the storm track where the hurricane had dissipated significantly, including prior landfall. The zeros caused an error and required manual removal from the table. Since the defaults are only applied when peak gusts are low, the default values do not impact losses.
- The Hurrevac Historic Storm database is now populated with Hurrevac files through 2017 for the Atlantic and Central Pacific.
- An existing defect was fixed where losses by count to manufactured housing were underestimated.
- An existing defect was fixed where losses to medium and large hospitals were overestimated.

- Formatting changes were made to the Global Summary Report to provide more clarity in results reporting and consistency with results tables.

Tsunami Model:

- Overall performance improvements were made that substantially reduces analysis run times and better allows for the use of high resolution (lidar-based) data.
- An incorrect label was removed from the TSTravelTime report.
- An extra button for Casualty Level 1 & Level 2 was removed.
- Walk speed times in the parameters menu can now be edited.

CDMS and Data Changes:

- All State databases were reprojected from NAD83 to WGS84 and all dasymetric Census Block geometries were repaired.
- The fields of Landslide Susceptibility Category, Liquefaction Susceptibility Category, Soil Type, and Water Depth were added to the Data Field Matching screen and defaults provide when AEBM or UDF data is being imported.
- CDMS will now filter hazard-specific fields when a hazard type is selected for data import; this avoids flood fields being visible for earthquake data import, etc.
- Required fields for Transportation, Utilities, and UDF now display in the same font color as required fields in other data types.
- NumStories field now displays correctly as a required field.
- Counties in South Dakota, Louisiana, and Alaska received new names in the Census; databases were updated with the correct names.
- Cities and counties that share the same name are now differentiated with a “City” notation after the city name.
- An error message displays when users attempt to load data from one state into another.
- Default replacement costs are provided for Building and Contents when a user imports AEBM or UDF data which have null values for these fields. Building and Content Cost are calculated using the Hazus methodology from the Hazus Flood Technical Manual Inventory Chapter 3, including the use of income ratio to adjust RES1 replacements costs.
- Default estimates of the number of Day and Night occupants based on relationships between number of occupants related to building area and occupancy types are provided when a user imports AEBM data with null values for those fields.
- A divide by zero error was resolved during import of COM10 occupancy data in AEBM.
- The EQ Building Type field no longer displays twice when importing site specific data.

3. Known Issues

In addition to items listed above, this section outlines issues that are known to occur in Hazus 4.2, but were present prior to 4.2 development. Workarounds are provided where applicable.

- Opening a layer attribute table through the Table of Contents within Hazus has occasionally caused Hazus to crash in previous versions. With the upgrade to ArcGIS 10.4, Esri identified a bug where the attribute table crashes became much more frequent. A patch was provided by Esri for use in Hazus 3.2, and is now incorporated into the software. However, users should be aware that this issue may continue to occur on rare occasion. If the attribute table data is needed, a manual export of the data to a program outside of ArcMap or Hazus may be necessary.
- When mapping Hazus inventory and results, the layer which is generated by Hazus can't be queried. To get around this issue, right click and export the layer. This new layer can be queried.
- CDMS users at the FEMA's Emergency Management Institute (EMI) and users with similar workstation security settings may be unable to export to Excel. Please contact the Hazus Help Desk for a workaround: hazus-support@riskmapcds.com

Appendix A

Results Discrepancies in Business Interruption Methodology

A current issue exists in the Business Interruption calculations for Hazus Flood where smaller return periods yield higher dollar losses than higher return periods. This is a result of an existing threshold in the business interruption calculation methodology and will be explained in the steps below. An example is provided for a county-side study region in Mecklenburg, NC.

Users should be aware of this issue, and if encountered, use this document to account for smaller return periods yielding larger losses than expected.

When using the full suite of return periods in Hazus Flood, an area-weighted method is used to assign flood depths to percentages of census blocks. In this case, the area-weighted damage functions are shown, increasing in return period from top to bottom.

Note, the function for the 10-year return period indicates that approximately 66%, or 2/3, of the block or building stock within the block, will experience flood depths of 19ft. The remaining 1/3 of the block will experience flood depths of 21ft.

Similarly, for the 25-year return period, flood depths of 20ft, 20.5ft, and 22ft will each impact around 1/3 of the block. For the 500-year return period, a flood depth of 24ft will cover 100% of the block.

The screenshot shows a SQL query and its results. The query is as follows:

```

23 Select * From fIAnAreaWeighted Where CensusBlock='371190031052002' And ReturnPeriodID='10'
24 Select * From fIAnAreaWeighted Where CensusBlock='371190031052002' And ReturnPeriodID='25'
25 Select * From fIAnAreaWeighted Where CensusBlock='371190031052002' And ReturnPeriodID='50'
26 Select * From fIAnAreaWeighted Where CensusBlock='371190031052002' And ReturnPeriodID='100'
27 Select * From fIAnAreaWeighted Where CensusBlock='371190031052002' And ReturnPeriodID='500'
  
```

The results table displays data for various return periods (R1350 to R2400) and Proc_Order. The following table represents the data shown in the screenshot:

Return Period	Proc_Order	Analysis
R1900	66.6666666666667	33.3333333333333
R2000	33.3333333333333	33.3333333333333
R2100	66.6666666666667	33.3333333333333
R2400	100	0

Each of these functions corresponds to a damage percentage value based on occupancy type and flood depth. These percentages, shown in the screen shot below under the field “SqPreADmgStrC,” are used as a threshold test for activating business interruption

calculations. Note for the Meckelnburg study region, the “percent affected” values shown in Step 1 are listed here under “PctAffected” and correspond to percent building damage for each flood depth and each return period. For the 10-year return period, we saw in Step 1 that the impact to the block is split between 66% at a depth of 19 ft, and 33% at a depth of 21ft. This corresponds to approximately 11.7% building damage and 5.8% respectively.

Similarly, for the 25-year return period, building damage of 5.8% is equally divided between the flood depths, just as the percent of the block affected is equally distributed.

	ReturnPeriodID	Depth	SqPreADmgStbC	DistPct	SqFt	DistPct	PctAffected	PrePct	PctOwnerOccupied	DisruptionCostsPerSqFt	RentalCostsPerSqFtPerDay	Restoration
1	10	1900	0	0	0.175	0	66.66666	100	55	1.1	0.05	900
2	10	1900	0	0	0.175	0	66.66666	100	55	1.1	0.05	900
3	10	1900	0.1166667	1	0.175	1	66.66666	100	55	1.1	0.05	900
4	10	2100	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
5	10	2100	0.05833333	1	0.175	1	33.33333	100	55	1.1	0.05	900
6	10	1900	0	0	0.175	0	66.66666	100	55	1.1	0.05	900
7	10	1900	0	0	0.175	0	66.66666	100	55	1.1	0.05	900
8	10	1900	0.1166667	1	0.175	1	66.66666	100	55	1.1	0.05	900
9	10	2100	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
10	10	2100	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
11	10	2100	0.05833333	1	0.175	1	33.33333	100	55	1.1	0.05	900
12	100	2200	0	0	0.175	0	66.66666	100	55	1.1	0.05	900
13	100	2200	0.1166667	1	0.175	1	66.66666	100	55	1.1	0.05	900
14	100	2400	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
15	100	2400	0.05833333	1	0.175	1	33.33333	100	55	1.1	0.05	900
16	100	2200	0	0	0.175	0	66.66666	100	55	1.1	0.05	900
17	100	2200	0.1166667	1	0.175	1	66.66666	100	55	1.1	0.05	900
18	100	2400	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
19	100	2400	0.05833333	1	0.175	1	33.33333	100	55	1.1	0.05	900
20	25	2000	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
21	25	2000	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
22	25	2000	0.05833333	1	0.175	1	33.33333	100	55	1.1	0.05	900
23	25	2050	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
24	25	2050	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
25	25	2050	0.05833333	1	0.175	1	33.33333	100	55	1.1	0.05	900
26	25	2200	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
27	25	2200	0.05833333	1	0.175	1	33.33333	100	55	1.1	0.05	900
28	25	2000	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
29	25	2000	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
30	25	2000	0.05833333	1	0.175	1	33.33333	100	55	1.1	0.05	900
31	25	2050	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
32	25	2050	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
33	25	2050	0.05833333	1	0.175	1	33.33333	100	55	1.1	0.05	900
34	25	2200	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
35	25	2200	0.05833333	1	0.175	1	33.33333	100	55	1.1	0.05	900
36	50	2100	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
37	50	2100	0.05833333	1	0.175	1	33.33333	100	55	1.1	0.05	900
38	50	2150	0	0	0.175	0	33.33333	100	55	1.1	0.05	900
39	50	2150	0.05833333	1	0.175	1	33.33333	100	55	1.1	0.05	900

In Section 14.2.8 of the Flood Technical Manual, note that the Relocation Expenses, and thus the set of calculations for Business Interruption, are only assumed to be incurred “once the building damage reaches a damage threshold of 10%.”

As shown in Step 2 when comparing the 10-year and 25-year return period, this percent damage to the buildings in the block only exceeds 10% for the 10-year return period... seemingly due to the distribution of damage among the different flood depths within that return period. For the 25-year return period, where no flood depth impacts more than 1/3 of the block, none of the building damage percentages exceed the 10% threshold.

14.2.8 Relocation Expenses

Relocation expenses in the Hazus Flood Model are estimated in a manner consistent with the current earthquake model. In the HAZUS99 & Hazus-MH earthquake model, relocation expenses represent disruption costs to building owners for selected occupancies. These include all occupancies except entertainment (COM8), theatres (COM9), parking facilities (COM10) and heavy industry (IND1). Expenses include "... disruption costs that include the cost of shifting and transferring, and the rental of temporary space". These costs are assumed to be incurred once the building reaches a damage threshold of 10% (beyond damage state "slight" in the earthquake model). Below that threshold, it is assumed unlikely that the occupants will not need to relocate. Relocation losses will be estimated as follows:

$$REL_i = \sum_j \text{If } \%DAM-BL_{i,j} > 10\%: Fa_{i,j} * \left[(1 - \%OO_i) * (DC_i) + \%OO_i * (DC_i + RENT_i * RT_{i,j}) \right] \quad (14-6)$$

where:

- REL_i = relocation costs for occupancy class i (i = 1-13 and 18-28)
- Fa_{i,j} = floor area of occupancy group i and depth j (in square feet)
- %DAM-BL_{i,j} = percent building damage for occupancy i and water depth j (from depth-damage function), if greater than 10%.**
- Dc_i = disruption costs for occupancy i (\$/ft², column 6 in Table 14.9)
- RT_{i,j} = recovery time (in days) for occupancy i and water depth j (See Table 14.11 for preliminary flood restoration time estimates)
- %OO_i = percent owner occupied for occupancy i (HAZUS99 Technical Manual Table 15.14, reprinted here as Table 14.10)
- RENT_i = rental cost (\$/ft²/day) for occupancy i (column 5 in Table 14.9)

The result of this methodology is that occasionally, some census blocks may report larger losses on smaller return periods, especially when compared with the "next highest" return period. In test runs, these blocks were typically a very low percentage of the overall blocks in a county-wide study region:

Charleston, SC: 4 out of 14,523
 St. Clair, IL: 5 out of 10,471
 Suffolk, MA: 6 out of 8,939

Recommendations for future enhancements to address this issue will be considered for future Hazus releases.

Appendix B

Notes on the Fire Following Earthquake (FFE) Module

Chapter 10 of the Earthquake Technical Manual provides details on the FFE methodology, however, of special note to users when reviewing results:

- The FFE module produces ignitions in area of high-building density and ground motion (PGA). As a result, rural study regions or areas of low PGA rarely have FFE results.
- The Average Number of Ignitions presented in the FFE Crystal Summary report is based on the Total Number of Ignitions for the Study Region divided by 1,000 to approximate an average and avoid estimating an average that is too low for very large study regions.
- Tracts may have fires, including an exposed population and building value and no Fire Flow (GPM). This simply means the model determined there was no fire fighting resource available for that Tract.

Appendix C

While detaching a database file in Hazus, SQL server removes the “Everyone” account setting for full permission. This creates an issue if you share this database with another user.

Before you attach the file, the “Everyone” account -- or local "NT Service\MSSQL\$HAZUSPLUSSRVR" needs to have “Full Control” on the database file and you need Admin privilege to do that. To resolve this issue the following steps allows the user (with Admin access) to set the—

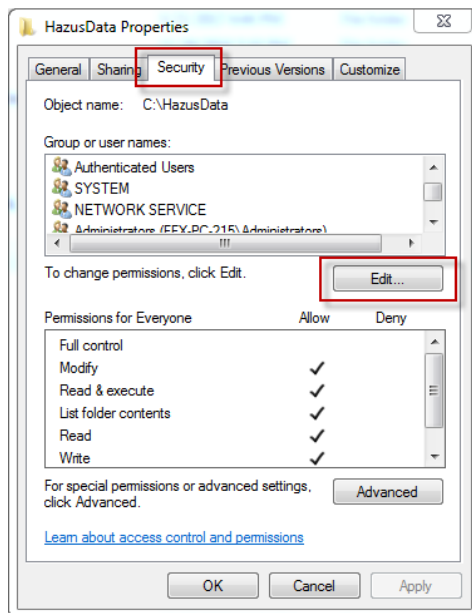
"NT Service\MSSQL\$HAZUSPLUSSRVR" local machine account to “Full Control” on the Hazus Folder. After that, a regular user can copy the shared database file under this folder. Doing that will allow the "NT Service\MSSQL\$HAZUSPLUSSRVR" account to grant “Full Control” and SQL server will be able to attach the database file.

Prerequisites:

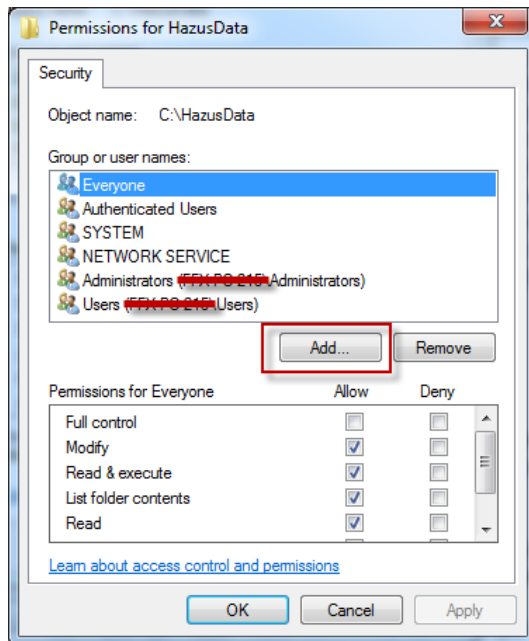
1. Hazus installed
2. HAZUSPLUSSRVR instance was created
3. You can log in to SQL HAZUSPLUSSRVR instance via hazuspuser account
4. User has the privilege to drop a Hazus MDF file into “HazusData” folder or sub-folders. Please check your System Admin to grant you the proper privilege for allowing you to drop an MDF file.

Steps:

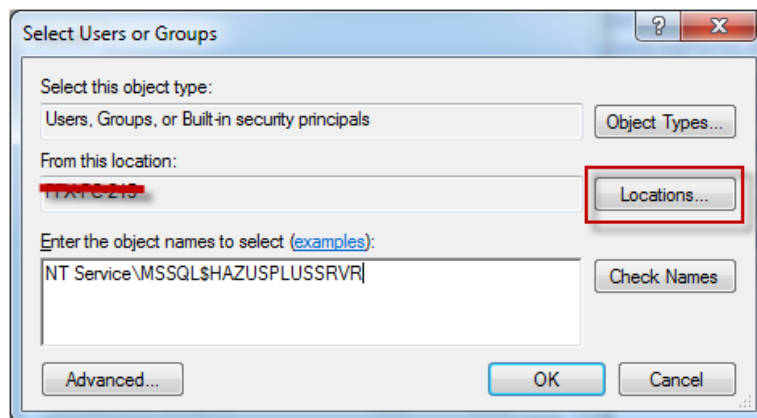
1. Right click the " HazusData" folder → Properties → Security → “Edit” button



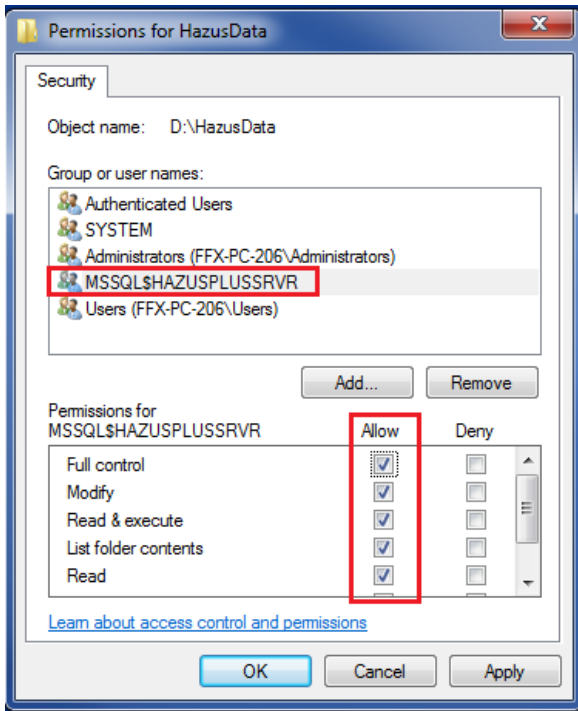
2. Click the “Add” button



3. Click the "Locations" button and select local PC name "YOURMACHINENAME" in this case. The machine name can be found in the Security tab (see crossed out sections in the screen shot from Step 2) or by going to Computer → System Properties.



4. Enter "NT Service\MSSQL\$HAZUSPLUSSRVR" and click "OK" button. It will grant "MSSQL\$HAZUSPLUSSRVR" service user.
5. Choose "Full Control" for "MSSQL\$HAZUSPLUSSRVR" user



Once these steps are done, a user without Admin privilege will be able to attach the database file, either using SQL Management Studio or SQLCMD command.