APPENDIX C

(i)

Field Survey of Structures and Geographic Information System Methods

Structure Survey Process

This section provides an explanation of the collection of structure data by the field survey crews in 18 communities as part of the development of the Phase II GIS. It consists of a brief description of the:

- the selection of structures to be survey;
- the field survey process;
- description of reference documents used for the field data collection;
- general observations from the effort.

Selection of Structures to be Surveyed

It was determined early in the Phase II study process that the generation of a data set of all of structures located within the erosion hazards areas of all 27 communities would not be feasible. A complete compilation of all structures so defined would:

1. far exceed the numbers of structures previously estimated for the study;
2. generate an unmanageable data set size logical for the Phase II study;
3. far exceed the allocated costs of structure surveys estimated in the survey portion of the Phase II contract;
4. require extensive unnecessary expense to include very difficult to survey structures or areas of structures;
5. create several resulting data sets without matching assessment data as a result of this assessment data not existing or not being available for the study.

As a result, after two initial community surveys that included all structures in the identified erosion zones (Sussex Co., DE and Glynn Co., GA) a process was developed to identify which communities would be included in the study, and a sampling selection process of structures within those communities.

As presented in chapter 2, a total of 11,234 structures (an average of 624 per community, with the most in one community being 1486 in Sussex Co., DE, and the least being 41 in Manitowoc Co., WI) were included in the Phase II GIS. All of these structures received some degree of field-surveyed location, condition, and description data. The data for the vast majority of the structures was the result of the full survey process as described herein.

The sampling of structures to be surveyed within each community was determined by the Heinz Center. Usually the "Sampling Frame" was a "T" shaped area, with the top of the "T" being on and along the coast and the stem reaching landward. A typical sampling frame contained between 20 and 30 structures.

The Field Survey Process

The field survey data collection process was performed in two stages, usually distinct and independent of each other. The first was by a two-man survey crew that developed a set of surveyor benchmarks for reference for each sampling frame to be surveyed. The second was by a three-person crew who surveyed and collected the required data on each structure.

As a result of the surveyor's experience and early attempts to get support from local surveying offices, it was determined that the best process would be to establish a new and unique control point network for the structure surveys. To do this, a two person survey crew, equipped with Trimble 4000 SSI GPS systems and utilizing National Geodetic Survey (NGS) control points in the region, established geodetic order benchmarks in the immediate area of the surveys. The design of the location of the benchmarks was to minimize the lengths of level runs for determining the elevations of the structures.

The benchmark process was to set a GPS unit on a known NGS regional elevation reference mark as a 'base station'. Then, optimal locations of the benchmarks in the structure survey areas were identified, marked with a "PK" nail, and documented. Roving GPS units were then placed on them for up to 30 minutes. After data collection was complete for a day, the data was downloaded, normalized with the base station data, and processed and the horizontal and vertical locations of the benchmarks accurately established and documented.

Following the establishment of the benchmarks, the three-person data collection crew moved into action. They collected data utilizing 4 methods:

1. digital camera for a front elevation of the structure;
2. level survey from a benchmark for elevation of structure
3. real-time kinematic GPS and laser distance meters for horizontal location of structures
4. visual collection of other required structure physical data

The structure survey crew was typically a three-man crew consisting of a level operator, a rod man, and a GPS operator. Using one of the benchmarks as a reference point, the survey crew proceeded through the neighborhood to be surveyed, using conventional level techniques to establish the elevations for each structure. In most cases access to each house was sufficient and allowed the reference elevation to be determined with high accuracy. In some cases, access to the property was not possible or denied by the owner. In those cases, the rod man could not approach the structure so other methods to establish the reference elevation for the structure were utilized. These alternative methods included, but were not limited to, establishing the height of doorknobs and porches with the surveyor's level from which the reference elevation could be estimated based on common building practice.

Contemporaneously with the leveling, a GPS operator with a real time differentially corrected GPS receiver established a position in the street, then established a bearing and range offset to the approximate center of the structure and took the digital picture of the structure. For surveys by 3001, Inc., these bearing and offset corrections were applied to the field data before GIS processing, but during the course of GIS processing, Towill, Inc. supplied data. An electronic data collector was used by all crews to record the structure characteristics including: house number, house subnumber, street, city, structure condition, Elevation Certificate building type, number of floors, foundation type, reference elevation, elevation of lowest grade adjacent to the structure, breakaway walls (presence), basement (presence), swimming pool (presence), and structure purpose. This data collector, part of the Trimble GPS Pathfinder Pro XR system, contained a data collection dictionary which prompted the surveyor to complete each data field for each structure. Attached as Appendix A of this report is a printout of the data dictionary most commonly used for the Phase II surveying effort.

Reference Documents for Field Data Collection

Besides the Data Dictionary that was created uniquely for this Phase II study survey effort, two other documents were utilized by the surveyors in the filed. They were:

1. "Elevation Certificate and Instructions", Federal Emergency Management Agency, NFIP; FEMA Form 81-31, Mar 97; attached to this report as Appendix B. This document, published by FEMA as a guide to surveyors who are determining the elevations of structures for Flood Insurance Program purposes, identifies the eight types of buildings (or, more correctly, the 8 types of building foundations) that were part of the required Phase II data for each structure. The Data Dictionary utilized in the field data collectors prompted the surveyor to select one of the building types as diagrammed in the document.
2. From the early survey efforts for the Phase II study, a second guide to the surveyors was created. Titled "Guide for Structures Surveys, Evaluation of Erosion Hazards Study", it is a compendium of photographs and building descriptors needed by the surveyors in responding to the field data requirements, such as the identity of separate versus connected buildings, building use, and condition. This document is included as Appendix C to this report.

General Observations from the Field Data Collection Effort for the Phase II Study

The following is a series of general statements and observations from the surveyors regarding the effort to complete the data collection effort for the Phase II Erosion Hazards Study.

Production Rates: On an excellent day, with excellent conditions, surveys and data collection on up to 150 structures per day could be accomplished. A bad day was considered to accomplish only 50 per day, except on the West coast where often only 30 to 40 structures could be collected in a day. The key differentiators between the East and West were the generally flat terrain of the East as well as the lack of tall vegetation in the East's coastal areas.

Structure Elevation Requirements: The establishment of the structures' elevations to within one-half foot accuracy was a very time consuming effort. The benchmark development and leveling

to each structure (usually to an accuracy of 1/10th foot) was about one-half of the entire field surveying and data collection program's costs.

Property Owner's Refusal: In most cases when asked, property owners allowed the surveyors onto their property to establish the structure elevation. Of greater problem was in Suffolk Co., NY and on the West Coast where walled and gated structures prevented access.

Data Dictionary: The development of the Data Dictionary for the Trimble GPS Pathfinder Pro XR data collector was key to the speed and consistency with the data was collected.

Community Assistance: The surveyors enjoyed little community assistance. They always informed the local police departments of their mission, but rarely received or were able to rely on community supplied surveying data.

GIS Development

The final product of the phase 2 portion of the Evaluation of Erosion Hazards study was a series of CD-ROMs, one for each of the eighteen counties selected from the original twenty seven. Each CD-ROM contains data from the phase 1 and phase 2 portions of the study and a customized ArcView GIS project file to display and query the data. The metadata, that is the documentation for each data layer, is also present on each CD and may be accessed through ArcView or with a standalone web browser. Advanced GIS users have been aided by inclusion of Arc/Info export files and triangulated irregular network (TIN) data on the CD-ROM that may be useful for further work. An important feature of the phase 2 data and CD-ROM product is consistency in the attributes of each data set and the interface to the data across all the counties. The phase 2 data and ArcView project may be used directly from the CD-ROM to conserve space or transferred to hard disk for faster response.

Data Layers

An individual county in the phase 2 data product may have up to sixteen data layers and three associated database files. If available, all of these data layers are loaded into the ArcView project for that county. The potential data layers and database files for each county are described briefly below; for more complete descriptions, the metadata for that layer should be consulted. Not all of these layers and data base files are present in all counties.

The names of the data layers that are given here are the names of themes as they appear in the ArcView project for each county. The actual data set names are different, systematic, and encode the coordinate system of the data set. The actual name of individual data sets may be seen by making an individual theme active, selecting Theme Properties from the Theme menu, then examining the contents of the 'Source:' line in the Theme Properties window, or by examination of the HTML metadata summary page, 'metadata.html' at the same directory level as the ArcView project file for the county.

Structures

Location of surveyed structures. Attribute-wise, this is the richest of all the data layers, including structure attributes directly observed during the survey operation and many other attributes derived by overlay, combination, and spatial operations with the other data layers. Hot Link and Structure Report tools are available when this theme is active and will display the structure picture or structure summary report, respectively.

Pseudo Structures

These point features are a product of the Transect Model. Their primary use was to derive future flood zone and BFE values to be attached to each structure in the Structures data layer however they also give pictorial representation of the relative (not actual) positions of actual structures and flood zones at ten year intervals in the future.

Structure Transect

A line data set used in the Transect Model that defines the track of a pseudo structure relative to flood zone boundaries over time. Each line passes through a structure point and the closest point to the structure on the current ERF line.

City Center

A point location that represents the 'center' of a city or village in the study area. This is used to calculate a value of 'distance to city center' for each structure.

Parcels

Tax parcel polygons in the study area. The primary use of this data layer was to attach assessment information to surveyed structures. The assessment information can be linked to parcels based on a parcel identification number, and a structure can be linked to an individual parcel if it falls within it. The parcel layer has been joined to the assessment database file in the ArcView project file, and linked to the historical sales database file if it is available.

Current ERF (Erosion Reference Feature)

A polygon data set split by the current Erosion Reference Feature line. By creating the data in this manner, as a polygon dataset, it is possible to use the data in overlay operations to tell if a structure is landward or oceanward of the Erosion Reference Feature.

10-Year Projected ERF

A polygon data set derived by interpolation between the Current ERF and the 60-Year Projected ERF. The central line of this data set which splits the polygon represents the location the Erosion Reference Feature is projected to be, 10 years after the Current ERF was in the location described in that data set.

30-Year Projected ERF

A polygon data set derived by interpolation between the Current ERF and the 60-Year Projected ERF. The central line of this data set which splits the polygon represents the

location the Erosion Reference Feature is projected to be, 30 years after the Current ERF was in the location described in that data set.

60-Year Projected ERF

A polygon data set split by the 60-Year Projected Erosion Reference Feature line. Modeling to estimate the location of 60-Year Projected ERF line based on historical erosion rates was one of the primary deliverables of the phase 1 part of the study.

Sampling Frame

In order to reduce the cost of structure surveying in each county, only select groups of structures were surveyed in certain counties. This polygon data set represents boundaries around each group of structures. Because some of these sampling groups (and enclosing Sampling Frame boundary) are T-shaped, the ratio of the T 'top' to 'stem' are attributes of the Sampling Frames, allowing sampling /valuation normalization.

Current Flood Zones

Flood zones derived from FIRM maps.

60-Year Projected Flood Zones

A polygon data set representing the 60-year projected location of flood zones. . Modeling to estimate the location of the 60-Year Projected Flood Zones based on historical erosion rates was one of the primary deliverables of the phase 1 part of the study.

CBRA Zone

Two-class polygon data set derived from Q3 data and identifying areas that are in or out of Coastal Barrier Resources Act designated areas.

Map Grid

Polygon data set that identifies and depicts the spatial extents of hard copy plots of flood zones, erosion reference features and structures that were created as part of phase 2 data processing and reporting.

Panels

The spatial extents of individual maps and plots of phase 1 deliverable data that were provided only in hard copy form. If this data set is present it means that the phase 1 data had to be digitized to produce the phase 2 data products.

Img_*.sid

Image mosaic(s) of orthophoto imagery for the study area in MrSID compressed form. By using the image data in compressed form it is possible to get all the data for each county onto single CD-ROMs without sacrificing much in image quality.

Database Files

Assessment

A table including fundamental assessment attributes for tax parcels, summed for each parcel if necessary when multiple assessments are associated with a parcel. This table is joined to the parcel layer if the parcel layer exists.

Assessment by Unit

A table including fundamental assessment attributes for each individual assessment. If necessary the individual assessments of this table are added and other assessment attribute data carried forward in a summing process of all assessment associated with each parcel to create the Assessment table. This table may be linked to the Assessment table on the PIN item if it is desired to see individual assessments.

Historical Sales

A table tabulating sales (and sale dates) of assessed properties. It may be linked to Parcels on the PIN-UNIT item.

Phase 2 Data Processing / Preparation / Delivery

Creation of the phase 2 GIS product involved several major steps:

- Conversion of the phase 1 data into consistently attributed GIS data layers.
- Survey and photograph selected structures within each phase 1 study area.
- Obtain assessment and tax parcel data for the areas of surveyed structures.
- Obtain orthophotography imagery for the study area if available but not part of the phase 1 data.
- Process the survey, assessment, tax parcel and orthophotography data to create data layers consistent with phase 2 database design.
- Overlay data layers and perform spatial operations to populate attributes of structure data set.
- Documentation of the data and data processing.
- Creation of the ArcView project file to display and query the data.
- Packaging of the data, metadata and ArcView display project on CD-ROM.

Phase 1 Data Conversion

The product of the phase 1 study was to be a map or maps that depicted the location of the current erosion reference feature, the current flood zone boundaries, the 60-year projected current erosion reference feature, the 60-year projected flood zone boundaries, and a report documenting the project and methodology. Unfortunately, there was no specification provided for the format and design of these maps for the phase 1 deliverable. Each county project was carried out with the resources the researchers had available and the delivered maps reflected this.

Phase 1 products (in increasing order of amount of work required to process for phase 2 included digital GIS data, digital CAD data, planimetrically correct hard copy maps, and non-georeferenced linework on unrectified aerial photography. The digital GIS and CAD data were converted into Arc/Info GIS data sets and attributes were created and populated consistent with phase 2 database design. Planimetrically correct hard copy maps were digitized into a GIS, then

attributed consistent with phase 2 database design. It was necessary to obtain other data, orthophotography, to convert the non-georeferenced data. Recognizable feature points in the orthophotography and unrectified aerial photography were used as control points to calibrate the digitizing of flood zones and erosion reference features from these data. Complications for processing all forms of the phase 1 data included discontinuities in the data, ambiguities in labeling and lack of certain data in the deliverables (e.g. projected ERF)

Structure Survey and Photography

The areas to be surveyed, and hence the structures to be surveyed were defined by the Heinz Center.

An advance team sent to the study area established local elevation control points using geodetic surveying procedures. A reference GPS station was established at an NGS control point and a second roving GPS unit was sent out with a field crew to establish local elevation control points in the areas where the surveyors were to survey structures. The GPS receivers were operated in real-time kinetic mode when establishing these local elevation control points.

The structure survey crew was typically a three man crew consisting of a level operator, a rod man, and a GPS operator. Using a local elevation control point as a reference point, the survey crew proceeded through the neighborhood to be surveyed, using conventional level techniques to establish the reference elevations for each surveyed structure. In many cases access to each house was sufficient and allowed the reference elevation to be determined with high accuracy. In other cases, access to the property was not possible or denied by the owner. In those cases, the rod man could not be used so other methods to establish the reference elevation for the structure were utilized. These alternate methods included, but were not limited to, establishing the height of doorknobs and porches from which the reference elevation could be estimated based on common building practice. While the leveling was going on, a GPS operator with a real time differentially corrected code GPS receiver established a position in the street, then established a bearing and range offset to the approximate center of the structure and took a digital picture of the structure. These bearing and offset corrections were applied to the field data before GIS processing in the case 3001, Inc. produced data, but during the course of GIS processing for Towill, Inc. supplied data. An electronic data logger was used by all crews to record the structure characteristics including: house number, house subnumber, street, city, structure condition, Elevation Certificate building type, number of floors, foundation type, reference elevation, elevation of lowest grade adjacent to the structure, breakaway walls (presence), basement (presence), swimming pool (presence), and structure purpose.

The total number of 'surveyed' structures for the phase 2 deliverable is 11,234. The breakdown by county is: Berrien 199, Brazoria 538, Brevard 619, Brunswick 656, Dare 1453, Galveston 1173, Georgetown 495, Glynn 638, Lee 547, Lincoln 497, Manitowoc 41, Ozaukee 202, Racine 241, San Diego 997, Sanilac 243, Santa Cruz 746, Suffolk 463, and Sussex 1486.

Assessment and tax parcel data

Assessed value of structures and internal structure characteristics (such as number of bathrooms or square footage) are typical components of tax assessment data and will be useful for the economic analysis portion of this project. Typically, the only spatial reference that assessment

data has is a parcel identification number (PIN). The only way to connect this assessment data to surveyed structures is via an overlay process using a parcel layer that also has PINs. Attempting to obtain, and processing these assessment and parcel data was a significant portion of the phase 2 work. This portion of the work revealed the extreme variability in sophistication, completeness, policy, form, and accessibility of assessment and parcel data for these counties.

To get counties to release parcel and assessment data sometimes only required a simple request, but in other cases required: a letter from FEMA outlining the project, the need for the data, and stating that the data would not be redistributed or sold; or completion of a licensing agreement and payment of licensing fees. In several cases, many phone calls over a period of months from the initial data request were necessary before the data were finally provided. The forms of data received were hard copy printouts or copies of assessment records, hard copy maps, digital dumps of assessment data, proprietary assessment databases, and digital parcel data. Digital data were received on floppy disk, CD-ROM, 4mm tape, 8mm tape, and 9-track tape. It was necessary to build custom scripts for each county to import digital assessment data. Hard copy assessment data had to be tabulated manually, and in the cases where parcel data was not available, manual address matching was necessary to connect the assessment data to individual surveyed structures.

Orthophotography

In cases where the phase 1 study data did not include orthophotography, an attempt was made to obtain such imagery from other sources. In many cases the needed imagery was obtained from the EROS Data Center. All imagery was mosaicked and compressed using MrSID Compress Publisher.

Overlay and Spatial Operations

Because the physical, spatial, economic, and flood zone properties (at the present time and in the future) of individual structures are central to the analysis phase of this study, it was necessary to devise methodology to transfer these attributes onto the structure points. This involved overlay and distance measurement spatial operations, creation of several new data layers, and creation of a GIS model, the Transect Model, to calculate select attributes.

Overlay operations allowed the attributes of polygon data to be transferred onto structure points contained within them. This allowed, e.g., the PIN of a parcel to be attached to a structure so assessment data could be joined, and designation of each structure as ‘landward’ or ‘oceanward’ of an ERF.

Triangulated Irregular Network (TIN) models were created between the current and 60-year projected ERF lines and across the current and 60-year projected flood zone layers. TINs are surface models that allowed several data layers to be created and several structure attributes to be determined from their location over the TIN. The TIN model for the ERF layers allowed creation of new 10 and 30 year projected ERF lines. The TIN model for the current (and 60-year projected) flood zone allowed interpolation of the BFE value for a structure within a zone that has a single nominal BFE.

The Transect Model was developed in response to the request by the Heinz Center to determine what flood zone structures would be in at years between the 'current' year and 60 years in the future from the 'current' year. Conceptually, this only required morphing the current zones to the 60-year projected zones, however it proved very difficult and time consuming to implement. The effect over time (if there is erosion occurring) is that of the flood zones moving toward and over the structures. The Transect Model inverts the problem by migrating the structure points over time in an oceanward direction relative to the fixed current flood zone boundaries and flood zone TIN. The structures are migrated toward the ocean along a transect line through the structure and which connects it to the closest point on the current ERF line. In 60 years the structure will move oceanward a distance equivalent to the difference between the current ERF and 60-year projected ERF along the transect (eha_width). Therefore, at each 10 year increment the structure moves a distance of (10/60) * (eha_width) along its transect. These migrated structures have been termed 'pseudo structures' because of course the actual structures are not moving. Drilling down from a pseudo structure location to the current flood zone layer and flood zone TIN allows assignment of nominal flood zone and interpolated BFE for the associated real structure at a point of time in the future corresponding to the migration time point of the pseudo structure.

Metadata

The metadata documents the source(s) for the data set, processing steps to create it, its coordinate system, and the definitions of all the attributes of the data set.

The ArcView Project

The ArcView project for each county provides a consistent display of data themes for all counties and provides specialized tools for advanced functions. For example, when the Structures theme is active, the Structure Report tool may be used to select structures and display the summary report for the selected structures. Other custom tools and buttons in the ArcView project allow the photograph of a selected structure to be displayed, zones to be labeled with classification and base flood elevation, and metadata to be displayed. The function of each custom tool and button is described in the readme.doc or readme.html file on each CD-ROM.

Of course, all the standard ArcView tools are also available so one could find the summed of average building assessment value for all structures in V zones via a method such as the following: make the Current Flood Zone theme active, open the attribute table for the theme, use the query builder button to compose a query like " ([C-zone_lab] = "V") or ([C-zone_lab] = "VE")" to build a New selected set, make the Structures theme active, choose Select by Theme from the Theme menu, build a New set of features that 'Are Completely Within' the selected features of 'Current Flood Zone', open the attribute table for Structures, select the bld_as field in the table, select 'Statistics' from the Field menu, and voila! Such a query will also likely demonstrate the limitations of certain of the data, e.g. some structures may not have bld_as values associated with them, thus their bld_as value will be something like '0' or '-9999' which will invalidate an average. In such a situation, after selecting the structures, one would use the query builder button to select all structures with bld_as greater than '0' from the currently selected set before performing the statistical analysis of the bld_as field for the selected structures.

Phase 2 Delivery CD-ROMs

The phase 2 delivery CD-ROMs contain the following: all the phase 2 vector data in ArcView shapefile and Arc/Info export forms, the imagery in MrSID compressed form, metadata for all data in HTML and text form, pictures of the surveyed structures, an ArcView project file to display the data, and a readme file that explains the installation process and customized features of the ArcView project. An insert in the CD-ROM case lists and describes all the files present on the CD-ROM, the agencies that contributed source data for the CD_ROM, a brief description of the project, software requirements to use the CD-ROM to its full extent, and a distribution contact for those who might like to get a copy of the CD-ROM.

Appendix A: Field Data collection Dictionary

The following documents the essence of the “Data Dictionary” utilized by the 3-person survey crew in the structure data collection phase of the study. The data was stored in a TRIMBLE GPS Pathfinder Pro XR: Submeter GPS Mapping/GIS Data Capture system. Only the digital photograph, which had a unique identifier number, was stored outside of this system.

"FEMA Structure Inventory" Dictionary

"Structure", point, "Surveyed Structure"
"Structure ID Number", numeric, 0, -1, 99999, -1, required, "Unique number from field crew"

"House Number", numeric, 0, -1, 999999, -1, required,

"Major numeric part of street address"

"Interpolated HouseNum", menu, required
"no"
"yes"

"Building Subnumber", text, 30, "To qualify a house/unit number in mult-un"

"Street Direction", menu,
" ", default
"N"
"S"
"E"
"W"
"NW"
"SW"
"NE"
"SE"

"Street Name (1-C)", menu,, "Street name for structure"
" ", default

Examples:
"17"
"707"
"10th"
……..
"Crystal Oaks"
"Cypress"
"Cypress Ridge"

"Street Name (D-J)", menu,, "Street name for structure"
" ", default

"Street Name (K-R)", menu,, "Street name for structure"
" ", default

"Street Name (S-Z)", menu,, "Street name for structure"
" ", default

"Type in Street", text, 40, "Use if street name doesn't appear in menu"
"Street Dir Suffix", menu,
" ", default
"N"
"S"
"E"
"W"
"NW"
"SW"
"NE"
"SE"

"Street Type", menu,
" "
Examples:
"Aly"
"Anx"
"Arc"
…….
"Av"
"Bend"
"Blk"

"City", menu,, "City, town or village of the surveyed structure"
" "
Examples
"Debidue"
"Garden City Beach"
"Huntington Beach"
"Litchfield Beach"
"Pawleys Island"

"Type in City", text, 40, "City Name"

"Bearing (true N)", numeric, 2, -1.00, 359.99, -1.00, required, "Direction from rangefinder to structure"

"Distance (US Survey F", numeric, 2, -1.00, 2500.00, -1.00, required, "Distance from rangefinder to structure"

"Photo ID", numeric, 0, -1, 999999, -1, required, "Number of the digital photo from camera b"

"Structure Notes", text, 80, "Comments on structure or other attributes"

"Structure Condition", menu,, "General Condition of Structure"
    "Good", default
    "New"
    "Poor"

"Building Type", menu, required, "Building Type from Flood Elevation Certificate"
    "Diagram # 1"
    "Diagram # 2"
    "Diagram # 3"
    "Diagram # 4"
    "Diagram # 5"
    "Diagram # 6"
    "Diagram # 7"
    "Diagram # 8"

"Number of Floors", numeric, 0, 1, 999, 1, "Number of floors in the structure"

"Foundation Type", menu, required, "Type of structure foundation"
    "slab on grade"
    "wood pile"
    "masonry pile"
    "concrete pile"
    "elevated on fill"
    "crawl space"

"Reference Elevation", numeric, 2, -9999.00, 30000.00, -9999.00, required, "Elevation of the building reference object"

"Low Grade Elevation", numeric, 2, -9999.00, 30000.00, -9999.00, required, "Elevation of lowest adjacent grade on rai"

"Low Grade Near AC", menu, required, "Is the lowest adjacent grade near the AC"
    "no"
    "yes"
    "not checked"
    "unknown"

"Breakaway Walls", menu, required, "Does structure have breakaway walls?"
    "no"
    "yes"
    "not checked"

```
    "unknown"

"Mult. Policies", menu,, "Dwelling unit with multiple policy holder"
    "no", default
    "yes"
    "unknown"

"Basement", menu, required, "Does structure have a basement?"
    "no"
    "yes"
    "not checked"
    "unknown"

 "Swimming Pool", menu, required, "Does the structure have a swimming pool?"
    "no"
    "yes"
    "not checked"
    "unknown"

"Structure Purpose", menu,, "Business or residence?"
    "residence", default
    "business"

"Date", date, auto, ymd, not_permitted, "date data collected"

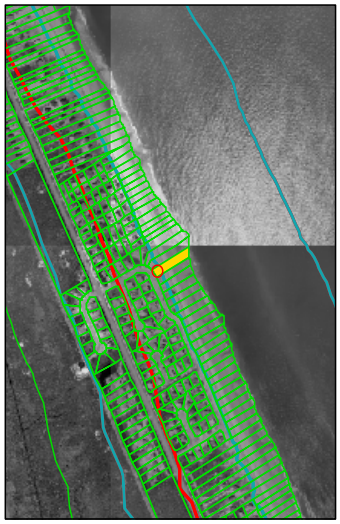
"Time", time, auto, 12, not_permitted, "time of day data collected"

"City Center", point, "Approximate center of business district"

 "City Center Name", menu, required, "Name of city this point is the center of"
    " "
    "Debidue"
    "Garden City Beach"
    "Huntington Beach"
    "Litchfield Beach"
    "Pawleys Island"

"Type in City Center N", text, 40, "Use if city not available in pick list"
```

Structure Attributes



Site Location

Legend

- # Structures
- Parcels
- Current ERF
- 60-Year Projected ERF

Structure Address: 9803 Surfside Dr, Nags Head - Dare County, NC

Parcel ID Number	071811575343
Parcel Area (in square feet)	27,792
Inside 60 Year Erosion Hazard Area	Yes
Distance from Current Erosion Reference Feature (in feet)	21.8
Current Flood Zone	VE
Current Base Flood Elevation	10
Projected Flood Zone	VE
Projected Base Flood Elevation	16
Reference Elevation (NGVD29)	24.42
General Condition of Structure	Good
Building Type	Residence
Foundation Type	Wood Pile
Age of Structure (Year Built)	1982
Square Footage of Structure	2,001
Assessed Value of Structure	$ 124,100.00
Latitude/Longitude	35.86516, -75.57193
Ocean Frontage	Yes

Produced by The Spatial Data Institute and The H. John Heinz III Center

Descriptive Summary of Items – Galveston County, Texas

Prepared by: Russell Watkins, Hugh Phillips, and Sam Henderson
3001, Inc., a Spatial Data Institute Partner Firm

Spatial Data Institute, L.C.
Bethesda, Maryland

Listed below are the attribute items that comprise the Galveston County, Texas structures inventory data layer. This data layer represents a compilation of GPS, flood zone, parcel and assessment data obtained from FEMA, 3001, Inc., Dewberry & Davis, Inc., and Galveston County. The data was initially compiled in the Arc/Info software and converted to shapefiles for use in the ArcView software.

Note: Every structure surveyed on a parcel is assigned the sum of the assessments for that parcel. As a result, every structure on a parcel with multiple structures is overvalued, and the sum of the values of the structures within any parcel is number of structures within parcel times as much as it should be.

Missing Data is represented by one of the following: -9999; x; “”; and in appropriate cases – 0. These values indicate data that was not supplied by source agencies and/or was not collected.

Source: d= derived with GIS by 3001, Inc., f= field survey data, g=Galveston County GIS, a=Galveston County Assessor, n/a= not available

Attribute Items	Description	Source
STRUC_PLOT	Unique structure ID number on map	d
HOUSE_NUM	House Number	f
INTRP_HNUM	House number derived by on-site interpolation	f
BLD_SUBNUM	Building subnumber	f
ST_DRN	Street Direction	f
ST_NAME	Street name for structure	f
ST_TYPE	Street Type	f
ST_DIR_SFX	Street Direction Suffix	f
GPS_CITY	City Name	f
SITE_ADDR	Parcel physical address	a
STRUC_COND	General Condition of Structure (Poor, Good, New)	f
BLD_TYPE	Building Type (ref: FEMA Elevation Certificate diagrams)	f
NUM_FLOORS	Number of floors in the structure	f
FOUND_TYPE	Foundation type	f
REFER_EL	Reference elevation of the first floor	f
LGRADE_EL	Elevation of lowest adjacent grade for raised foundation structure	f
LG_NEAR_AC	Lowest adjacent grade near the AC (yes/no)	f
BRKAWAY_WA	Breakaway walls present in structure (yes/no)	f
MULT_PLCY	Dwelling unit with mult. policy holders present (yes/no)	f
BASEMENT	Basement present (yes/no)	f
SWIM_POOL	Swimming pool present (yes/no)	f
STRUC_PURP	Purpose of structure: business or residence	f

PICT_ID	Unique picture identification/filename	d
STRUC_NOTE	Note on the structure (general comments)	f
LONG_NAD83	Structure longitude (North American Datum 1983)	f
LAT_NAD83	Structure latitude (North American Datum 1983)	f
PIN	Parcel Identification Number	g
PIN_UNIT	Parcel Subunit Identification Number, -x indicates multiple	a
BLD_SQFT	Square footage of building(s)	n/a
BLD_AS	Assessed value of PIN_UNIT, or sum by PIN	a
LAND_AS	Assessed value of PIN_UNIT, or sum by PIN	a
TOT_AS	Total assessment for land and buildings	d
YR_BUILT	Year building was built	n/a
NUM_BEDR	Number bedrooms	n/a
NUM_BATHR	Number bathrooms	n/a
GARAGE	Garage present?	n/a
CENT_AIR	Is there central air?	n/a
FIREPLACE	Is there a fireplace?	n/a
OWN_NAME	Owner name	a
OWN_ADDR	Owner address	a
REC_SAL_PR	Most recent sale price, -9999 if n/a or sum on PIN	a
REC_SAL_YR	Most recent sale year, -9999 if n/a or sum on PIN	a
REC_SAL_MN	Most recent sale month	a
REC_SAL_DY	Most recent sale day	a
NUM_AS	Number of assessments (PIN_UNITS) attached to parcel (PIN)	d
PARC_SQFT	Square footage of parcel (from parcel area), -9999 is not-in-parcel	d
WATERFRONT	Waterfront property (yes/no)	d
C_ZONE_LAB	Current flood zone type	d
C_BFE	Current Base Flood Elevation	d
P_ZONE_LAB	Projected flood zone type	d
P_BFE	Projected Base Flood Elevation	d
C_ERF_SIDE	Side of Current Erosion Reference Feature line	d
P_ERF_SIDE	Side of Projected Erosion Reference Feature line	d
GRIDCELL	Map plot cell number	d
IN_COBRA	Structure in COBRA zone (in/out)	d
CENT_CITY	Nearest city for city center determination	d
DIST_CENTC	(1.414 x straightline distance to nearest city center in miles)	d
DIST_CERF	Shortest distance to Current Erosion Reference Feature (feet) This distance is negative if point is on ocean side of ERF.	d
DIST_PERF	Shortest distance to Projected Erosion Reference Feature (feet) This distance is negative if point is on ocean side of ERF.	d
EHZ_WIDTH	Sum of absolute values of DIST_CERF and DIST_PERF -9999 if point does not fall between current and projected ERF	d
CNTY_NAME	County name	d
STA_NAM_AB	Two letter abbreviation of state name	d
STA_FIPS	FIPS code for state	d
CNTY_FIPS	FIPS code for county	d

Field Data collection Dictionary

The following documents the essence of the “Data Dictionary” ustilized by the 3-person survey crew in the structure data collection phase of the study. The data was stored in a TRIMBLE GPS Pathfinder Pro XR: Submeter GPS Mapping/GIS Data Capture system. Only the digital photograph, which had a unique identifier number, was stored ouside of this system.

"FEMA Structure Inventory" Dictionary

"Structure", point, "Surveyed Structure"
"Structure ID Number", numeric, 0, -1, 99999, -1, required, "Unique number from field crew"

"House Number", numeric, 0, -1, 999999, -1, required,

"Major numeric part of street address"

"Interpolated HouseNum", menu, required
"no"
"yes"

"Building Subnumber", text, 30, "To qualify a house/unit number in mult-un"

"Street Direction", menu,
" ", default
"N"
"S"
"E"
"W"
"NW"
"SW"
"NE"
"SE"

"Street Name (1-C)", menu,, "Street name for structure"
" ", default

Examples:
"17"
"707"
"10th"
……..
"Crystral Oaks"
"Cypress"
"Cypress Ridge"

"Street Name (D-J)", menu,, "Street name for structure"
" ", default

"Street Name (K-R)", menu,, "Street name for structure"
" ", default

"Street Name (S-Z)", menu,, "Street name for structure"
" ", default

"Type in Street", text, 40, "Use if street name doesn't appear in menu"
"Street Dir Suffix", menu,
" ", default
"N"
"S"
"E"
"W"
"NW"
"SW"
"NE"
"SE"

"Street Type", menu,
" "
Examples:
"Aly"
"Anx"
"Arc"
…….
"Av"
"Bend"
"Blk"

"City", menu,, "City, town or village the surveyed struct"
" "
Examples
"Debidue"
"Garden City Beach"
"Huntington Beach"
"Litchfield Beach"
"Pawleys Island"

"Type in City", text, 40, "City Name"

"Bearing (true N)", numeric, 2, -1.00, 359.99, -1.00, required, "Direction from rangefinder to structure"

"Distance (US Survey F", numeric, 2, -1.00, 2500.00, -1.00, required, "Distance from rangefinder to structure"

"Photo ID", numeric, 0, -1, 999999, -1, required, "Number of the digital photo from camera b"

"Structure Notes", text, 80, "Comments on structure or other attributes"

"Structure Condition", menu,, "General Condition of Structure"
    "Good", default
    "New"
    "Poor"

"Building Type", menu, required, "Building Type from Flood Elevation Certif"
    "Diagram # 1"
    "Diagram # 2"
    "Diagram # 3"
    "Diagram # 4"
    "Diagram # 5"
    "Diagram # 6"
    "Diagram # 7"
    "Diagram # 8"

"Number of Floors", numeric, 0, 1, 999, 1, "Number of floors in the structure"

"Foundation Type", menu, required, "Type of structure foundation"
    "slab on grade"
    "wood pile"
    "masonry pile"
    "concrete pile"
    "elevated on fill"
    "crawl space"

"Reference Elevation", numeric, 2, -9999.00, 30000.00, -9999.00, required, "Elevation of the building reference objec"

"Low Grade Elevation", numeric, 2, -9999.00, 30000.00, -9999.00, required, "Elevation of lowest adjacent grade on rai"

"Low Grade Near AC", menu, required, "Is the lowest adjacent grade near the AC"
    "no"
    "yes"
    "not checked"
    "unknown"

"Breakaway Walls", menu, required, "Does structure have breakaway walls?"
    "no"
    "yes"
    "not checked"

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    "unknown"

"Mult. Policies", menu,, "Dwelling unit with multiple policy holder"
    "no", default
    "yes"
    "unknown"

"Basement", menu, required, "Does structure have a basement?"
    "no"
    "yes"
    "not checked"
    "unknown"

 "Swimming Pool", menu, required, "Does the structure have a swimming pool?"
    "no"
    "yes"
    "not checked"
    "unknown"

"Structure Purpose", menu,, "Business or residence?"
    "residence", default
    "business"

"Date", date, auto, ymd, not_permitted, "date data collected"

"Time", time, auto, 12, not_permitted, "time of day data collected"

"City Center", point, "Approximate center of business district"

 "City Center Name", menu, required, "Name of city this point is the center of"
    " "
    "Debidue"
    "Garden City Beach"
    "Huntington Beach"
    "Litchfield Beach"
    "Pawleys Island"

"Type in City Center N", text, 40, "Use if city not available in pick list"
```

Reference for the FEMA ArcView Projects

August, 1999

Setup:

ArcView 3.1 is required to display the imagery associated with each project.

In order to use all the functions of the ArcView project to display the FEMA Evaluation of Erosion Hazards data, it is necessary to install an extension and to update a .dll for ArcView. In these procedures, a '~' in a path just indicates the path to you ArcView installation directory, often just 'c:\'

1. Install the Theme Metadata extension for ArcView by copying the file 'theme_metadata.avx' from the CD-ROM 'support' directory to the ~esri\av_gis30\arcview\ext32 directory.

2. Update the MrSID .dll in the ~esri\av_gis30\arcview\bin32 directory. Rename the existing AVMrSID.dll in ~esri\av_gis30\arcview\bin32 to AVMrSID_dll_orig.sav, then copy the file 'AVMrSid.dll' from the CD-ROM 'support' directory to the ~esri\av_gis30\arcview\bin32 directory.

Launching the Project:

The ArcView project can be launched directly from the CD by double-clicking the fema_[county].apr in the [county] folder, or by starting ArcView, selecting Open Project from the File menu, then navigating to the location of the fema_[county].apr file on the CD (where [county] equals the County name of the particular project, e.g., Galveston).

Alternatively, the entire folder may be copied from the CD-ROM onto a local hard drive, and the project launched via either of the two methods described in the paragraph above, but using the fema_[county].apr which is on the local hard drive.

GIS Theme Layers:

Each ArcView project contains data on the location of the 60-year erosion hazard zone, current and projected flood zones, field surveyed structures and assessment attributes, and orthophoto imagery. Some of the projects also contain parcel map data, coastal barrier resource system unit boundaries, and locations of the 10 and 30-year erosion hazard zones. Complete descriptions of the content, quality and source of each theme layer are provided in the metadata record for each theme. The principal theme layers in each project are:

- Surveyed Structures (location, photo, attributes)
- Imagery (black and white or color orthophotos)
- Flood Zones (current and projected)
- Current and Projected (10, 30, and 60 year) Erosion Reference Features
- Parcels and Assessment
- Transect Model (for determining positions of structures in 10-year increments)
- Spatial Reference information (description, source, use restrictions, etc.)

Analysis Features of the FEMA ArcView Projects:

Flood Zones Menu-enables the viewer to turn on or off the Current Flood Zone and the 60-year Projected Flood Zone	
Structures by Flood Zone Menu-enables the viewer to highlight specific structures that fall into one or more of the individual zones in the Current Flood zone or the 60-year Flood zone; for example, if Current Flood Zone was chosen in this menu, a window appears asking which flood zone or zones you wish to have the structures highlighted in (A, AE, VE, X, X500)	
ERF Menu-enables the viewer to turn on or off the Current ERF and the 60-year Projected ERF without having to do it in the Table of Contents	
Structures by EHA Menu-enables the viewer to select specific structures that fall into the 60 year EHA, that is, the structures between the current ERF and the 60 year projected ERF.	
	**Remove Red Label button**-removes red labels that were created by the Label Flood Zone tool
	**Remove Red Circle button**-removes red circle drawn by the Generate Structure Report tool
	**Image Shuffler button**-shuffles images in the View Table of Contents so that they are all together either at the top or the bottom
	**Image Toggler button**-turns images ON or OFF in the view and in the Table of Contents
	**Generate Theme Report button**-issues a text file report about all themes contained in each view of the project
	**Display Theme Metadata button**-displays the HTML metadata document for the active theme
	**Label Flood Zone tool**-labels Current Flood Zones if it is active theme and turned on or Projected Flood Zones if it is the active theme and turned on.
	**Hot Link tool**-structures theme must be active; allows you to click on a certain structure and then brings up the ground based photography of that structure
	**Generate Structure Report tool**-generates a report that shows the ground based photograph, the view with the structure inside of a red circle, and gives the attributes of that structure; can select one structure at a time or several at once to produce many reports

Data access and distribution:

In most cases, the ArcView projects developed for the Evaluation of Erosion Hazards study are available for use by coastal hazard researchers and others at minimal cost. Some or all of these data, however, may be protected by distribution and use restrictions.

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