

**North Carolina Master Address Project
Final Report**

**Prepared for
North Carolina Office of State Budget and Management
and
North Carolina State Data Center**

**Prepared by
North Carolina Center for Geographic Information and Analysis**

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Executive Summary

The United States conducts a decennial census to establish population counts that influence voting districts and the allocation distribution of resources to state and local governments. The results of the decennial census will have long term effects in the distribution of federal and state funding. This importance is magnified in the current economic client. Based on the 2000 decennial Census, the US Census Bureau estimated approximately \$300 billion in Federal funding directed to states and local governments are apportioned by census figures. This represents \$1,000 per person per year coming to state and local government in North Carolina for each person counted in the Census. Conversely, each person missed as part of the Census tabulation represents a potential loss of \$10,000 of federal funding for the upcoming decade.

In preparation for the upcoming 2010 Census, the North Carolina General Assembly provided resources for the North Carolina Center for Geographic Information and Analysis to work closely with the Governor's Census Liaison in the Office of State Budget and Management to develop the North Carolina Master Address Dataset. The NC Master Address Dataset represents a compilation of the best available representation of situs addresses and their location. CGIA contacted county and municipal governments to acquire this information, and insight on how each local jurisdiction manages address assignment and maintenance.

Aside from developing a dataset suitable supporting the upcoming 2010 Census, the project has developed a comprehensive and flexible workflow for ingesting and managing address-related data. The process has been specifically designed to be adaptable for meeting business requirements of state and local agencies. Documented business requirements can be integrated from a stakeholder into the appropriate processing steps throughout the workflow to generate custom output products suitable for existing applications. This workflow development also supported the development of automation tools to streamline initial processing. For future iterations and updates, these tools will provide a foundation for automating significant portions for the ingest and standardization of source data. The NC Master Address Dataset is built on recognized and emerging standards for easy adoption and maintenance in the future.

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Introduction

The US Census Bureau conducts a comprehensive enumeration of the population once every ten years, commonly on April 1 of each decennial year. These figures are tabulated to support a number of programs and functions at the federal, state, and local level. Three of the most critical functions this data supports are the allocation of representation within the United States House of representatives, redistricting of voting districts at the state and local level, and the apportionment of funding from federal programs received by state and local governments. These census results also drive important policy and planning process at the state and local government level.

In preparation for the upcoming 2010 Census, the North Carolina General Assembly provided resources for the North Carolina Center for Geographic Information and Analysis to work closely with the Governor's Census Liaison in the Office of State Budget and Management to develop the North Carolina Master Address Dataset. The NC Master Address Dataset represents a compilation of the best available representation of situs addresses and their location. CGIA contacted county and municipal governments to acquire this information, and insight on how each local jurisdiction manages address assignment and maintenance.

CGIA has engaged the stakeholder community with a specific focus on local government partners to develop the NC Master Address Dataset resource. Preceding each decennial census, the US Census Bureau provides local governments an opportunity to provide updated address information through the Local Updated of Census Addresses (LUCA) program. Seventy-four of North Carolina's one hundred counties participated in this exercise in 2008.

In addition to the direct support to the decennial census, the NC Master Address Dataset will provide a foundation for adapting the process used for compiling the dataset for other business processes and applications at the state and local level. The data flow and processing steps provide a framework for evaluating business cases and application requirements. With modifications to the types of input data, identifying additional processing steps, and integrating specific data fields through the data flow, the NC Master Address Dataset processing data flow is capable of meeting the needs of a diverse range of public sector applications.

Outreach

As local governments have the responsibility for the creation and maintenance of addresses, engaging the county and municipal sector was an acknowledged priority within the project. At the outset of the project, CGIA engaged local government officials and GIS users to describe the project and gain insight into issues related to creating and maintaining address datasets. CGIA briefed participants in workshops and conferences, including Carolina Urban and Regional Systems Association, the NC Property Mappers Association, the NC Chapters of the National Emergency Number Association and the Association of Public-Safety Communications Officials, the NC Emergency Managers Association, the Charlotte Regional GIS User Group, the Chapel Hill/Orange County GIS User Group, and the Local Government Committee of the NC Geographic Information Coordinating Council. CGIA also consulted the NC League of

Municipalities and staff to the Emergency 911 Board. In addition, CGIA held sessions with the Department of Environment and Natural resources and the Department of Labor to gain insight into how state agencies use address lists in environmental permit management, site inspections, and communication with customers. Topics covered included process descriptions, current address data, address data integration issues, and potential solutions and benefits. This outreach effort proved invaluable in setting the stage for data requests from 100 counties and in database design.

Advisory Meetings

From the outset of the project, the value of external input and networks was identified as a key component for project success. CGIA organized four monthly meetings in the fall of 2008 (September through November) to engage stakeholders and solicit input on key programmatic and technical issues. Participants discussed the issues most important in gaining input and buy-in from local governments, and potential benefits for stakeholders among state and local agencies and their customers.

In sometimes lengthy discussions, the advisors identified data integration issues and potential uses in support of local and state business operations. Local government practitioners made distinctions between addressing practices in local government relating to permitting, planning, and tax assessment on one hand and emergency 911 communications and response on the other. Advisors also described a collaborative project involving the Division of Motor Vehicles and the Department of Revenue that requires accurate physical addresses in the context of vehicle registration and excise taxes on vehicles. The group described numerous business needs, potential for efficiencies, and related benefits for various state and local operations with agreement that reliable, current, complete, integrated address datasets are essential for many purposes.

The NC State Data Center in the Office of State Budget and Management collaborated with CGIA in the advisory meetings, with special attention to preparation for Census 2010 and the benefits of achieving a complete count of the population. The State Data Center highlighted the value of a statewide dataset for the final stage of the Local Update of Census Addresses and emphasized the opportunity to achieve benefits for state agencies as well.

Local Government Component

The Master Address Dataset relied on timely and effective participation by 100 counties and several municipalities. Early in the project, the Local Government Committee of the NC Geographic Information Coordinating Council provided guidance on ways to engage local officials, lessons learned from county master address projects, and suggestions for wording questions and requests to minimize the required effort by local governments and to obtain the needed datasets. The E-911 Board solicited assistance and cooperation from local emergency numbering operations. Participation by local officials was outstanding and timely. The NC OneMap GIS Inventory and its many participants proved to be invaluable in reaching geographic information system practitioners to obtain, verify and supplement the best available datasets in short order during the final weeks of the project.

Maintenance of the most useful source datasets for the MADB project is achieved successfully by county and municipal governments as part of their emergency services, tax assessment, planning, and other

operations. As stressed by the project's local government advisors, local datasets are the best available geospatial representations of street addresses, address locations, structure locations, street centerlines, and tax parcel boundaries. While the positional accuracy, currency, completeness, and content quality of these datasets varies from county to county, local governments have operational needs to keep the information up to date and accessible to the public.

US Census Local Update of Census Addresses Program

A driving force behind the NC Master Address Dataset project was the US Census Bureau's Local Update of Census Addresses (LUCA) program in preparation for the 2010 Census. The overriding goal of the Bureau of the Census is to count all residents in North Carolina by mailing a Census 2010 form to all residential addresses and to obtain the information from non-respondents by going door-to-door. A complete count depends on a complete list of addresses and their locations. The Census Bureau maintains a Master Address File for every jurisdiction in North Carolina. Through the LUCA program, the Census Bureau solicits address datasets from all counties and municipalities. The process includes local submissions of datasets (2008) and updates for new construction (2009).

The NC Master Address Dataset provides that latest available address information, including additions since LUCA submission last year, in the required LUCA format for all 100 counties including incorporated areas. North Carolina will submit the dataset to the Bureau of the Census in support of the goal to achieve a complete count of residents in April 2010. The benefits of a complete count to North Carolina include the maximum possible federal funds to state recipients in programs that are based on formulas that include population count and per capita measures. An additional person counted in North Carolina translates to approximately \$1,000 in federal funds to some person or entity in the state.

Beyond Census 2010, a master address dataset has value for local, regional, and state purposes. A reliable site address for a residential structure, a commercial building, or other building types is essential for a range of public and private business needs. From inspection of a boiler to notification of a zoning change to issuance of a permit to leasing an industrial building, geospatial representations that are readily accessible and accurate on the ground save time, including travel time and processing time.

Master Address Context for Local Governments

The term "Master Address Dataset" has a specific context for local government activities, and has the potential to cause confusion with the goals of the NC Master Address Dataset. In a local government context, a master address dataset project seeks to coordinate the multiple sources for address creation to eliminate redundancy and increase the compatibility of data. At the local government level, several organizations track address-based information for their own missions (e.g.: tax assessment, utilities, and emergency response). These independent maintenance paths provide a challenge for comparing information across these datasets, as well as inefficiencies in maintaining similar datasets. For local governments, a master address dataset project seeks to streamline the process of assigning authoritative addresses, and reconcile business datasets to the authoritative source.

The NC Master Address Dataset does not seek to provide or impose any form of reconciliation of address information. The NC Master Address Dataset does provide a compilation of consistently

formatted address data sourced from the authoritative maintenance source for address representing the best available address data for each jurisdiction.

The existence and continued maintenance of the NC Master Address Dataset resource can be mutually beneficial for local governments and state entities. Supporting initiatives at the local government level that can implement the local version of master address tenants and workflows is the most direct method for compiling a higher quality NC Master Address Dataset product.

Data Acquisition

Through the outreach to state level agencies, CGIA worked closely with the North Carolina 911 Board in developing the strategy for acquiring local government address information. Every county and some municipalities maintain Public Safety Answering Points (PSAPs). PSAPs coordinate the dispatch of emergency services, and have a significant, and in some cases the singular role of assigning addresses in a jurisdiction. CGIA and NC 9-1-1 Board Executive Director Richard Taylor jointly distributed a letter to county managers to build awareness of the NC Master Address Dataset Project and seek the support and assistance of their jurisdiction.

In follow-up to the letter distribution, CGIA staff contacted the GIS managers and PSAP technical contacts for each county in the state. The county contacts were briefed on the goals of the project, and information was collected for each jurisdiction to gain insight on the address assignment and maintenance process for each community. As part of the communication from CGIA, staff collected details on the source data availability for supporting the statewide compilation activity. In the majority of cases, this amounted to verification of the currency of dataset(s) already available for public access and download. In specific cases, counties provided more up-to-date data directly to CGIA, or CGIA worked with the local governments contractor to acquire the most up-to-date datasets. In each instance, CGIA staff stressed the flexibility of the compilation process to accept the widest variety of data and that no custom processing of data would be required of local government partners willing to provide datasets for the project.

Technical Approach

There are two primary objectives in the technical implementation of the NC Master Address Dataset project. The first objective is to fulfill the mandate from the General Assembly to generate a statewide address dataset to support the 2010 decennial census. The second objective is to create a data flow and process that is flexible, scalable, and reliable for creating address-based data products to meet many potential business cases across the public sector stakeholder community.

This section will present detailed information on the data flow of address-related data, standards implemented throughout the data flow, the data processing procedures developed for the compilation process, supporting automation tools, repository schema, and data quality matrix.

Data Flow Diagram

The data flow diagram provides a conceptual overview of how local government source address data is compiled into the NC Master Address Dataset. There are four components to the data flow diagram: Source Data Input, Staging, Production Repository, and Distribution Products

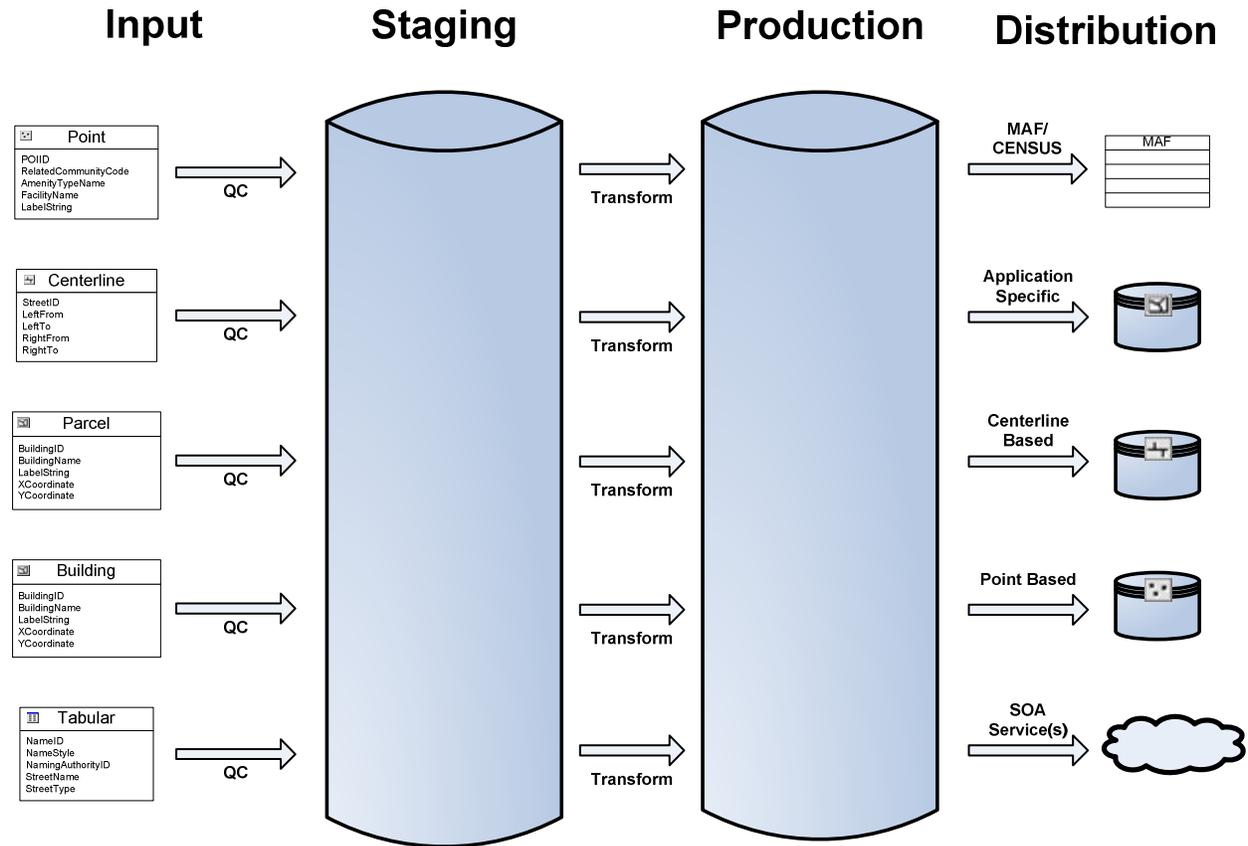


Figure 1: Data Flow Diagram

The source data inputs (far left column) are representative of the variety of datasets that local governments may provide as sources for authoritative addresses. For the development of the first version of the North Carolina Master Address Dataset, these datasets can be integrated into the final compilation of the Census MAF output dataset; generating alternative distribution datasets may need specific source datasets, depending on the technical requirements.

Data provided as source data is first moved to the staging database (left blue cylinder). This database contains two similar versions of the source data: the original source dataset(s) provided by the local government stakeholder, and a modified version of the source data that has undergone basic quality control to standardize field names (when necessary) and prepare the dataset for automation operations. Data stored in this area is in a flat file format.

The transformation process moves the data from flat files to a relational database. This transformation step analyzes the various local government inputs to generate the individual address records within the repository. The repository records are stored as geographic features and structured to provide flexible presentation for creation of the distribution dataset, in this case the Census's Master Address Format flat file. The repository data structure is discussed in detail later in the technical section.

The final column of the data flow diagram represents the output datasets that can be generated from the analytical processes. The current version of the process generates the Census MAF output dataset, but with appropriate modifications to the processing steps preceding the repository can output spatial or tabular datasets meeting custom requirements, and become a data source for applications and web services.

Standards

The records generated and stored in the production repository are formatted based on the Federal Geographic Data Committee's draft Addressing Standard. This standard has been in development over several years and is in the final stages of becoming a finalized standard, with full release anticipated in early 2010. Adopting this standard has many benefits. Chief among them will be the opportunity to site this reference standard as a common interchange format for both incoming source data as well as an output and distribution dataset for the statewide representation of address-based information.

The NC Master Address Dataset also has adopted the integration of coordinates generated to the US National Grid (USNG) format. These coordinates follow a standard endorsed by the NC Geographic Information Coordinating Council (GICC) and are complementary with ongoing efforts within the state to raise awareness and usage of this standard for referencing point locations and features.

These identified standards do not compromise the flexibility of the NC Master Address Dataset for accommodating additional features and attributes. Geographic features in the current database are oriented towards structures and meeting the requirements of the Census MAF content and formatting. The repository schema can integrate additional features that may not be related to structures, but can be addresses and used as a reference point to meet alternative business or application requirements. As long as each feature contains a subset of the required content for these standards, records can be flagged for inclusion or exclusion when generating a particular distribution dataset.

Data Processing Model / Standard Operating Procedure

The goal of the data processing model is to efficiently evaluate and ingest source data provided from local governments. Where source data provided by local governments closely matches the repository schema with a minimal amount of translation and analytical manipulation, these data are efficiently migrated through to the data repository. In cases where source data requires additional analysis for preparation for moving to the repository, this additional analysis can introduce a degree of uncertainty in the final product. In many cases there are instances where multiple processing flows are required to bring source data from a county into the repository. The quality matrix, discussed later in the technical section, provides a tabular index for evaluating the level of processing required for the constituent components that are compiled to generate the final NC Master Address Dataset product.

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The standard operating procedure (SOP) serves several purposes within the context of the project. While the data work flow and data processing model provide an abstract framework, the standard operating procedure captures the implementation details for moving data through this compilation process. The SOP provides a resource for documenting detailed processing steps. These detailed processing steps are important to ensure consistency in processing across operators. These detailed processing steps also served as the functional requirements for the development of automation tools used in portions of the compilation processing.

The SOP will be an integral piece for future implementations of the NC Master Address Dataset workflow. The combination of the data flow diagram and SOP will provide an ability to evaluate business and technical requirements for defining new distribution formats and products, any required modifications to data inputs from local government partners, modifications to specific analytical steps for capturing or modifying fields not already captured in the repository, and scoping requirements for additional effort above and beyond the basic processing already in place.

The data processing model is depicted in Figure 2 below. Sections labeled with lettered references note workflows and processes that move data into the staging workflow, while processes referenced as numbers reflect operations that move address-based information into the repository. A summary of each of the references contained in the processing model follows. The final standard operating procedure document is provided in Appendix A in the document.

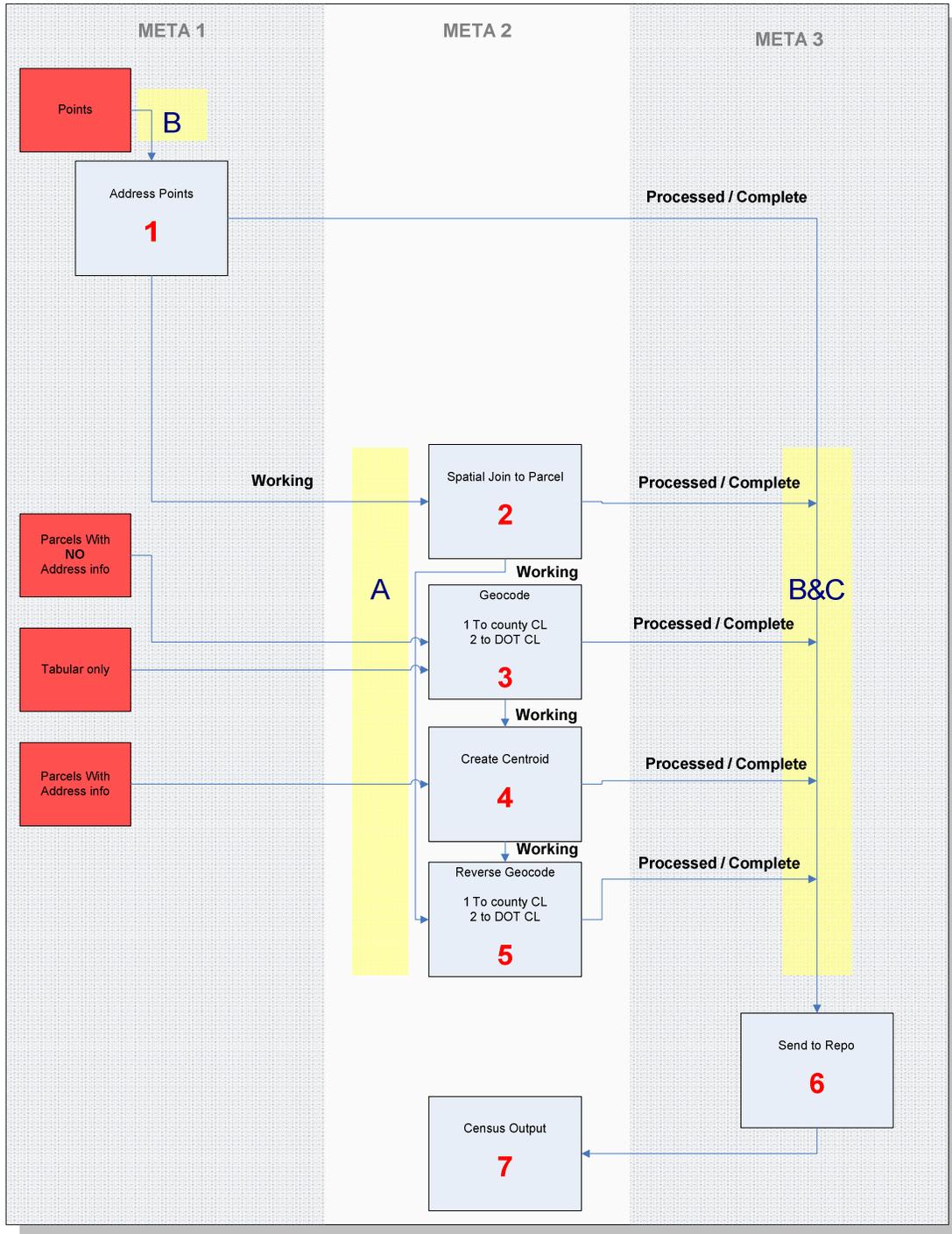


Figure 2: Data Processing Model

A- Data Preparation

County data used in steps 2 through 5 needs to be prepared before use in processing.

All parcel data used in steps 2, 3 and 4 needs to have a physical street address field to be processed into valid address points. When there is no physical address information available, step 5 will create it through the reverse geocoding process. In cases where the parcel data has multiple polygons with the same PIN and address, the data is dissolved so that multiple points are not created for those polygons. A physical address zip code field must be present in the parcel data for the geocoding process. For parcels without zip code information, it is calculated using the "Spatial Join" command to a country wide zip code file.

A centerline is a digitized line along the center of a linear geographic feature such as a street. County centerline data is clipped to the county boundary and must have a street name, address range and right & left zip code fields. If any of these fields are missing or incomplete, a NCDOT centerline file is used in its place.

B-Separating Working Points from Processed/Complete Points

After the data has passed through processing, this step determines which points will be passed to the Repository (Processed / Complete points) and which points will be moved to the next process (Working points).

When attempting to determine good points from working points the analyst must use his or her own logical thinking to combine or split multiple fields to create the physical address. Incomplete addresses, PO boxes and mailing addresses are sorted out then removed.

At this stage, address points from the county are checked for duplicate points. In ArcMap the user performs an intersection routine on the matched geocoded or address points. The coincident points are looked at and distributed or removed as necessary.

C-Standard File Naming Convention

In this step a standard naming convention is applied to Processed and Working points after process completion.

During processing all naming conventions are based on the same standard. This is achieved by using a numbering sequence that has been assigned to processes within the workflow. These numbers are included in the naming convention when saving the outputs. As Working files are processed further, they are named with "Working" and the step number assigned to that process. A Processed file will be labeled with "Processed" and the final step number. An example would be "Wake_Working_1" and "Wake_Processed_1." "Wake_Processed_1" will be loaded into the Repository and "Wake_Working_1" will move to step 2.

1-Address Points

The following steps are used on county address points with complete address information.

Address points from within the county are selected with the “Select by Location” command. These points are processed further (steps B&C) and the points outside of the county are saved in the appropriate overflow folder to be incorporated later.

2-Spatial Join to Parcel

This step attaches the parcel address information to a “Working” address points file.

Address points with incomplete or missing addresses are given the attributes of a parcel that contains them through the "Spatial Join" command in ArcMap. This is a process in which fields from one parcel layer's attribute table are appended to the address point layer's attribute table based on the relative locations of the features in the two layers.

3-Geocode

The address points in this step are created from geocoded tabular data.

Geocoding is the process of creating an address to a point based on its location along a street centerline. The two important parts involved in geocoding are the address list (tabular data), and the address locator file. The tabular address file to be geocoded must have a physical address and a zip code field.

The address locator stores the address attributes and rules that define the process for translating street addresses into points. The address locator is created in ArcGIS and sets the parameters for standardizing addresses, searching for match locations and creating output. County centerlines are the preferred source for creating the locator followed by the NCDOT centerlines.

In ArcGIS, geocoding is done by selecting “Geocode Addresses.” Unmatched addresses in the geocoded shapefile are removed by the user.

4- Create Centroid

In this step, address points are created from a parcel layer.

Centroid points are created for unmatched geocoded addresses and parcels with physical address information. In this case, a centroid is the geometric center of a parcel. The ArcGIS command to create centroids is under Data Management Tools, “Feature to Point.” The resulting output file will contain the address information from the parcel if available.

5-Reverse Geocode

This step assigns an address to points through reverse geocoding.

Reverse geocoding is the process of finding a street address from its geographic location along a street centerline. The “Reverse Geocode Address” tool from the ArcGIS Developer Sample Library is used along

with the address locator created in step 3. If an address locator does not exist, it is created at this time from either the county or the NCDOT centerlines.

6- Send to Repository

The Processed / Complete data in this step is ready to be loaded into the Statewide GIS Data Repository.

Before loading the data into the Repository, two tasks must be performed. First, a unique United States National Grid (USNG) ID is created for each address point. This is a simple calculation done by the Military Analyst extension from ESRI. Second, the address for the file must be standardized with the “Standardize Addresses” tool in the ESRI Geocoding toolbox. This tool standardizes directional information, street type, road prefixes and suffixes into the same format.

The standardized data is loaded into the Repository with the “Load Data” tool in Arcmap. This tool allows the user to specify which fields in the input data are loaded into which fields of Repository.

Once the completed files have been loaded into the repository, all intermediate and unnecessary files are deleted from the county folder. All that remains are original parcel, address and / or centerline files received from the county, overflow files and the final address point files with the appropriate process step naming convention.

Automation Tools and Metadata

Through the development of the SOP, all processing steps for the compilation of local government source data can be completed through manually driven procedures using the desktop tools and interfaces. Given the time for meeting the requirements of the General Assembly’s timeline, development of automated tools could not precede the collection and compilation of the datasets provided by the local governments. Tools were developed and tested against production data to ensure consistent results.

In the same manner that future flexibility is designed into the data flow and SOP, the ArcGIS desktop tools can be modified as necessary to meet future requirements. As processing steps and requirements are identified, CGIA can develop accurate estimates on the level of effort for modifying existing tools as required. The tools in place from this initial effort will increase the efficiency of future iterations of the compilation process.

Repository Data Structure

The transformation operations setting up the loading of address-based information into the repository are key to the flexible and dynamic output of distribution datasets that can be either tabular or spatial, or are directly suited as a source for back end applications and web-based services. Figure 3 documents the incoming data flow for standardizing the attributes for incoming spatial data, while the repository column in the figure is based on the FGDC Draft Address Data standard. These repository fields will be referenced as a required subset for future NC Master Address activities. The inclusion or exclusion of

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any of the repository fields, or creation of additional repository fields to meeting requirements for alternative distribution products can be as flexible as necessary.

Standardized Address	Repository	Census MAF Format
ADDR_HN	ADDRESS_NUMBER	Street_Number
ADDR_PD	STREET_NAME_PRE_DIRECTIONAL	Street_Name_Prefix_Direction
ADDR_PT	STREET_NAME_PRE_TYPE	Street_Name_Prefix_Type
ADDR_SN	STREET_NAME	Street_Name
ADDR_ST	STREET_NAME_POST_TYPE	Street_Name_Suffix_Type
ADDR_SD	STREET_NAME_POST_DIRECTIONAL	Street_Name_Suffix_Direction
STRNM_ST	COMPLETE_STREET_NAME	
	BUILDING_IDENTIFIER	
	UNIT_IDENTIFIER	Unit_Number
	LANDMARK_NAME	
	PLACE_NAME	GQ_Quarters
	COUNTY	
STATE_ST	STATE_NAME	
ZIP_ST	ZIP_CODE	City_Style_Mailing_ZIP_Code
	ZIP_PLUS_4_CODE	
LONG_ST	ADDRESS_LONGITUDE	Structure_Longitude
LAT_ST	ADDRESS_LATITUDE	Structure_Latitude
USNG	US_NATIONAL_GRID_COORDINATE	
COUNTY_ST	COUNTY	
PROCESS	PROCESS	
		County_Code*
		State_Code*
		MAF_ID
		Census_Tract_Number*
		Census_Block_Number*
		Action_Code
		Non_City_Style_Mail_Delivery_Address_RR_HCR_POBOX_
		Non_City_Style_ZIP_Code
		Group_Quarters_Flag
		City_Style_Address_Flag
		Structure_Point
		Street_Name_Prefix_Qualifier
		Street_Name_Suffix_Qualifier

Figure 3: Repository Data Structure and Census Master Address File Distribution Format

Processing Quality Matrix

The overall quality of the statewide dataset is a direct function of the constituent components. These individual components are derived from different business processes and applications from jurisdiction to jurisdiction increasing the challenge for portraying a consistent quality metric for the entire dataset, or even individual components. As each address is processed into the NC Master Address Dataset repository, the *PROCESS* field is added as an attribute of the geographic feature. The Processing Quality Matrix can provide a reference for the individual source records compiled by county. This matrix view does not provide a surrogate for “accuracy” for any points or datasets. It does provide a surrogate for the amount of processing necessary to generate the compiled statewide product; the higher the processing number, there is a relative increase in the amount of processing and with it assumptions that should be made about relative accuracy of the dataset.

This representation is not infallible and should not be used to assume absolute accuracy. For instance, many datasets indicate that the source data from local government partners was derived completely from point data, and has *PROCESS* value of 1. In reality, one jurisdiction may derive the point representations from GPS observations, or building footprint data, while another jurisdiction may provide point-based address data that is generally derived from parcel centroids or some geocoding process from a tabular listing of existing addresses.

Conclusions and Recommendations

Where are structures located in North Carolina? The most pressing need to know is related to Census 2010 and residential structures. The General Assembly tasked CGIA to develop a statewide dataset for all addresses (structures, but no names of residents or businesses) to help support a full count for Census 2010 and to benefit state and local government operations.

The NC Master Address Dataset project establishes a database design, data processing tools and techniques, standard operating procedures, a tabular list for the Local Update of Census Addresses for Census 2010, geospatial data representing locations of addresses, and the capability to produce tabular and geospatial data in custom formats. The procedures were carefully researched, designed, tested, documented and carried out in a 12-month effort. State and local advisors were invaluable in shaping the design and implementation of the project.

The first set of address points published from the project is as complete and as current as the source information provided by local governments throughout the state. The quality of the address points varies from county to county. The key factors in quality are completeness, the date of the last update by local address managers, the accuracy of the address numbers and names, the positional accuracy of the address locations, and when the data were updated locally. For the first release, the quality is reasonable and the data will be reliable for multiple purposes, including a comprehensive list of where people could be residing in April 2010 when the Census forms are issued.

Future Releases

The Master Address Dataset project achieved Release 1 and has detailed workflows in place to produce future releases, including variations on the format produced for Census 2010. As for Release 1, future releases will rely on the best available address datasets from local governments. The quality of local datasets varies from county to county, and much more integration of addresses managed by multiple jurisdictions within a county could be achieved in the next few years. The quality of future cycles depends on widespread adoption of best practices, including address format standards and data development standards.

Benefits to local governments

The positional accuracy, completeness, and currency of the final master address dataset could be improved with a more consistent approach to data maintenance in local government operations. Counties that have achieved an integrated address dataset for all incorporated and unincorporated areas are realizing benefits, including time savings for emergency services where response time is critical. For example, Orange County integrated address data management between the county and its three largest municipalities, with daily updates and online accessibility. The integration effort is significant in counties where addresses are assigned and updated by multiple jurisdictions.

The absence of a standard format for address information in North Carolina is evident in the source datasets received for this project. The project workflow processed source datasets into a standard format that is consistent with a draft federal standard (Federal Geographic Data Committee) and the format used in the Local Update of Census Addresses. Clearly, inconsistent formats complicate the process of address integration for multiple jurisdictions. More widespread application of best practices in creating and managing local addresses would reduce the effort needed to integrate a statewide dataset and would serve needs for data sharing between municipalities and counties, particularly in emergency operations.

Benefits to state government processes

State agency have business processes and applications that depend directly on address- referenced information. The foundation provided by the NC Master Address Dataset can be adapted to meet programmatic and technical requirements for existing applications. Although the current NC Master Address Dataset infrastructure is geared towards supporting the Census Master Address File distribution format, its largest untapped potential is for providing an adaptable solution to reduce redundancy in the resources currently utilized in maintaining multiple sources of address-related data across agencies.

CGIA has a set of tools, and workflows in place that can produce updated versions of the NC Master Address Dataset. These are flexible and scalable to specific projects and needs. Those tools will be most efficient and effective and the results will be of higher quality when and where local address data managers improve their addressing practices. CGIA looks forward to opportunities to support local governments and state agencies in data management, workflows, and documentation. The project team anticipates sharing lessons learned with the NC Geographic Information Coordinating Council and its committees in support of a state standard for geospatial address datasets.

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Appendix A: NC Master Address Dataset Operating Procedure

CGIA Department of Environment & Natural Resources Master Address Dataset SOP MANUAL	Subject: MADB Master Workflow
	Reference:
	Issued Date:4/17/09 Revision Date:5/28/09

PURPOSE: To establish a standard set of operating procedures for the Master Address Dataset (MADB) project, from receiving data to processing to delivery of address point products.

The desired source datasets are address points with physical (site) street addresses. There are three sets of tasks (A-D) for preparation of datasets received from local governments, followed by seven sets of tasks (1-7) for processing address points into a standard format and standard products.

<u>NOTES AND DISCLAIMERS</u>	
	<p>To begin the processing, open the ArcMap document (.mxd file) located here:</p> <p>Z:\MADB\ReceivingStage\!! DATA_TOOLS!!\SOPMap.mxd</p> <p>Copy the .mxd file to your folder and rename it for the</p>

		<p>county you are working on. Using this .mxd file will assure you have access to the tools mentioned later in the SOP.</p> <p>This process was applied by CGIA in May and June 2009 to generate a statewide Master Address Dataset consisting of address points that represent locations of residential and non-residential structures in all 100 counties in North Carolina. The products are based on the best available datasets furnished by county and municipal officials. The accuracy and quality varies by county as noted in the products and report.</p>	
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		A	
		Purpose: to create points to represent site address locations based on parcel center points (where no address points or county street centerlines are available).	
		NOTE: The parcel data must have a physical street address field (site address), and the centerlines data must have street name, address ranges, as well as right and left zip code fields. If they do not, contact the county and see if they have a version of the data with those attributes (or an address table).	
		In working with the parcel data, if you get an ‘invalid topology’ error, use the following commands: Double click on “Data Management Tools”... “Features”... “Repair Geometry”	
Task	Responsible Party	Responsibilities/Steps	Revision Date
A-1	GIS Analyst / Technician	<p><i>In ArcMap, clip the DOT road file by county boundary file (use steps below):</i></p> <ol style="list-style-type: none"> 1. From the cgiaproj/projects/madb/research/workflow folder, add the roads_ncdot_export20081229 and DOT_CB_Dissolved shapefiles as new data (both have been projected to state plane NAD83 feet) 2. Click on “Selection” and “Select by Attributes” 3. Select DOT_CB_Dissolved shapefile in “Layer” dropdown window. 4. Double click on “NAME_LOCAS” 5. Click on “=” 6. In dialog window, type a space, then type county name in upper/lower case with single quotes (Ex. 	

		<p>“NAME_LOCAS” = ‘New Hanover’)</p> <ol style="list-style-type: none"> 7. Click “OK” 8. In ArcToolbox window, double click on “Analysis Tools”... “Extract”... “Clip” 9. “Input Features” should be the roads_ncdot_export20081229 file 10. “Clip Features” should be the DOT_CB_Dissolved file 11. Change the “Output Feature” pathname to your directory 12. Change the “Output Feature” shapefile name to <county>_roads_clip (example Chatham_roads_clip) 13. Click on “Save” 14. Click on “OK” 15. Close window when process is completed (may take a few minutes) 16. Remove roads_ncdot_export20081229 and DOT_CB_Dissolve from session 17. Zoom to layer (roads clip shapefile) 	
<p>A-2</p>	<p>GIS Analyst / Technician</p>	<p><i>Prep the parcel data:</i></p> <ol style="list-style-type: none"> 1. Add the parcels shapefile into the ArcMap session 2. Right click on file name under “Layers” and open attribute table 3. Make sure the parcel data has a physical address field (could also be named property address) 4. If the field is just titled ‘address’, scroll down and see if the address field has PO Boxes or if the city/state field has a lot of entries outside NC (this would be a flag that the addresses are owner mailing addresses) 5. If data does not have physical address, contact county and ask if they have parcel data with physical addresses (or a separate address table). If not, contact the 911 office to see if they have a county address table. 6. <i>NOTE: Read section below on PIN#s - county will need to be contacted also if PIN# is missing.</i> 7. PIN #s: 8. Check to make sure data has a PIN # or PID # field (may sometimes be labeled ALPHA) 9. If data does not have PIN, PID or ALPHA, contact county for parcel data with PIN #s. 10. Open attribute table. 11. Right click on PIN column and click on “Sort Ascending” 12. Check to see if there are entries that are blank or all 9’s 13. If so, select those and pan around to see what these polys look like 14. These should be right-of-ways and rivers. If legitimate polygons have blank PIN #s, contact county and ask if they have parcel data with PIN #s for all the polygons. 15. Use the following commands to select out blanks and 9’s in the PID field. <i>(If there are no blanks or all 9 PINs – skip to next bold command line.)</i> 	

		<ol style="list-style-type: none"> 16. Use Selection and Selection by Attributes to select the polygons in the parcel data that are blank or all 9s (make sure and change the layer name to the parcel data before doing the select) 17. Also select parcel boundaries that are large lakes 18. Right click on parcel data under “Layers”, click on “Open Attribute Table” 19. Click on “Selected” 20. Click on “Options”, then on “Switch Selection” 21. Close window 22. Right click on parcels under “Layers” 23. Click on “Data”, then on ‘Export Data” 24. Change folder, if needed, and name export file “parcels_select” 25. Click on “OK” 26. Then click “Yes” 27. Remove the previous version of the parcel data from ArcMap 28. Physical (Site) Address (multiple fields): 29. Sometimes the physical address will be broken out into two fields – house number & street name 30. If that is the case, use the following commands to join the two fields for geocoding: 31. Click on “Options”... “Add Field” 32. Type “Name” as PHYS_ADDR 33. Choose “Text” from dropdown window for “Type” 34. Leave “Field Properties” as the default 35. Scroll over & right click on PHYS_ADDR 36. Click on “Field Calculator” 37. Then click on “Yes” 38. Double click on house number field 39. Then type & “ “ & (with a space in between each symbol and a space at the end) 40. Then double click on the street name field 41. The command line should read something like: [HSENO] & “ “ & [STREET] 42. Then click on “OK” <i>This should populate the field with the street number, space, and street name</i> 	
		<p>There are cases where the parcel data will have multiple polygons with the same PIN and address (for example, when a parcel is transected by a river). Therefore, the parcel data will need to be dissolved (so there won’t be multiple output points for these polygons).</p>	
<p>A-3</p>	<p>GIS Analyst / Technician</p>	<ol style="list-style-type: none"> 1. Under “ArcToolBox”, double click on “Data Management Tools”... “Generalization”... “Dissolve” parcels. 2. Under “Input Features”, select the parcels_select shapefile (or the original parcels shapefile if there were 	

		<p>no blank or all 9 PINs)</p> <ol style="list-style-type: none">3. Browse to directory and change output name to parcels_dissolve4. Select PIN# (or ALPHA)5. Click "OK"6. (Dissolve only keeps one field, so use commands below to join other fields back in)7. Click on parcels_dissolve under "Layers"8. Right click and Click on "Joins and Relates", then click on "Join"9. Under "1" select PIN (or ALPHA) from dropdown window10. Under "2" browse to the original parcels_select file (or the original parcels shapefile if there were no blank or all 9 PINs)11. Under "3" select PIN (or ALPHA) from dropdown window again12. Click on "OK"13. Right click on parcels_dissolve under "Layers"14. Click on "Data"... "Export Data"15. Name output file parcels_joined16. Click on "OK" and "Yes"17. <i>(Use the commands below to delete duplicated fields)</i>18. Double click on "Data Management Tools"... "Fields"... "Delete Field" 19. Input Table should be parcels_joined20. Select any fields that end with "*_1"21. Click on "OK"	
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		<p>A physical (not mailing) zip code field must be present in the parcel data in order to do geocoding. If it does not, use the commands below to pull zip code from data supplied with ArcMap CDs. If zip code field exists, skip to Section B.</p>	5/20/09 FO
A-4	GIS Analyst / Technician	<ol style="list-style-type: none"> 1. In ArcMap, double click "Data Management Tools"... "Features"... "Feature to Point" 2. For "Input Features" – select the parcels_joined shapefile 3. Under "Output Feature Class" – verify folder name and change output name to centroids 4. Click on "Inside" and then click "OK" 5. Close window when process is complete 6. <i>This gives us a points file to use with the spatial join command (spatial join will not work correctly with two polygon files)</i> 7. Double click on "Analysis Tools"... "Overlay"... "Spatial Join" 8. For "Target Features", select centroids shapefile 9. For "Join Features", browse to cgiaproj/projects/madb/research/workflow and select nc_Zip5_Dissolved 10. For "Output Features", confirm folder name and change output name to centroids_withzip 11. Click on "OK" 12. Close window when process is complete 13. <i>This pulls in the zip code for each centroid</i> 14. Double click on "Data Management Tools"... "Fields"... "Delete Fields" 15. The Input Features should be to parcels_joined shapefile 16. Click on "Select All" 17. Click box beside PIN (or ALPHA) to unselect 18. Click on "OK" 19. Close window when process is complete 20. <i>This step is necessary in order to strip all the attributes so the join will not have duplicates</i> 21. Click on parcels_joined under "Layers" 22. Right click and Click on "Joins and Relates", then click on "Join" 23. Under "1" select PIN (or ALPHA) from dropdown window 24. Under "2" browse to the centroids_withzip file 25. Under "3" select PIN (or ALPHA) from dropdown window again 26. Click on "OK" 27. Right click on parcels_joined under "Layers" 28. Click on "Data"... "Export Data" 29. Name output file parcels_withzip 30. Click on "OK" and "Yes" 31. <i>(Use the following commands to delete duplicated fields)</i> 32. Double click on "Data Management Tools"... "Fields"... 	

		<p>“Delete Field”</p> <p>33. The “Input Table” should be parcels_withzip</p> <p>34. Select the following fields: FID_1, Join_Count, PIN_1 (or ALPHA_1) near the top of the list and ORIG_FID near the bottom of the list</p> <p>35. Click on “OK”</p> <p>36. Close window when process is complete</p>	
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B			
		<p>Purpose: to select “acceptable quality” address points from “working” points. This step separates the points that will pass on to the repository (REPO) and the “working” points that will continue to be processed to include proper address information.</p> <p><i>(See top and right-hand side of workflow diagram)</i></p>	
Task	Responsible Party	Responsibilities/Steps	Revision Date
B-1	GIS Analyst / Technician	<p>Open ArcCatlog:</p> <ol style="list-style-type: none"> 1. When attempting to determine good points from working points the analyst must use logic and judgment to combine multiple fields to create potential physical addresses. 2. This process is used in conjunction with Google maps (or NC OneMap) to visually check the address location and verify that it appears to be an actual address. 	
B-2	GIS Analyst / Technician	<p>In ArcCatalog:</p> <ol style="list-style-type: none"> 1. With the attributes table open for the parcels.shp. Look for the CITY_STATE field. Sort by ascending. 2. Combine fields ADDRESS_CITY_STATE together. By copying the value of these three fields you will be able to use these attributes in Google maps. 3. With Google maps open, paste your combined address values into the search bar and see if these files are located in the county. 4. After doing this procedure for three or more combined “addresses” and verifying they located within your county you can determine if they are tax mailing addresses or physical (site) address. 	
B-3	GIS Analyst / Technician	<p>In the ArcCatalog:</p> <ol style="list-style-type: none"> 1. For example, when using the onslow county.shp, to find the physical address you must combine the following fields: DESC4_SITUSCITY_SITUSZIP. 2. You must repeat the same processes as above using Google maps again to verify your address. 	

		<p>3. This has been the most current process of deciphering the data provided. During your processing you may be able to use this process or not. Attribute naming varies from county to county, so no one method will work for every county. Document alternative methods. MAKE NOTES AND INCLUDE THEM WITH THE PROCESSED DATA! This will help everyone in the long run.</p>	
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		C	
		Purpose: Check address points from your county for duplicate points.	
		<p>Follow the next steps manually if you are checking address points from your county for duplicate points. Do not use the custom tool for these points. And only perform the “Intersect” tool on your points (steps 1-4 only). Once complete, process your coincident points by removing those necessary.</p> <p>Otherwise, within ArcMap, click the tool on the “Tools” toolbar that looks like a cylinder. When the dialog opens, select the county you are working on, the file you wish to process and the name of the field containing the unique parcel ID information. Then click “Run”.</p> <p>*Also, please note that as part of the process, “stacked” points will be joined to the parcels layer containing address information. The file name needs to end in “parcels_joined” or “parcels_withzip” (as referenced above). The tool looks for a file ending in one of these configurations and will create an error if not found.</p>	
Task	Responsible Party	Responsibilities/Steps	Revision Date
C-1		<p>Note: Perform an “intersection” routine on the matched geocoded OR address points file and prepare the resulting output file.</p> <ol style="list-style-type: none"> 1. If processing address points from county, select and delete all points with blank addresses before continuing. 	

		<ol style="list-style-type: none"> 2. In ArcToolbox expand “Analysis Tools” and “Overlay”. Double click the “Intersect” tool. 3. Select the “county_matched.shp” file as the input feature. 4. For output FC, navigate to your county folder and name the the file “county_matched_intersect.shp”. If working with county supplied address points, stop after step 4 is completed. Skip to C-1A. 5. Click “OK” and “Yes” to add the new file to the ArcMap TOC. This output file contains only the coincident address points. 6. Open the attribute table for the “_intersect.shp” file. 7. Click “Options” and “Add Field”. 8. For Name type “Stacked” 9. For Type choose Text 10. For Length choose 3 11. Click “OK” 12. Right click the heading for the new field and select “Field Calculator” 13. In the white expression box type “Y” (within double quotes) 14. Click “OK” 15. Close the attribute table 16. In ArcToolbox expand “Data Management Tools” and “Fields” 17. Double Click “Delete Field” 18. For the input table, select the “_intersect.shp”file. 19. For “Drop Fields” click the “Select All” field and then uncheck the “Stacked” field and the unique Parcel ID field for the file (PID or Alpha”). 20. Click “OK” 	
<p>C-1A</p>		<p>Notes:</p> <p><i>This section pertains to duplicate address points only.</i></p> <ol style="list-style-type: none"> 1. Once you have identified the coincident points, review and slightly adjust duplicate points with the same address 2. To do this, click “Start Editing” on the Editor tool bar. Make the address points file the “target” file. 3. Using the Intersect output file as a guide, locate the duplicate points in the input address points and select a duplicate and move it slightly in any direction. Only move the point a few feet from its coincident counterpart. 4. Once you have done this with all of the duplicate points, save edits and stop editing. 	

<p>C-2</p>	<p>GIS Analyst / Technician</p>	<p>Notes:</p> <p><i>Join the intersect address points to the parcel layer. This will identify the parcels needing centroids for reverse geocoding:</i></p> <ol style="list-style-type: none"> 1. In Map right click the “parcels_joined or parcels_withzip” file and click “Joins and Relates” and “Join”. 2. In Box 1 choose the unique Parcel ID (PID or Alpha). 3. In Box 2 choose the “_intersect.shp” file. 4. In Box 3 choose the unique Parcel ID (PID or Alpha). 5. Click “OK”. 6. In ArcMap click “Selection” and “Select by Attributes” 7. For Layer select “parcels_joined or parcels_withzip” 8. Make sure Method is set to “create a new selection” 9. Double click “Stacked” and click the “ = “ sign and then type ‘Y’ (with single quotes). 10. Click “OK”. 11. When the section is complete right click “parcels_joined” or “parcels_withzip” 12. Select “data” and “Export Data” 13. Name the output file “county_stacked_pullcentroid”.shp” 14. Click “OK” and “Yes”. 	
<p>C-3</p>	<p>GIS Analyst/ Technician</p>	<p>Notes:</p> <p><i>Create centroid file for parcels with coincident address points:</i></p> <ol style="list-style-type: none"> 1. In Arc ToolBox expand “Data Management Tools” and “Features”. 2. Click on “Feature to Point”. 3. For input features select the county_stacked_pullcentroid.shp” file. 4. For output feature class navigate to the correct folder and name the output file “county_stacked_centroid.shp”. 5. Click “OK”. 6. The file is now ready to be reverse geocoded. 	

D			
		Standard naming convention for good points/working points after process completion.	
Task	Responsible Party	Responsibilities/Steps	Revision Date
D-1	GIS Analyst / Technician	<p>During point processing:</p> <ol style="list-style-type: none"> 1 During processing all naming conventions will be based on the same standard. This will be achieved by using a numbering sequence that has been assigned to certain processes within the simplified workflow. These numbers will be included into the naming convention when saving desired outputs. The number of the process will only be included for that current step. If further processes are needed they will be processed and named with current step number assigned to that process. 	04/14/09
D-2	GIS Analyst / Technician	<p>Points ready for REPO:</p> <ol style="list-style-type: none"> 1 After completing the desired process and you have produced <u>acceptable points that are ready for transfer to the REPO</u>. You must name the output file in this format; <u>“county name” points ”process#” I.E. CUMBERLAND POINTS 2.SHP</u> 2 The remaining points that need to continue with processing will be named: <u>“county name” points ”process# working” I.E. CUMBERLAND POINTS 2 WORKING.SHP</u> 	04/14/09

		1	
		<p>Use the following workflow if you have local Address Points with Address information.</p> <p>You may need to perform the tasks in section “B” to remove duplicate points and filter out “working” points for further processing.</p> <p>Purpose: Use the “SELECT BY LOCATION” Command to select address points within and outside of a county.</p>	5/7/09
Task	Responsible Party	Responsibilities/Steps	Revision Date
1-1	GIS Analyst / Technician	<p>Open ArcMap session</p> <ol style="list-style-type: none"> 3. Load DOT county data into the ArcMap session from \\MADB\Research\!!DATA_TOOLS!!\DOT_CB_Dissolved.shp 4. Load county address points file into the Arcmap session 5. Click “Selection” in the ArcMap main menu. 6. Click “Select by Location” in the drop-down window. 	05/28/09
1-2	GIS Analyst / Technician	<p>Open Attribute table of DOT_CB_Dissolved. Select county of interest i.e. “Lincoln” and leave selected, or export the selected county boundary to its own shapefile.</p> <p>In the ‘Select Location’ dialog box:</p> <ol style="list-style-type: none"> 5. Choose “Select Features From” in the first drop-down window. 6. Check the county addresses point’s shapefile in the second window. 7. Choose “are completely within” in the third window. 8. Choose DOT county data in the fourth window. 9. Click “OK” to select the address points within the county 	3/27/09

		and to exit the dialog box. 10. The points within the county boundary should be selected now. Verify that they are selected.	
1-3	GIS Analyst / Technician	In the ArcMap session: 1. Right click on the county address points shapefile. Click on “Data” and “Export Data...”.	3/24/09
1-4	GIS Analyst / Technician	In “Export Data” dialog box: 4. Choose “Selected features” and check “this layer’s source data” as the coordinate system for the exported shapefile. 5. Navigate to desired location using browse function and name the shapefile (e.g., “county_addressespts_withincounty”). 6. Click “OK” to export the shapefile.	3/24/09
1-5	GIS Analyst / Technician	In the ArcMap session: 1. Right click on the county address point’s shapefile. Click on “Selection” and then “Switch Selection”. 2. Right click on the county address point’s shapefile. Click on “Data” and “Export Data...”	3/24/09

1-6	GIS Analyst / Technician	<p>In "Export Data" dialog box:</p> <ol style="list-style-type: none"> 1. Choose "Selected features" and check "this layer's source data" as the coordinate system for the exported shapefile. 2. Navigate to \MADB\ReceivingStage\COUNTY_DIRECTORY\ folder using browse function and name the shapefile "COUNTY_addrespts_outsidecounty". (Replace "COUNTY" with the county name you are working in.) 3. Click "OK" to export the shapefile. 	3/26/09
1-7	GIS Analyst / Technician	<p>In ArcMap:</p> <ol style="list-style-type: none"> 1. In ArcMap, display ortho images and county centerlines data: 2. Copy the template.mxd arcmap session in the cgiaproj/projects/madb/research/workflow/files folder. (This template accesses the orthos from nconemap.) 3. Scroll down and click on your county. 4. Right click and zoom to layer. 5. Add your county address points to the session. 6. Add the county centerlines data or, if none, 7. Add the DOT Roads - cgiaproj/projects/madb/research/roads/roads_ncdot_export20081229.shp 	2/24/09
1-8	GIS Analyst / Technician	<ol style="list-style-type: none"> 1. Pan around and check location of building points: <ol style="list-style-type: none"> a. at building footprint entrance b. near center of rooftop c. center of property boundary d. approximate location along street address range 	2/24/09
1-9	GIS Analyst / Technician	<p>Add a sentence to the 'Abstract' section of the address metadata.</p> <p>For example: "Address points are located at an apparent main entrance to a building."</p>	2/24/09
2			
<p style="text-align: center;">SPATIAL JOIN TO PARCEL</p> <p style="text-align: center;">These procedures will attach the parcel attribute information to a "working" Address Point file.</p> <p style="text-align: center;">Use steps in section A to prepare the parcel data before performing a Spatial Join to Address points that lack the required address information.</p>			5/8/09

Task	Responsible Party	Responsibilities/Steps	Revision Date
2-1		<ol style="list-style-type: none">1. In ArcMap or ArcCatalog, open ArcToolbox.2. Double click on "Analysis Tools"..."Overlay"..."Spatial Join".3. The "Target Features" will be the Address Point file provided by the county, (or the Centroids_withzipcodes if address points were not provided).4. The "Join Features" will be the parcel file provided by the county.5. Specify an output file name6. Leave everything else set at the default.7. Click the "OK" button.	5/20/09

3

GEOCODE COMMANDS:

If you have parcel data with NO Address information or Tabular-only data, use the workflows below to Geocode the data.

Note: You may need to use the procedures outlined in section “A” to prep the date to perform the following geocoding workflow.

Task	Responsible Party	Responsibilities/Steps	Revision Date
		<p>NOTE: the file with the addresses to be geocoded must have a physical address and a zip code field.</p> <p>21. If address table is in any other format, save it as a dbf file. 22. Check for physical address and zip code fields. 23. If it does not have them, contact the county to see if they can provide a table with those fields.</p>	3/26/09
3-1	GIS Analyst / Technician	<p><i>Use the following commands to geocode the addresses from the parcel data:</i></p> <ol style="list-style-type: none"> 1. Copy the dbf file from the parcels_withzip shapefile (or the parcels_joined shapefile if the zip code did not need to be added) and rename it to geocode.dbf 2. In ArcMap, add the county centerlines shapefiles and the geocode.dbf file with addresses as new data 3. Right click the dbf file and then click “Geocode Addresses” 4. Click “Add” on the “Choose an address locator to use” dialog box 5. The “Add Address Locator” dialog box will open 6. Double click on the <county>_geocode_setup.mdb file 	

		<p>you generated in Access earlier</p> <ol style="list-style-type: none"> 7. Click "US_ Streets_ with_ Zone_ Locator" 8. Then click "Add", then click "OK" 9. This will open the "Geocode Addresses" dialog box 10. Make sure the "Street or Intersection" and "Zone" fields have been populated. 11. (NOTE: "Street or Intersection" should be physical address, not mailing address; "Zone" should be zip code) 12. If fields are not populated, click on the dropdown window and choose the appropriate field for each. 13. Click on "Geocoding Options" and change "Side Offset" to 50 feet. Click on "OK" 14. Under the Output section, click the browse button to define the output 15. Navigate to your folder 16. Change output name to geocoding_result.shp 17. Click on "Save" 18. Click OK to start geocoding 19. Click on "Close" when process is complete 20. Record the number of addresses matched and unmatched (and the percentages). 21. Add this information to the metadata 22. Click on "Close" 23. The resulting shapefile will be added to the map 	
<p>3-2</p>	<p>GIS Analyst / Technician</p>	<p>The geocoded shapefile will have unmatched addresses in the dbf file. These entries will need to be removed. Follow the steps below to remove them.</p> <ol style="list-style-type: none"> 1. Click on "Selection"... "Select by Attributes" 2. In the dropdown window under "Layer", select the geocoding_result points file. 3. Double click on "Status" 4. Double click on "<>" 5. In command window, beside <>, type a space and then type 'U' 6. (command line should read: "Status" <> 'U' which selects entries not equal to unmatched) 7. Click on "OK" 8. Right click on geocoding_result shapefile in layers list. 9. Click on "Data"... "Export Data" 10. Navigate to your folder and name export file matched.shp 11. Click on "OK" and "No" 12. <i>(This file will be merged with the centroid points later)</i> 	

		<p>NOTE: For geocoding in ArcGIS 9.2 and 9.3, the process asks for an address locator. Follow the detailed instructions below to set up the address locator for each county centerline file.</p>	
<p>3-3</p>	<p>GIS Analyst / Technician</p>	<p>Create a new address locator using County Centerlines: <i>(If there are not county centerlines, use NC DOT road data which is described in the next step of the workflow.)</i></p> <ol style="list-style-type: none"> 1. You'll need to match the items below (see section 6) to fields in the centerlines database. 2. In ArcMap, open the table for the centerlines data and make a note of which fields match. (This will make it easier than trying to guess later.) 3. SEE METADATA STEP "X" BEFORE PRECEDING. 4. Right click in side Catalog under county directory and select "New", then click on "Address Locator" 5. The Create New Address Locator dialog box will appear 6. Scroll down and click the "US Streets with Zone" address locator style, then click OK 7. Replace the default name with "US_Streets_with_Zone_Locator" 8. Near "Reference data:" click on the browse button (looks like a file folder) 9. Navigate to the folder containing the county centerlines shapefile 10. (NOTE: make sure you select the shapefile and not the access database file) 11. Select the shapefile and click add 	

<p>3-4</p>	<p>GIS Analyst / Technician</p>	<ul style="list-style-type: none"> • Match the following items to fields in the centerlines database: (NOTE: Light grey fields are optional – but enter them if the field exists in the county centerlines shapefile) <ul style="list-style-type: none"> ○ “House from left” ○ “House to left” ○ “House from right” ○ “House to right” ○ “Prefix Direction” ○ “Prefix Type” ○ “Street Name” ○ “Street Type” ○ “Suffix Direction” ○ “Left Zone” (Left Zip Code) ○ “Right Zone” (Right Zip Code) • Change the offset distance to 50 feet • (Let other items stay at the default) • Then click OK • Exit out of ArcCatalog 	
		<p>NOTE: For geocoding in ArcGIS 9.2 and 9.3, the process asks for an address locator (used with the DOT Roads</p>	
<p>3-5</p>	<p>GIS Analyst / Technician</p>	<p><u>To geocode addresses from parcel data dbf file:</u></p> <p><i>Using NC DOT Roads</i></p> <ol style="list-style-type: none"> 1. Copy the dbf file from the parcels_withzip shapefile (or the original parcels if the zip code did not need to be added) and rename it geocode.dbf 2. In ArcMap, add the clipped county roads shapefiles and the geocode.dbf as new data 3. Right click the geocode.dbf file and then click “Geocode Addresses” 4. Click “Add” on the “Choose an address locator to use” dialog box 5. The “Add Address Locator” dialog box will open 6. Navigate to DOT_geocode_setup.mdb in cgiaproj/projects/madb/research/workflow 7. Click “US_Streets_with_Zone_Locator” 8. Then click “Add”, then click “OK” 9. This will open the “Geocode Addresses” dialog box 10. Make sure the “Street or Intersection” and “Zone” fields have been populated. (NOTE: “Street or Intersection” should be physical address, not mailing address; “Zone” should be zip code) 11. If fields are not populated, click on the dropdown window and choose the appropriate field for each. 12. Click on “Geocoding Options” and change “Side Offset” to 50 feet. Click on “OK” 13. Under the Output section, click the browse button to 	

		<p>define the output</p> <ol style="list-style-type: none"> 14. Navigate to your folder 15. Change output name to geocoding_result.shp 16. Click on "Save" 17. Click OK to start geocoding 18. Click on "Done" when process is complete 19. Record the number of addresses matched and unmatched (and the percentages) 20. Add this information to the metadata 21. Click on "Close" 22. The resulting shapefile will be added to the map 	
<p>3-6</p>	<p>GIS Analyst / Technician</p>	<p>The geocoded shapefile will have unmatched addresses in the dbf file. These entries will need to be removed. Follow the steps below to remove them.</p> <ol style="list-style-type: none"> 1. Click on "Selection"... "Select by Attributes" 2. In the dropdown window under "Layer", select the geocoding_result points file. 3. Double click on "Status" 4. Double click on "<>" 5. In command window, beside <>, type a space and then type 'U' 6. (command line should read: "Status" <> 'U' which selects entries not equal to unmatched) 7. Click on "OK" 8. Right click on geocoding_result shapefile in layers list. 9. Click on "Data"... "Export Data" 10. Navigate to your folder and name export file matched.shp 11. Click on "OK" and "No" 12. <i>(This file will be merged with the centroid points later)</i> 	

4

CREATE CENTROIDS

Begin at step 1 if creating centroids from geocoded addresses.

If you have parcels with address information, skip to step 26 and create center points (centroids)

Task	Responsible Party	Responsibilities/Steps	Revision Date
4-1	GIS Analyst / Technician	<p><i>Points for the unmatched records will need to be generated from the parcel data centroids. Use the following commands:</i></p> <ol style="list-style-type: none"> 1. Copy geocoding_result.dbf and change name to need_centroids.dbf 2. Add need_centroids.dbf to ArcMap session 3. Double click on "Data Management Tools"... "Fields"... "Delete Fields" 4. Select "need_centroids" from the "Input Table" dropdown window. 5. Click on "Select All" 6. Click on "Status" and "PIN" (or "ALPHA") to unselect those. Click on "OK" 7. Add parcels_joined to ArcMap session. 8. Right click on parcels_joined in under "Layers" 9. Click on "Joins and Relates"... "Join" 10. Under "1" select PIN (or ALPHA) from dropdown window 11. Under "2", browse and select the need_centroids.dbf file from the dropdown window 12. Under "3" select PIN (or ALPHA) from dropdown window again 13. Click on "OK" 14. <i>(This joins the status field from the geocoding output)</i> 	

		<ol style="list-style-type: none"> 15. Right click on parcels_joined under “Layers” 16. Click on “Data”... “Export Data” 17. Change output name to parcels_status and click on “OK” 18. Add as layer 19. Click on “Selection” and “Select by Attributes” 20. Select parcels_status in “Layer” dropdown window 21. Scroll down and double click on “Status” 22. Double click on “=” 23. Then type a space and ‘U’ with single quotes 24. (The command line should read “Status” = ‘U’ – which will select the unmatched entries) 25. Click on “OK” 26. Right click on parcels_status under “Layers” 27. Double click “Data”... “Export Data” 28. Name output file pull_centroid 29. Add as layer 30. Double click on “Data Management Tools”... “Features”... “Feature to Point” 31. Select “pull_centroid” from Input Features dropdown window 32. Click on “Inside” 33. Name Output Feature Class as “unmatched.shp” and click on “OK” 34. Close window when process is complete. 	
4-2	GIS Analyst / Technician	<p>Prepare shapefiles for merging:</p> <ol style="list-style-type: none"> 1. Add matched shapefile to ArcMap session 2. Double click on “Data Management Tools”... “Fields”... “Delete Fields” 3. Select matched in the Input Table dropdown window 4. Select Status, Score, Match_type, Side, Match_addr, ARC_Street, ARC_Zone to be deleted 5. Click on OK 6. Close window when process is complete 7. Double click on “Data Management Tools”... “Fields”... “Delete Fields” 8. Select unmatched in the Input Table dropdown window 9. Select OID1, Status, ALPHA_1, and ORIG_FID to be deleted 10. Click on OK 11. Close window when process is complete 	
4-3	GIS Analyst / Technician	<p>Merge shapefiles:</p> <ol style="list-style-type: none"> 1. Double click on “Data Management Tools”... “General”... “Merge” 2. Enter matched and unmatched under Input Databases 3. Change Output Database to <county>_phase1_addressespts 4. Click on “OK” 5. Close window when process is complete 6. <i>Update metadata to reflect processes used</i> 	

		<p><i>NOTE: There are cases where the parcel data will have blank entries for physical address. A decision needs to be made on how to handle these. With the above commands, these will be pulled as centroids from the parcel data (along with the other unmatched entries), but the address will be blank in the final address points data.</i></p>	

5

REVERSE GEOCODE

Task	Responsible Party	Responsibilities/Steps	Revision Date
5-1	GIS Analyst / Technician	<p>In ArcMap:</p> <ol style="list-style-type: none"> 1. Navigate to Z:\MADB\ReceivingStage\!! DATA_TOOLS\!!\REV GEOCODE and select BatchReverseGeocode tool. 2. This will open a window that will ask for three fields to be selected: Input, locator, and output. 3. In the Input field navigate and select desired county points shp. 4. For the locator file, give priority to the county created locator file first and allnc locator file second. (This file should be located in your centerlines folder) 5. When selecting output destination navigate to county directory under your address point's folder. (default name will be RG_centroids) 6. Now select the process button and wait until you see the "working box" complete. After it disappears you will not get a "done box," so you must open the attribute table and verify that the required fields are applied. (They will be located at the end of the table labeled REV_street and REV_Zone). 	05/08/2009

6

SEND POINTS TO REPOSITORY

Task	Responsible Party	Responsibilities/Steps	Revision Date
6-1	GIS Analyst / Technician	<p>NOTE: Before loading the data into the repository, two tasks must be performed. First, a unique United States National Grid (USNG) ID must be created for each address point. This requires that the Military Analyst extension from ESRI be installed on your computer. Please see the network administrator if you do not have this extension.</p> <p>In addition to the USNG, the tool will add Lat/Long coordinates and several final fields to your file. These fields are "STATE_ST", "COUNTY_ST", "ZIP_St", "STRNM_ST", and "Process". After the tool is run, calculate values for "COUNTY_ST", "ZIP_ST", AND "Process".</p> <p>Generate a unique USNG:</p> <ol style="list-style-type: none"> 1. In Arc ToolBox, expand the MADB Toolbox and double click "Standardize Data Fields". 2. For Input Table navigate to the final .shp file you are using. You cannot select it from the ArcMap TOC. You must browse for and select the actual .shp file. 3. Click Run 4. When completed, open the table and populate the new fields as mentioned above. 5. Right click on the newly created Longitude Field and select "Calculate Geometry". 6. For 'Property' select "X Coordinate of Point" 7. For 'Units' select "Decimal Degrees" 8. Do the same for the new Latitude field, selecting "Y Coordinate of Point" for the 'Property'. 	

		<p>To add the USNG ID manually using the Military Analyst Tool Box, follow these steps:</p> <ol style="list-style-type: none"> 1. In Arc ToolBox, expand the Military Analyst toolbox and expand "Utilities". Then double click "Convert Coordinates in File". 2. For input table, select the file in the TOC that you want to add the coordinates to. 3. For "Input Coordinate Format" choose "Shape". 4. Skip the "Output Coordinate System" box. This will be automatically populated when you enter the output coordinate format. 5. For "Output Coordinate Format" choose "USNG" 6. For "Geographic Transformation" choose "NAD_1983_To_WGS_1984_5". 7. For "First Generated Field" type "USNG" 8. Click "OK" 	
<p>6-2</p>	<p>GIS Analyst / Technician</p>	<p>Standardize the addresses.</p> <p>This will be accomplished using the "Standardize Addresses" tool in the Geocoding toolbox.</p> <p>NOTE: Review the attribute data for your file. In rare cases, the address information (address #, street name and street type) are spread out in more than one field. IF they are, you will need to create another field and perform a calculation to add all of these elements into one address field for standardizing.</p> <p>If you need to create a single address field, start at step #1 below. If one already exists, go to step #10 to begin standardizing the addresses.</p> <p>YOU MUST STANDIARDIZE THE ADDRESSES BEFORE LOADING DATA.</p> <ol style="list-style-type: none"> 1. Create a field. Go here to recall how to do this. 2. Name the field "AD_SINGLE" 3. The field type should be Text 4. Accept the default length 5. Click OK 6. Right click the new field name and select "Field 	<p>5/20/09 FO 5/25/09 WR</p>

		<p>Calculator”</p> <ol style="list-style-type: none">7. In the white box create a query like this: [Add. #] & “ “ & [DirPrefix] & “ “ & [Street Name] & “ “ & [Street Type] where the components of [] are the field names containing those elements.8. Click OK.9. You now have a single address field to be standardized.10. Expand the “Geocoding” toolbox in Arc ToolBox and double click the “Standardize Addresses” tool.11. For Input Address Data select the points file that has the single field address.12. For Input Address Fields select the field that contains the address. Select this field only.13. For address locator style click the “browse folder” button and select “US Alphanumeric Ranges”. If your address data is in an obviously different format select the appropriate locator type for you data. Note, you are not selecting an actual address locator, just a locator type.14. For Output Address Fields check the address fields to be populated. At a minimum this will be House Number, Street Name and Street Type. If your data contains directional, prefixes, suffixes, etc, include these fields in the output file.15. For Output Address Data name the file “CountyName_matched_parsed(Process#).shp”16. Click OK. When the process is complete, the output address file with standardized addresses will be listed in the TOC.17. Open the table for the newly standardized file18. Create a field called “ADDR_COMP”19. Type = “String”20. Length = “50”21. Calculate this field by concatenating the standardized address fields that resulted from the “Standardize Address” output. <p>NOTE: Please perform a careful review of your county data file before proceeding with the data loading process. This is very important and will help assure a successful load of the data without receiving error messages.</p> <p>Not all county fields will be included in the final repository.</p> <p>Regarding zip codes, the field type for Zips in the</p>	
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		repository is integer. There can be no characters other than digits in your source Zip Code field. No hyphens, etc., in the field	
6-3	GIS Analyst / Technician	<p>To Load Data:</p> <ol style="list-style-type: none"> 22. In ArcMap add the "Object Loader" tool to a toolbar 23. With your target SDE feature class in edit mode and selected as the target layer, click on the "Object Loader" tool. 24. Click the "Browse to Folder" button and navigate to the source layer that you want to load into the repository 25. Select the shapefile you will load and click "Open" 26. Click "Add" and then click "Next" 27. On the left is a listing of fields in the target feature class and on the right are drop down boxes that will list fields in the source shapefile. 28. For each target field you want to populate, click the corresponding box under "Matching Source Field" and select the source field that will be used to load data into that target field. 29. Click "Next" 30. Select "Load all of the source data" 31. Click "Next" 32. Select the defaults of "No" for snapping and validation. 33. Click Next 34. Now you see a summary of the data load operation 35. Click "Finish" 36. If errors were encountered review the information in the fields being mapped in the source file. Are there any empty or <NULL> values? Are the ZIP code values comprised only of numbers with no other characters? 37. Make any necessary revisions to the source file to standardize the values of the fields to be mapped and repeat the "Data Load" operation. 38. When the load data operation is complete, preview the SDE database in ArcCatalog and then in ArcMap. 	
6-4	GIS Analyst/ Technician	<p>Preview target feature class table:</p> <ol style="list-style-type: none"> 7. In ArcCatalog highlight the target feature class in the catalog tree. 8. Click the "Preview" tab and switch the selection to "Table" if necessary. 9. Scroll through the database and review the fields that were mapped. Make sure all records have a value and that the data matches that of the source file. 	

6-5	GIS Analyst / Technician	<p>Preview target feature class in ArcMap:</p> <ol style="list-style-type: none"> 1. Start an ArcMap session 2. Add the target feature class and the source shapefile. 3. Click on "Selection"... "Select by Location" 4. Choose "select features from" in the first drop-down menu. 5. Check the source data file 6. Under "that:" choose "are identical to" 7. In the next drop-down menu select the target feature class 8. Click "OK" 9. When complete, right click on the source layer, choose "Selection" and "Switch Selection". If the data load operation finished with no error messages, this should be a very small selection. 10. Zoom to the selected features and ensure that there is a feature there in the target layer. If so, the reasons for the features not being identical are likely due to a small spatial shift during the data load operation. If there is no feature there at all, there was a problem during the data load operation that needs to be addressed. 	
6-6	GIS Analyst / Technician	<p>Clean up data once final files are in the repository:</p> <ol style="list-style-type: none"> 1. Once the final files have been loaded into the repository, please proceed to remove all intermediate and unnecessary files from the county folder. All that should remain are original parcel, address and / or centerline files received from the county, overflow files and the final address point files with the following naming convention: County_pts_processed_# 	5-29-09

7

DELIVER ADDRESS POINTS TO CENSUS
USING CENSUS TOOLS FOR ArcGIS
To prepare data for census final product.

Task	Responsible Party	Responsibilities/Steps	Revision Date
		<p>Reference: http://www.esri.com/software/arcgis/extensions/census-tools/download.html</p>	May 6, 2009
7-1	GIS Analyst/ Technician	<p>NOTE:</p> <p>Go to http://www.esri.com/software/arcgis/extensions/census-tools/download.html</p> <p>Click on “Census Tools for ArcGIS” beside “Download”</p> <p>If you have not registered before, click on “Register” and enter all required fields. Then download the zip file they provide. Unzip the zip file and double click on the “exe” file. Proceed through the directions.</p> <ol style="list-style-type: none"> 1. Open ArcMap. Click on Tools...Extensions...LUCA Tools. 2. The Toolbar menu will appear in the ArcMap session, along with the workflow manager. (if you open ArcMap 	May 6, 2009

		again, you may need to turn the extension off and back on to start.)	
7-2	GIS Analyst/ Technician	<p>NOTE: Click on “LUCA”, then click on “Establish Workspace” and go through these detailed directions.</p> <ol style="list-style-type: none">1. Click on “Create New Workspace”...”Next”2. Click on “Option 3” in the “Select Participation Option” window.3. Click on “No” when it asks if you want to edit map features.4. The next window will ask for a dbf file of addresses. Browse to dbf file and click on “Open”5. Browse to folder where the output should go.6. Click “Finish”.7. This brings up a window where you have to select which features to “map”.	May 6, 2009

7-3	GIS Analyst/ Technician	<p>NOTE: You will need the state or county FIPS code along with needing to match the following LUCA fields to your data:</p> <p><u>MAFID</u></p> <p><u>STATE</u> (you have to add a STATE field if there is not one included into the attributes fields. Then you must populate all items in the this field with the value to “NC”)</p> <p><u>STPREDIR</u> (N, E, S, W) “street pre direction”</p> <p><u>STRNUM</u> (street number)</p> <p><u>STNAME</u> (street name)</p> <p><u>STSUFTYPE</u> (Rd, Blvd, Dr, etc) “street suffix type”</p> <p><u>CITYMAILZI</u> (zip code)</p> <p>Any features that are not mapped will be added to the output, but all the entries will be bank. The output is a dbf file.</p>	May 6, 2009
“END”	“END”	“END”	“END”

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COUNTY	PROCESS STEP						TOTAL	
	1	2	3	4	5			
Alamance	57,246	(100.00)					57,246	
Alexander	18,262	(100.00)					18,262	
Alleghany				7,461	(100.00)		7,461	
Anson	12,831	(100.00)					12,831	
Ashe	16,927	(100.00)					16,927	
Avery					24,078	(100.00)	24,078	
Beaufort				22,382	(86.30)	3,554	(13.70)	25,936
Bertie			9,097	(100.00)			9,097	
Bladen	21,632	(100.00)					21,632	
Brunswick	108,824	(100.00)					108,824	
Buncombe	117,089	(100.00)					117,089	
Burke					34,310	(100.00)	34,310	
Cabarrus	174,869	(100.00)					174,869	
Caldwell	39,872	(100.00)					39,872	
Camden	4,728	(100.00)					4,728	
Caswell	11,362	(100.00)					11,362	
Catawba	79,971	(100.00)					79,971	
Cateret	50,483	(100.00)					50,483	
Chatham	34,068	(100.00)					34,068	
Cherokee	20,073	(100.00)					20,073	
Chowan	7,851	(81.97)			1,727	(18.03)	9,578	
Clay	10,370	(100.00)					10,370	
Cleveland				42,116	(100.00)		42,116	
Columbus	40,456	(100.00)					40,456	
Craven	51,108	(80.22)		12,604	(19.78)		63,712	
Cumberland	129,565	(100.00)					129,565	
Currituck	21,555	(100.00)					21,555	
Dare	40,532	(100.00)					40,532	

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COUNTY	PROCESS STEP					TOTAL
	1	2	3	4	5	
Davidson					20,416 (100.00)	20,416
Davie	20,667	(100.00)				20,667
Duplin	30,918	(100.00)				30,918
Durham	124,017	(100.00)				124,017
Edgecombe				36,604 (100.00)		36,604
Forsyth	171,343	(100.00)				171,343
Franklin	29,719	(100.00)				29,719
Gaston	111,435	(100.00)				111,435
Gates			3,320 (100.00)			3,320
Graham	5,996	(100.00)				5,996
Granville				30,174 (100.00)		30,174
Greene				9,966 (99.08)	93 (0.92)	10,059
Guilford	263,587	(100.00)				263,587
Halifax					9,609 (100.00)	9,609
Harnett	51,638	(100.00)				51,638
Haywood	37,636	(100.00)				37,636
Henderson	45,864	(100.00)				45,864
Hertford					12,839 (100.00)	12,839
Hoke	19,639	(90.93)		1,960 (9.07)		21,599
Hyde	4,199	(100.00)				4,199
Iredell	82,655	(100.00)				82,655
Jackson					29,237 (100.00)	29,237
Johnston	41,441	(100.00)				41,441
Jones	5,911	(100.00)				5,911
Lee	26,943	(76.73)	7,015 (19.98)		1,155 (3.29)	35,113
Lenoir	30,523	(77.18)		9,027 (22.82)		39,550
Lincoln	35,860	(100.00)				35,860
Macon	29,046	(100.00)				29,046

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COUNTY	PROCESS STEP					TOTAL	
	1	2	3	4	5		
Madison	8,422	(100.00)				8,422	
Martin				13,062	(94.05)	827 (5.95)	13,889
Mcdowell						4,480 (100.00)	4,480
Mebane	2,376	(100.00)					2,376
Mecklenburg	469,474	(100.00)					469,474
Mitchell	10,082	(100.00)					10,082
Montgomery	28,612	(100.00)					28,612
Moore	54,713	(100.00)					54,713
Nash	37,308	(100.00)					37,308
New hanover	101,004	(99.88)				122 (0.12)	101,126
North hampton	13,282	(100.00)					13,282
Onslow	67,757	(100.00)					67,757
Orange	63,789	(100.00)					63,789
Pamlico	7,310	(100.00)					7,310
Pasquotank	17,513	(100.00)					17,513
Pender	29,383	(100.00)					29,383
Perquimans	8,616	(100.00)					8,616
Person				26,268	(100.00)		26,268
Pitt	89,251	(100.00)					89,251
Polk						9,597 (100.00)	9,597
Randolph	62,370	(100.00)					62,370
Richmond	22,610	(100.00)					22,610
Robeson	61,375	(100.00)					61,375
Rockingham	48,148	(100.00)					48,148
Rowan	61,397	(99.66)	210	(0.34)			61,607
Rutherford	34,753	(100.00)					34,753
Sampson	28,680	(100.00)					28,680
Scotland	17,566	(100.00)					17,566

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COUNTY	PROCESS STEP										TOTAL	
	1	2	3	4	5	6	7	8	9	10		
Stanly	25,921	(100.00)										25,921
Stokes	23,977	(100.00)										23,977
Surry	40,470	(100.00)										40,470
Swain	7,968	(100.00)										7,968
Transylvania	20,429	(100.00)										20,429
Tyrrell						1,345	(92.89)	103	(7.11)			1,448
Union	73,384	(94.61)	4,181	(5.39)								77,565
Vance								17,379	(100.00)			17,379
Wake			318,890	(91.26)	30,528	(8.74)						349,418
Wanye	59,294	(100.00)										59,294
Warren	13,686	(79.22)				2,330	(13.49)	1,260	(7.29)			17,276
Washington	7,929	(100.00)										7,929
Watauga					41,027	(94.26)	2,498	(5.74)				43,525
Wilkes					28,090	(100.00)						28,090
Wilson	45,025	(100.00)										45,025
Yadkin	18,574	(100.00)										18,574
Yancey								17,445	(100.00)			17,445
Totals	3,921,159	(82.21)	330,296	(6.93)	112,062	(2.35)	217,797	(4.57)	188,231	(3.95)		4,769,545