Business Plan

Statewide Street Centerline & Road Network Program for Connecticut

Developed for the:

The Connecticut Geospatial Information Systems Council
(CGISC)

September 24, 2008

Prepared by:

The Transportation Subcommittee of
The Data Inventory and Assessment Working Group of
The Connecticut Geospatial Information Systems Council

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1 EXECUTIVE SUMMARY

A Geographic Information Systems (GIS) is a system of computer hardware, software, and data that is used to capture, store, display and analyze a wide variety of geospatial information. GIS is used by many public and private entities in Connecticut to deliver information services help make complex decisions, and support essential functions. In Connecticut state agencies alone, GIS is an integral part of flood hazard determination, emergency management, traffic safety, and general purpose transportation and route planning. But the development of applications and data at the state, local, and regional level across many different agencies and groups has resulted in a fragmented collection of geospatial data that is not always useful or available to the stakeholders.

Recognizing the need for a coordinated program of geospatial data development, Connecticut established a statewide council in 2005 through Public Act. No. 05-3. The Connecticut Geospatial Information Systems Council (CGISC) is made up of representatives from state, regional, local government, academic, and individual users of geospatial technology. The mission of CGISC is to coordinate and enable the development of geospatial data that can be used through out the state. The Council adopted a Strategic plan in September, 2007 and since then has worked to implement the plan.

As part of this effort, the Transportation Subcommittee, one of twelve data subcommittees of the Data and Inventory Working Group, has prepared this business plan to develop a comprehensive statewide road network data layer. The development of this data was identified as a priority in the Strategic Plan and is required to address the redundancy and shortfalls of digital road data that are currently used in Connecticut. Today the various existing roadway data layers do not meet the needs of many users because they are incomplete, inconsistent in scale, or are not kept up-to-date in a timeframe that is acceptable to users.

Responses to an on-line survey done during the CGISC's Strategic planning efforts regarding the need for a Street Centerlines indicated the following:

- 80% of all respondents and local government respondents said they "need this layer to do their work",
- 12% of all respondents said they want to have it, but do not know it exists,
- 32% of all respondents said they created it from scratch because there was no statewide source.

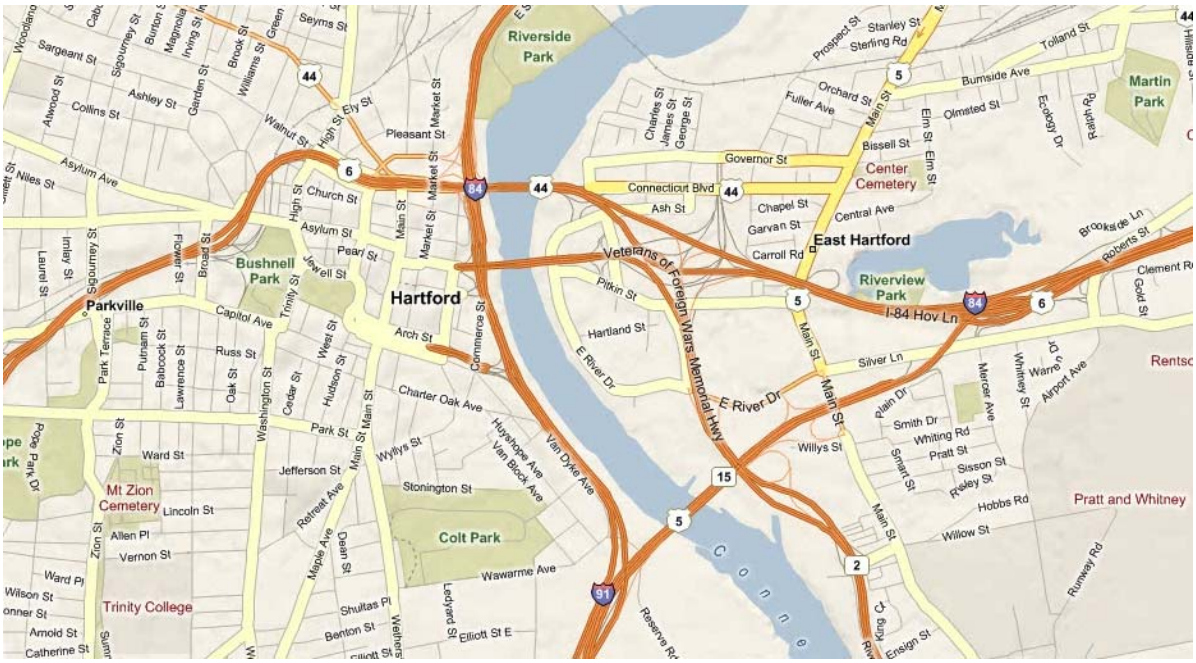
The purpose of this document is to not only focus on the identified need for a statewide street centerline layer, but to also understand Connecticut's applications that require a more detailed statewide road network. It will discuss a solution to meet these statewide needs along with issues that may affect this goal including costs to implement a statewide street centerline program. It will also detail development efforts currently underway at the DOT designed to support statewide networking, linear referencing, routing and addressing for Connecticut and the northeast region. Lastly the document will discuss the need for a recognized transportation data steward to be charged with the responsibility for coordination and maintenance of the street centerlines and road network for the State.

1.1 Data Set Definition and Requirements

Connecticut's highway system is comprised of several differing tiers: interstates, US, state, local and private roadways; each contributing to the successful daily movement of both goods and people throughout the state and region. The highway system is often displayed on maps as a set of linear features which comprise Connecticut's highway network. Point features can also be used to reflect features along this network or other transportation facilities throughout the State. State, regional and local governments maintain a vast amount of tabular data which pertains to transportation and can be associated to this network through a Geographic Information System or GIS which can be used to support a whole host of needs across the State. To provide for a clear definition of a street centerline and of a road network the following definitions have been provided:

Street Centerlines

A Street Centerline base for Connecticut can be clearly defined as a series of vector lines that represent the center line of a full hierarchy of all roads in the State. This layer would include ramping, and turning roadways HOV lanes, and all levels of both public and private roadways used to traverse geography in the daily movement of both goods and people from one location to another either within or through the State of Connecticut. These lines would be used mainly for reference purposes and could be displayed on such products as the Connecticut Tourism Map. Street Centerlines would be drawn or digitized against accurate base mapping such as the 2004 orthophotography and information may or may not be attached to the segments for analysis.



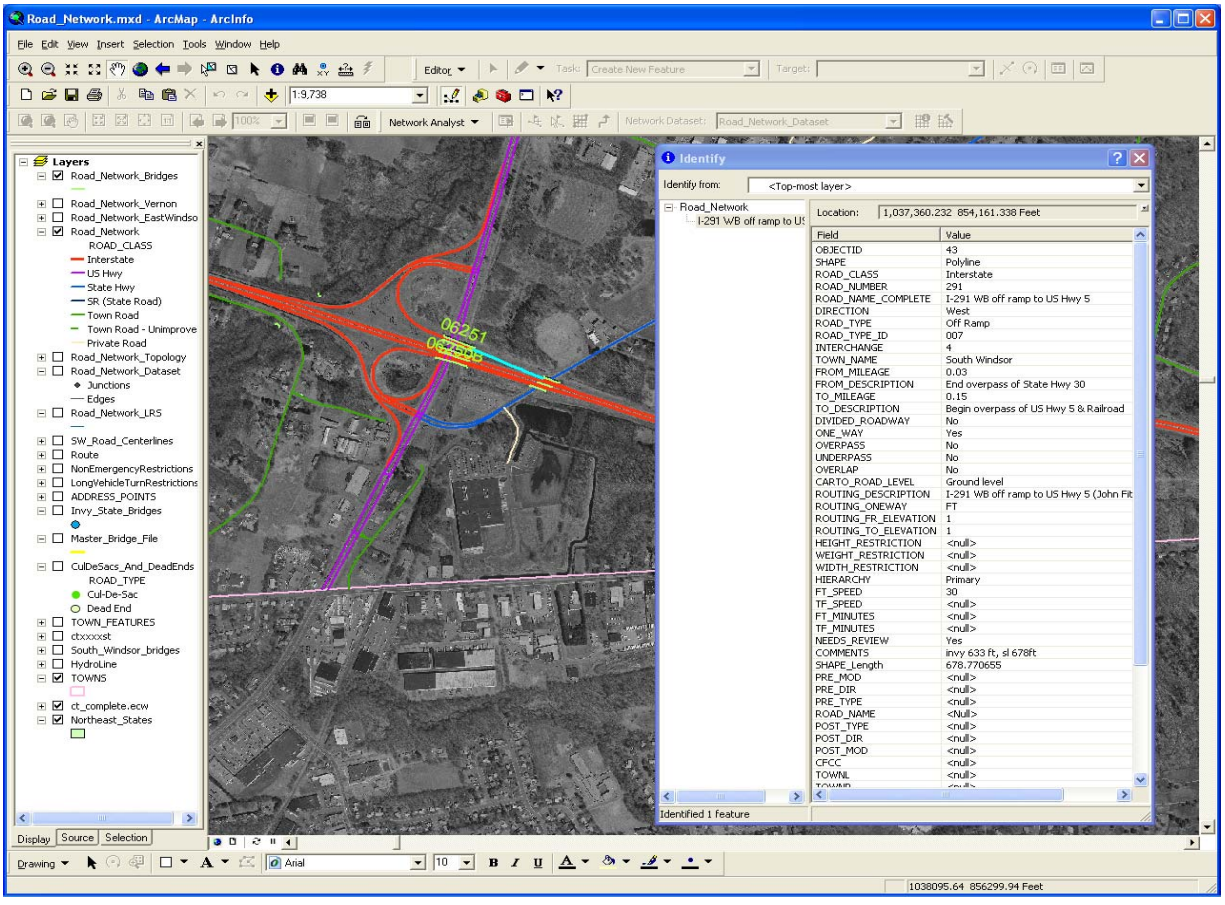
To succeed at implementing a new set of street centerlines for the State of Connecticut the final product must meet the following criteria:

- The Street Centerlines must be complete and comprehensive.

- The information must be kept as up-to-date as possible incorporating changes and additions as frequently as possible.
- The design of the centerlines must be understood and be accepted by all stakeholders.
- The Street Centerlines should be drawn to an acceptable design scale which aligns with a Statewide Orthoimagery Program.
- The Street Centerlines should be developed from municipal, regional and state data collectively and should be consolidated into a standardized set of graphic for all to use.

Road Network

Comprised visually of linear and point based geometry, a digital centerline road network utilizes geographic information systems (GIS) technology to attach the roadway segments to attributes or intelligence maintained within a database and to insure road network topology or connectivity between the road segments. A GIS is a computerized system used to create, store, manage, analyze and display maps and associated data using the characteristics of where the object is or its location, as the fundamental organizing principle. Like other database technologies, GIS and digital road networks are increasingly deployed on the World Wide Web through commercial examples like MapQuest, Yahoo Maps and Google Earth. Road Networks and GIS technologies are even finding their way into personal navigation systems like Magellan, TomTom or Garmin Global Positioning Systems (GPS). With GIS, the resulting road network can be designed to support routing and address location, E-911 response, evacuation planning, and to efficiently move goods and people throughout our State.



To succeed at implementing a statewide new road network solution for the State of Connecticut the final product must meet the following criteria:

- The Road Network should be based on the Street Centerlines.
- The Road Network should include the essential core attribution required for the various transportation related application statewide.
- It should be maintained in an open and accessible environment for all to use.
- It should be kept as up-to-date as possible inclusive of the latest updates and changes statewide.
- It should be maintained by the DOT as the central coordinating body to a statewide effort.
- Acceptable statewide standards should be incorporated to insure common use across the state, region and nation.
- It should closely align with the intent of the NSDI and the Transportation for the Nation initiatives.

1.2 Additional Objectives

In the short term, the following tasks will be required to successfully develop and maintain a digital road work.

- A **data model** has been developed and is provided in this document.
- Statewide coordination. DOT has considered the needs of the essential stakeholders in the development of this program and will continue the active **stewardship** of this core data layer. An effective **maintenance** plan must be established. This may involve the local stakeholder community to collect, review, and update changes to the network.
- Train users of street data about access, use, and enlist support for documentation of data maintenance.

1.3 Implementation

The Department of Transportation has begun the first part of implementing comprehensive statewide street centerline program which will be carried out over the next over the next five years. It is anticipated that the program will cost roughly $1.3 million dollars which is similar in scope to the previous estimates of $1.6 million identified in the strategic plan. The cost savings is felt to be achieved through the use of in-house staffing to develop the street centerlines.

2 PROGRAM OBJECTIVES

In 2007, the CGISC developed a Strategic and Business Plan which described several identified goals for developing and coordinating Connecticut's GIS Program. One of these goals described the need to develop a core set of framework priority data layers that could be shared across all levels of state, regional and local government with the objective of building out a Connecticut State Spatial Data Infrastructure (SSDI). Through this build out, Connecticut would also be supporting the National Spatial Data Infrastructure (NSDI) initiatives of the Federal Geographic Data Committee (FGDC). The theory would be to have various data, generated at all levels of government, aggregated in a coordinated way, and then published for wider distribution across the State and up eventually to the nation through the NSDI. This would standardize the information and base mapping from which our many of our common geospatially driven decisions are made at both the state and national levels. The Strategic Plan further breaks down these core framework priority data layers to four (4) specific layers which were identified to be in the greatest demand across the State. Of these identified layers, the need for a set of statewide street centerlines was identified as one of the most critical. The goal this business plan is to form a program to develop statewide street centerlines and an associated road network that will support the broad transportation needs of Connecticut's stakeholder community.

From these standardized set of Street Centerlines, a comprehensive road network should be developed to meet the networking needs statewide. A database model should be incorporated with the design of meeting the needs of Connecticut's vast array of transportation related applications inclusive of networking, routing, linear referencing, address geocoding, evacuation planning and map production.

Connecticut's system of roads and highways are critical to the movement of goods and people through the state and region. There is a vast amount of daily activity that occurs throughout the state at all levels of government to insure that these systems remain operational meeting the needs of the traveling public. From response to traffic incidents or accidents; to planning for maintenance and construction activities restricting operational flows; to tracking the movement of oversized or overweight permitted goods; to preparedness or crisis planning in the event of a natural disaster, emergency or threat; to the analysis of traffic data and statistics; to even development of cartographic mapping; many of these activities require the use of a geographical representation of the State's roads along with the associated transportation data which can be related to these roadway segments, often done using a Geographic Information System or GIS.

Today the data required to support many of these initiatives exist at differing levels of government in deferring formats and often only support localized needs or applications not designed for a larger scale or purpose. Graphics depicting our roadways are often drawn from differing bases and very in their content, detail, attribution and accuracy. Connecticut needs a single comprehensive set of street centerlines which has been developed and maintained through a coordinated approach including the interests of all stakeholders statewide.

In order to best meet the transportation road networking and street centerline needs across the state today, the design of the network model should take into consideration its intend uses. Polling the interest groups is a first good step towards understanding the larger statewide needs.

Several of these identified needs were discussed during the CGISC Strategic Plan Public Informational Sessions and have been identified below:

- **Statewide street centerline layer:** Connecticut should create a single, authoritative and geographically accurate and consistent street centerline layer for the state. The layer should be created by taking advantage of available sources where appropriate and the layer should be developed to meet all stakeholder needs.
- **Cooperative Effort:** All levels of government (federal, state, regional, and local) will benefit from this layer and should be involved in its development and/or maintenance.
- **Maintain Annually:** Consensus was reached by the stakeholder community that this data layer should be updated (at a minimum) on an annual basis. It was felt that municipalities are the first and best source of modifications to this layer and the collection of the changes should be done at a local level and consolidated at a state level. Some agencies do have a need for more frequent updates (quarterly). These updates could be collected and incorporated quarterly, but distributed more broadly on an annual basis.
- **Scale 1"=100':** A 1"=100' scale mapping program that meets National Map Accuracy feet Standards would produce a product that is accurate to 1/40th of the mapping scale, or 2.5 (100/40=2.5). This scale was determined to be the minimum scale that would be needed to meet the majority of the requirements of the stakeholder groups.

As a participant in the statewide transportation planning process and a recognized lead in managing Connecticut's transportation system, the Connecticut Department of Transportation is positioned within the State to best initiate this coordinated effort. If fact in recognizing the need for someone to spearhead this effort, the DOT took the lead by spending the past 2 + years researching the statewide needs and the various successful data models that are currently in play in the industry. As a result of its research, the DOT developed a comprehensive data model which is designed to meet the core needs of Connecticut's stakeholder community and the region. The model was also designed to coordinate with the needs of the NSDI and "Transportation for the Nation" initiatives along with the ESRI data model. To test out this new design, the DOT developed a pilot project to fully put the model through its paces against its own internal needs. Satisfied with the results, the DOT initiated a project to create a new statewide street centerline base through in-house digitizing efforts against the 2004 statewide orthophotos in January of 2007. Initially efforts in this project are focusing on the publically funded roadway segments and the associated attribution from the Department's Inventory files. However the plan is to extend out to include local input from each of the municipalities for local and private road coverages.

2.1 Sub Objectives

Additional to the clearly defined program objectives of creation of statewide street centerlines and an associated road network for the State of Connecticut, several other objectives are required to meet these goals. These sub-objectives are detailed below.

2.1.1 Data Model Development

Through its research efforts the DOT has developed a data model which is designed to meet the core needs of Connecticut's priority applications and stakeholder community.

		Field	Data Type	Use	Example
DOT REQUIRED FIELDS	System	OBJECTID	Object ID	Auto-generated Sequencial Number	61
		SHAPE	Geometry	Auto-generated Geometry	Polyline M
		SHAPE_LENGTH	double	Auto-generated Geometry	32.43
	Road Network	ROAD_CLASS	text	Type of Road Class	Interstate, US Hwy, State Hwy, Town Road, etc
		ROAD_NUMBER	text	Road Number	91, 6, 160, 1320001
		ROAD_NAME_COMPLETE	text	Official name of a street as assigned by a local governing authority, or an alternate (alias) name that is used and recognized.	Yankee Expressway, I-384, East Main St Ext #1
		DIRECTION	text	Direction of Roadway	Both, North, South, East and West
		ROAD_TYPE	text	Needs to be text for routing and for town road numbering the leading zeros	Mainline, Turning Roadway, Collector Distributor, On Ramp, Off Ramp, etc.
		ROAD_TYPE_ID	text	The number associated with the Turning Roadway, ramps, etc.	001A
		INTERCHANGE	text	Identify the interchange number.	5, 47A
		TOWN_NAME	text	Name of town	Rocky Hill
		FROM_MILEAGE	float	Segment Begin Mileage	7.52
		FROM_DESCRIPTION	text	Description of Begin Junction	Cronin St
		TO_MILEAGE	float	Segment End Mileage	7.66
		TO_DESCRIPTION	text	Description of End Junction	Harvest La
		DIVIDED_ROADWAY	text		Yes/No
		ONE_WAY	text		Yes/No
		OVERPASS	text		Yes/No
		UNDERPASS	text		Yes/No
		OVERLAP	text		Yes/No
	Routing	ROUTING_DESCRIPTION	text	Allows customized description use in Routing Directions	
		ROUTING_ONEWAY	text	Used in routing to handle one ways	FT, TF or Blank
		ROUTING_FR_ELEVATION	short Integer	Used in Routing to handle op and up	-2 to 10
		ROUTING_TO_ELEVATION	short Integer	Used in Routing to handle op and up	-2 to 10
		HEIGHT_RESTRICTION	float	Restricts passage along a road based on vehicle height	
		WEIGHT_RESTRICTION	float	Restricts passage along a road based on vehicle weight	
		WIDTH_RESTRICTION	float	Restricts passage along a road based on vehicle width	
		HEIRARCHY	text		Primary, Secondary, Local
	Speed	FT_SPEED	short Integer	Road segments speed limit.	
		TF_SPEED	short Integer	Road segments speed limit.	
		FT_MINUTES	float	Time to traverse the road segment.	
		TF_MINUTES	float	Time to traverse the road segment.	
	Cartography	CARTO_ROAD_LEVEL	text	This field is for cartographic purposes only	Ground Level Overpass 1st Level Overpass 2nd Level Overpass 3rd Level Overpass 4th Level Overpass 5th Level Tunnel 1st Level
	Review	NEEDS_REVIEW	text	Use New for a new road. This field may be modified further.	Yes, No or New
		COMMENTS	text	Allows all comments relented to a record a place to reside.	
DPS REQUIRED FIELDS	Address	PRE_MOD	text	A word or phrase that precedes all other elements of the street name and modifies it, but is separated from the street name by a street name pre-directional and/or pre type.	**Old** North First Street
		PRE_DIR	text or domain	A word preceding the street name that indicates the directional taken by the thoroughfare from an arbitrary starting point, or the sector where it is located.	**North** Main Street
		PRE_TYPE	text or domain	The element of the complete street name preceding the street name element that indicates the type of street.	**Avenue** A
		ROAD_NAME	text	Official name of a street as assigned by a local governing authority, or an alternate (alias) name that is used and recognized, excluding street types, directionals and modifiers.	North **Main** Street
		POST_TYPE	text or domain	The element of the complete street name following the street name element that indicates the type of street.	1234 Central **Street** Southwest
		POST_DIR	text or domain	A word following the street name that indicates the directional taken by the thoroughfare from an arbitrary starting point, or the sector where it is located.	1235 Central Street **Southwest**
		POST_MOD	text	A word or phrase that follows all other elements of the street name and modifies it, but is separated from the street name by a street name post-directional and/or posttype.	North Main Street **Extension**
		CFCC	text	Census Feature Class Codes	A15, A41
		TOWNL	text or domain	Name of Town (left side)	Rocky Hill
		TOWNR	text or domain	Name of Town (right side)	Rocky Hill
		FRADDL	text		
		TOADDL	text		
		FRADDR	text		
		TOADDR	text		
DPS REQUIRED FIELDS	Address	PARITYL	domain	This field tells whether the address range is odd number only, even number only or mixed number addresses on the left side of the road	ODD, EVEN, or MIXED
		PARITYR	domain	This field tells whether the address range is odd number only, even number only or mixed number addresses on the right side of the road	ODD, EVEN, or MIXED
		ZIPL	text	Postal zip code (left side)	06457
		ZIPR	text	Postal zip code (right side)	06457
		ESNL	Short Integer	Emergency Service Number (left side)	473
		ESNR	Short Integer	Emergency Service Number (right side)	473

To develop this model DOT considered several other models in use through out the industry, the nation and region including the NSDI and Transportation for the Nation models several other state DOT models, and the ESRI transportation data model. To incorporate the input of the larger stakeholder community DOT coordinated the model development with the Department of Public Safety and the Town or South Windsor along with other members of the Transportation Subcommittee of the Data Inventory and Assessment Working Group of the Connecticut Geographic Information Systems Council. The final database model is provided below:

2.1.2 Establish Statewide Coordination

In December of 2005, the CGISC established several Work Groups to assist with its activities. Among these was the creation of the Data Inventory and Assessment Working Group which was charged to identify framework datasets for Connecticut, establish individual subcommittees tasked to evaluate, document and provide recommendations for each framework dataset, and establish policies, standards and general procedures for the submission, evaluation, maintenance, on-line access, and dissemination of all geospatial data within the purview of the Council. As one of its first steps, the Data Working Group established twelve Data Framework Subcommittees charged with inventorying and assessing the framework data that comprise the SSDI. As one of the State's Priority Framework Layers the Transportation Subcommittee was established. DOT has taken an active role on the CGISC in chairing both the Council's Data Inventory and Assessment Working Group and the Transportation Subcommittee. DOT is joined by the Connecticut Department of Public Safety (DPS) - Office of Statewide Emergency Telecommunications (OSET), The Connecticut Office of Policy and Management (OPM), the town of South Windsor, and many other Stakeholders in taking an active role in defining a new Street Centerline and Road Network program. Today these stakeholders and many others continue to work closely with the DOT to press forward with the implementation of the new program.

2.1.2.1 Establish Stewardship

In December of 2005, the CGISC established several Working Groups to assist with its activities. Among these was the creation of the Data Inventory and Assessment Working Group which was charged to identify framework datasets for Connecticut, establish individual subcommittees tasked to evaluate, document and provide recommendations for each framework dataset, and establish policies, standards and general procedures for the submission, evaluation, maintenance, on-line access, and dissemination of all geospatial data within the purview of the Council. As one of its first steps, the Data Working Group established twelve Data Framework Subcommittees charged with inventorying and assessing the framework data that comprise the SSDI. As one of the State's priority Framework layers the Transportation Subcommittee was established. DOT has taken an active role on the CGISC in chairing both the Council's Data Inventory and Assessment Working Group and the Transportation Subcommittee. DOT is joined by the Connecticut Department of Public Safety (DPS) - Office of Statewide Emergency Telecommunications (OSET), The Connecticut Office of Policy and Management (OPM), the town of South Windsor, and many other Stakeholders in taking an active role in defining a new Street

Centerline and Road Network program. Today these stakeholders and many others continue to work closely with the DOT to press forward with the implementation of the new program.

2.1.2.2 Stakeholder Involvement

To succeed at this goal the input and involvement of all stakeholders will be critical. The statewide needs of the stakeholder community and the various priority applications in use throughout the state should be considered and incorporated into a successful program. Buy-in to and support of the program by local governments will be critical to the success of this effort and without the local information a complete set of street centerline and road network information could not be achieved.

2.1.2.3 Establish Maintenance Plan

To develop, implement and continually maintain of a set of street centerlines and an associated road network for the State of Connecticut, an effective maintenance plan must be established. Clear roles and responsibilities must be defined and agreed to by the stakeholders and each level of government needs to commit to the timely supply and update of information for their coverage areas. Several of these needs were discussed during the CGISC Strategic Plan Public Informational Sessions and consensus was reached by the stakeholder community that this data layer should be updated (at a minimum) on an annual basis. It was felt that municipalities are the first and best source of modifications to this layer and the collection of the changes should be done at a local level and consolidated at a state level. Some agencies do have a need for more frequent updates (quarterly). These updates could be collected and incorporated quarterly, but distributed more broadly on an annual basis.

The Department of Emergency Management and Homeland Security (DEMHS) is currently in the process of implementing a web-based utility to collect, update and review critical infrastructure information from Connecticut's municipalities. The design of this utility includes capabilities for a redlining and data interface allowing municipal stakeholders to review and update critical infrastructure information and locations within their own coverage areas. To expand on this, a concept for developing an additional tab to support the collection, update and review of street centerline data and addressing information on this application is currently being reviewed by the CGISC Data Inventory and Assessment Working Group and its Transportation Sub Committee. This would allow for the interface with and collection of local and private street centerline data and addressing information from each municipality. It would provide the means from which the involvement of the local stakeholder community could be achieved and would allow for utility in the aggregation of this information into a statewide data layer and road network.

2.1.2.4 Distribution

To insure success of a statewide street centerline and road network program open and broad based access to the information should be available to the stakeholder community and public. Opportunities for dissemination of this information are currently being researched and investigated.

2.1.3 Develop Training and Documentation

As demonstrated many times throughout Connecticut's history attempts like these have failed due to the support, involvement, commitment and awareness of the local statewide stakeholder community.

Public Act 05-3 created the Connecticut Geospatial Information Systems Council (CGISC) to coordinate, within available appropriations, a GIS capacity for the state, regional planning agencies, municipalities, and others as needed. The system GIS must guide and assist state and local officials involved in transportation; economic development; land use planning; environmental, cultural, and natural resource management; public service delivery; and other areas as necessary. With the efforts the CGISC focusing on supporting the Geospatial needs across the state and at the municipal levels of government, effective training programs and documentation will be critical. It may be as simple as providing clear and current metadata for the street centerlines to providing instructional sessions training users on the access and use of the applications or web utilities. In either case the support of the CGISC Education and Training Working Group will be enlisted to help support and meet these needs.

3 PROGRAM BENEFITS

Through a coordinated effort to develop a statewide comprehensive set of street centerlines and associated state road network many benefits to the State and the State's stakeholder community can be realized.

- Stakeholders can now cut the redundant costs and efforts required to maintain their own individualized solutions including costs for data collection and maintenance and the support of the required IT infrastructures.
- Stewardship and responsibility for a statewide street centerlines and an associated road network can be realized.
- Unlimited and broad based access to an authoritative common base of street centerlines and an associated road network will now be available to all stakeholders statewide. Thus new abilities and access will be available to new stakeholders who were previously isolated or had limited capabilities due to localized constraints.
- Better coordination of analysis can be realized through the use of common data in our transportation corridors within Connecticut's municipalities and planning regions along with other initiatives of the New England states, region and nation.

4 CURRENT CHALLENGES AND CONDITIONS

In recognizing the needs for better Transportation information statewide, the inadequacy of its current transportation Street Centerlines, Road Network and data, and its own growing internal

planning and engineering needs, the DOT began development of a new comprehensive road network solution in early 2007. As part of its initial research efforts done for this project, the DOT reviewed current business processes and models in use throughout the New England region and with other states similar in condition and status to Connecticut. Several other transportation data models were also considered such as the NSDI, HSIP and ESRI models. Several meetings were also held with the New York State Office of Cyber Security, the New York Department of Transportation, TeleAtlas Corporation and Environmental Systems Research Institute (ESRI), to discuss the design of the New York State transportation data model and business process. Ultimately, the DOT chose to develop a hybrid version of the ESRI model designed to meet the core needs of transportation throughout Connecticut.

4.1 Existing Resources/Inventory

There are several prominent resources for street and centerline information currently in use in Connecticut today, some of which are localized to a municipality while others present a more statewide focus. Each of these has their own design, benefits and drawbacks. Several of these data sources are described in more detail below:

4.1.1 TeleAtlas North America (TANA)

TeleAtlas North America's (TANA) DynaMap is a street centerline product that is licensed by the Department of Public Safety for use by all levels of government agencies in Connecticut. The TeleAtlas data is a standardized product that is used by many states and local government agencies around the country. It includes state, local, and private roads and has address ranges associated with each road segment.

Information is updated within DynaMap product by TANA through the following process:

- DPS solicits and then receives edits and corrections to the roadway information from local government agencies and Public Safety Answering Points,
- DPS then provides the proposed edits to TANA, which are then incorporated if the changes meet TANA's standards.
- TANA then submits these revisions back to the State on a quarterly basis.
- Updates are then pushed out to the requesting agencies statewide by DPS.

Some issues and concerns that have been raised with this data layer include:

- Stakeholders are not always aware of this layers existence.
- TANA data is not complete for all roads
- Edits that are reported to TANA are not always incorporated (although this is improving and TANA will incorporate any edit that meets their modeling specifications)
- Data is not consistently spatially accurate (TANA plans to achieve at least 7 meter accuracy for all of its centerlines by 2010)
- Data layer does not include route identifiers and mile markers consistent with DOT and statewide need (although these could be conflated to the data)
- Network breaks in TANA data are not consistent with the DOT's needs
- Numerous inaccuracies found in the road naming and numbering.

- Segment attribution differs greatly from DOT and statewide need.
- Quarterly network updates are expensive.

4.1.2 Various Local and Regional Street Networks

Several road network initiatives have been created at the local and regional levels of government in Connecticut. They are designed and built to meet a localized or regional needs only and are often driven by the amount of money or accuracy of mapping from which they are drawn. Consistently these networks fall short of the statewide needs for transportation and for road networking. A few however have stood the challenge of time and have succeeded very well in achieving the goals for which they were designed. As two examples, both Hartford and South Windsor have designed, built and are continuing to use, their own road network solutions today. It should be noted that any statewide road network solution should be designed to coordinate with any current and in-place initiatives rather than replacing them.

4.1.3 The Department of Transportation TRU Maps

The TRU maps are the State's official representation of the publicly funded roadways for each of Connecticut's 169 municipalities. They contain a cartographic representation of all levels of Connecticut's publicly funded roadways including: Interstates, US and State routes and local roads. These files are updated annually by DOT's Inventory Section.

TRU Update Process:
As new roads are accepted by a municipality, notice is provided to the DOT Inventory Section via an ENG-29 form which prompts the Section to re-inventory the roads and map the centerline changes by driving the road using GPS technology. The TRU maps are is then updated and route change notices are sent out to reflect these changes on an annual basis.

Some issues and concerns that have been raised with this data layer include:
- Stakeholders are not always aware of this layers existence,
- Data layer is not consistently accurate. New roads are digitally created using GPS while older roads were entered through cartographic rendering,
- Data in not consistently spatially accurate having been developed off varying projections (North American Datum of 1927)
- Local and private road portions of data layer are maintained only in Microstation format.
- Data layer does not include street address ranges,
- Layer was not setup for network analysis purposes.
- Slow Process.
- Lacks dual carriageways

4.1.4 The Department of Transportation Roadway Inventory System

The Roadway Inventory System (RIS) is the System in which DOT maintains an inventory of all publicly funded roadways in Connecticut. Previously referred to as MRIS, it was originally developed as a mainframe application and was then converted into today's RIS Oracle based system in 2004. RIS tracks the State's roadway inventory using a series of routes and mileages and four (4) digit tie codes to representing the differing inventory features along our roadways.

Update Process:
As a result of any given construction season, several construction, maintenance, permit or Vendor-In-Place (VIP) projects may occur which impact the State and local systems. Each of these changes is flagged to the Inventory Section for additional field investigation through receipt of construction notices and/or project plans. In addition to these changes, DOT re-inventories 1/3 of the State highway system each year. Local roads are only re-inventoried when a state or town project causes change to occur affecting a local road.

Some issues and concerns that have been raised with this data layer include:

- Stakeholders are not always aware of this information,
- The information is maintained only in tabular format without any form of graphic representation,
- Geographical or location information (longitude and latitude) is not available for every point in the data set,
- The RIS system only tracks information on the State's publicly funded roadways and does not include information on Private or locally maintained roadways,
- The data does not include street address ranges,
- The RIS System is updated on an annual basis which may not be frequent enough for today's road networking needs,
- Having originally been designed as a mainframe application (MRIS), the new Oracle design of the RIS system perpetuated the legacy 80 character limitations due to its reporting requirements. Today RIS tracks mileages out to only the hundredth place (example 104.56) using only 5 characters leaving room for mileage variations due to rounding by 52 to 78 feet,
- The RIS System does not account for elevation or Z value data which may be required for tomorrow's road networking solutions,
- The design of the RIS System does not account for reverse log direction of travel.

4.1.5 The Department of Transportation Current GIS Road Network

The Department's GIS Development Section of the Bureau of Policy and Planning has been maintaining a centerline road network since early in the 1980's. It was originally developed off the Census Tiger line files and represents the Connecticut's Interstates, US and State Route System. To better align with the need a representation of the State's local road system, the network was then conflated to better align with the Department's TRU Mapping in the mid 80's.

GIS Network Update Process:
Consistent with the updates to the TRU mapping and RIS, GIS Development Section uses the Route Change Notices published by the Inventory Section to update the GIS layer on an annual basis.

Some issues and concerns that have been raised with this data layer include:
- Stakeholders are not always aware of this layers existence,
- Data layer is not consistently accurate. New roads are GPS'd while older roads were entered through cartographic rendering,
- Data is not spatially accurate having been developed off an older projection datum of NAD27,
- Local and private road portions of data layer are maintained only in Microstation format.
- Data layer does not include street address ranges,
- Layer was not setup for network analysis purposes.

4.1.6 SBC/AT&T Centerline Network

SBC/AT&T has had an advanced GIS mapping program in place for many years. In 2000, AT&T (then SNET) performed a statewide mapping program that included producing digital orthophotos, street centerlines, road edges, hydrography, and building points and building polygons. The data was developed and maintained at a 1:200' scale. This data set is used by several of Connecticut's municipal governments and is growing is acceptance across the state.

Update Process:
Since that time, AT&T has been updating these data sets on a three-year cycle in which they fly and update one third of the state each year. This past spring no flight was performed.

Some issues and concerns that have been raised with this data layer include:
- Data is a licensed product. Only licensed users have access to the data.
- Data layer does not include street address ranges
- On and off ramps are not created for network analysis

4.1.7 US Census Bureau's TIGER Data

The Census is performing an update of their centerline data as part of the 2010 census. It will have a spatial accuracy of seven meters and will be available for free in 2010. This data source should also be considered.

4.1.8 The Department of Environmental Protection (DEP) Road Layer

In order to meet their growing need for a road network layer back about ten to fifteen years ago DEP developed a road network layer off the USGS quadrangles at the time. This layer is only relevant as it has been made readily available to all levels of

government and the public for some time and has become widely accepted and used by many across the state.

In summary, as evident from the various resources listed above, there have been several on-going initiatives within the State to maintain road network data and geometry. Despite these initiatives users are still left with many questions: of which road layer to use; which is the best representation; which has the best accuracy; which is the most up-to-date or even who is the identified data steward for the data set? Today, the identified need for a better statewide road network solution has never been in greater demand at all levels of government. Availability and awareness of the layer have also played a large role in which layer has become more widely used or standardized upon. As an example the DEP data layer, which is significantly out of date, is more widely today because of its availability on the DEP and UCONN websites and due to its advantage of aligning better with all the other DEP layers of information. This layer still falls short though, as it also lacks the necessary components and attribution to meet many of transportation analysis needs across the State. Users are left with out standards and commonality of data across the board.

4.2 Existing Applications

A common road network solution for Connecticut will benefit many current on-going or planned initiatives in the State. Several of these important initiatives are detailed within the CGISC's Strategic Plan. Several additional initiatives that are more directly dependant on a new common road network solution are discussed below:

4.2.1 Emergency E-911 Response

The Department of Public Safety - Office of Statewide Emergency Telecommunications (OSET) has the responsibility of managing Connecticut's Emergency Response E-911 System. Currently, OSET licenses the TeleAtlas DynaMap product for E-911 routing and addressing needs through a Master License Agreement (MLA) with the State. Under this agreement, TeleAtlas provides quarterly updates to their licensed road network at a cost of roughly $300,000 annually. With the advent of the new comprehensive road network, Connecticut will have its own universal road network solution which will support this critical need at a greatly reduced expense and will ensure that the responsibility for Connecticut's road network remains in the hands of the State and not a vendor.

4.2.2 Permitting Oversized Overweight Vehicles

The DOT in coordination with the Department of Motor Vehicles (DMV) is developing an electronic permitting process for the movement of oversized, overweight vehicles through the State. The DOT currently issues between 500 - 600 permits per day for oversized, overweight, radio active and industrial movements which translated to $3,183,000 in permit fees collected in fiscal year 2006-2007. The incorporation of routing and electronic bridge analysis into the electronic permitting process will allow for faster turnover for permitting issuance, 24 hour, 7 day permitting access to the Motor Carriers, and a significant reduction.

4.2.3 Evacuation Planning

Having the ability to efficiently move or evacuate people in the event of a flood, natural disaster or other major crisis is imperative and a road network plays a critical role in these types of activities. Being able to not only route and address geo-code using the new road network , but to also have information on traffic volumes and roadway characteristics available through GIS to the network will provide for the aspects necessary to effectively move both people and goods in the time of a crisis. A clear understanding of accidents, road closures and restriction to traffic flows are imperative as well. None of these functions could be done as efficiently today without the use of a road network.

4.2.4 Linear Referencing

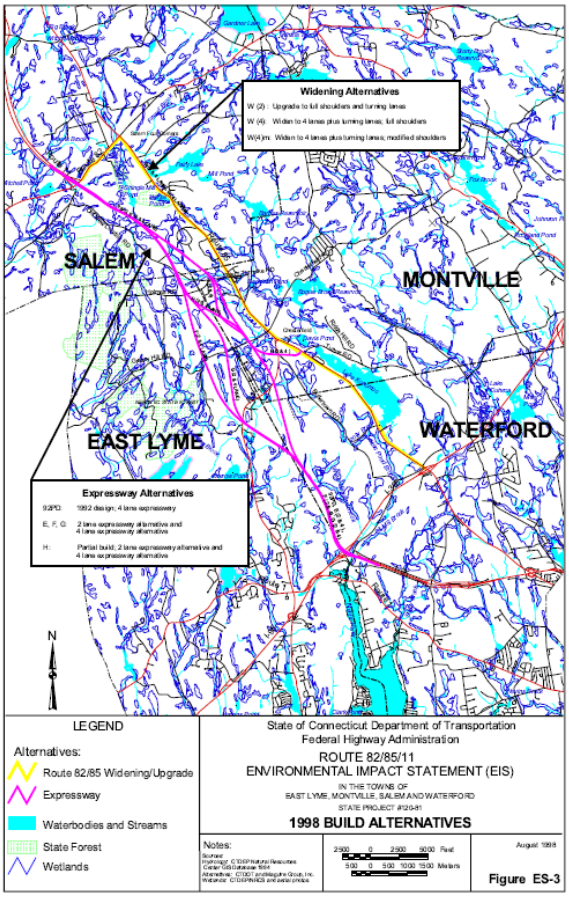
Aside from DOT's current GIS Road Network, there are no solutions in use today which include the necessary attribution to support the needs of linear referencing for the State.

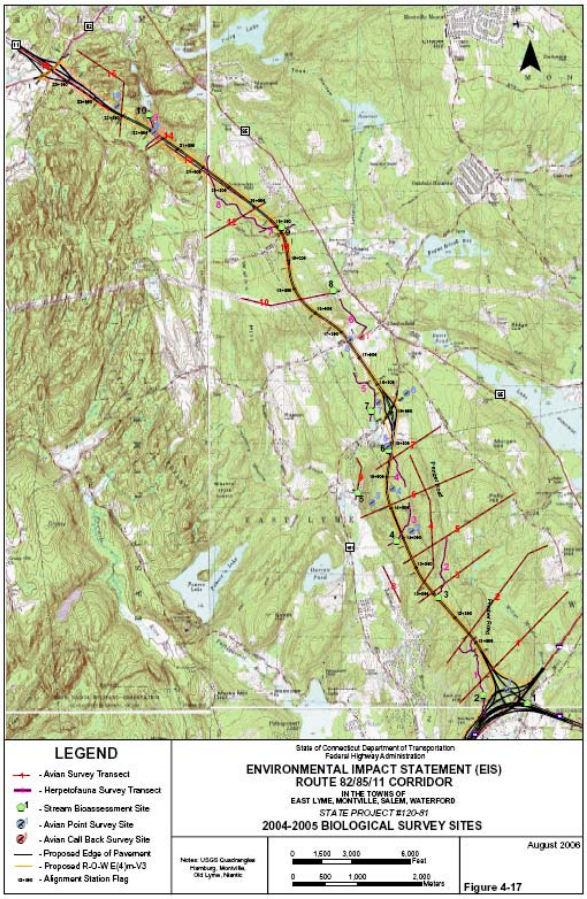
As a definition: Linear referencing is a natural and convenient means to associate attributes or events to locations or portions of a linear feature. It has been widely used in transportation applications (such as for highways, railroads, and transit routes) and utilities applications (such as for gas and oil pipelines). The major advantage of linear referencing is its capability of locating attributes and events along a linear feature with only one parameter (usually known as measure*) instead of two (such as* longitude/latitude *or* x/y *in Cartesian space). Sections of a linear feature can be referenced and created dynamically by indicating the start and end locations along the feature without explicitly storing them.*

Linear Referencing is a primary tool used to meet many of the DOT's daily business needs and is often used by the Department to support the various needs at the municipal or regional levels as well. DOT's current GIS Road Network layer includes route identifiers and mileages to support the basis for their linear referencing system. Thus events such as accident location or average daily traffic can be shown on its mapping.

4.2.5 Transportation Planning and Corridor Analysis

Understanding and planning for the movement of goods and people are truly the function of transportation professionals in Connecticut. Combining information on land use, soil type, real estate ownership, economic impacts, costs and transportation data come into play when considering transportation planning and corridor analysis. Often these analyses are tracked in a GIS system which uses a road network solution to help determine alternatives. The following are examples taken from the Route 11/82/85 Environmental Impact Statement (EIS) and Executives Summary:





4.3 Challenges

4.3.1 Reduction of Redundancy

With a common set of statewide street centerlines and associated road network Connecticut's stakeholder community will have one authoritative source of information allowing:

- Users to stop the redundant creation, maintenance and support of various other sets of street centerlines and road networks which may differ in there scale, source alignment, or content.
- With one authoritative source, users will have one common base from which standardized analysis and layout can be achieved.
- We can eliminate the need to contract with commercial providers for the data.

4.3.2 Cost Benefit

As with any reduction in the duplication of effort users can and will see significant savings from a State wide comprehensive set of street centerlines and an associated road

network. In fact these savings could be channeled into a more productive process of updating the State's road network with local information. Some of these savings that could be realized are:

- Currently the Department of Public Safety – Office of Statewide Emergency Telecommunications (OSET) is under contract with Tele Atlas North America (TANA) to acquire and maintain a comprehensive set of street centerlines at a cost of roughly $350,000 annually. The State DOT maintains its own version of publically funded roadways annually and the local and regional levels of government each maintain their own version of the same, updated off more accurate local data. At a minimum the State could realize a likely savings of well over $500,000 to $1,000,000 annually through the development of a comprehensive set of statewide street centerlines and a common road network.

5 IMPLEMENTATION PLAN

Consistent with the recommendations from the CGISC's Strategic Plan, a Transportation Sub-committee was established under the Data Inventory and Assessment Working Group with role of inventorying and assessing Connecticut's transportation data and providing recommendations necessary to develop the framework data for all in Connecticut to use. Two primary components to this layer are the street centerline base and associated road network. Working closely with the DOT, DPS and DOIT along with several other stakeholders, the Transportation Subcommittee has worked to draft this for the development of a comprehensive road network for the State of Connecticut.

5.1 Implementation Schedule

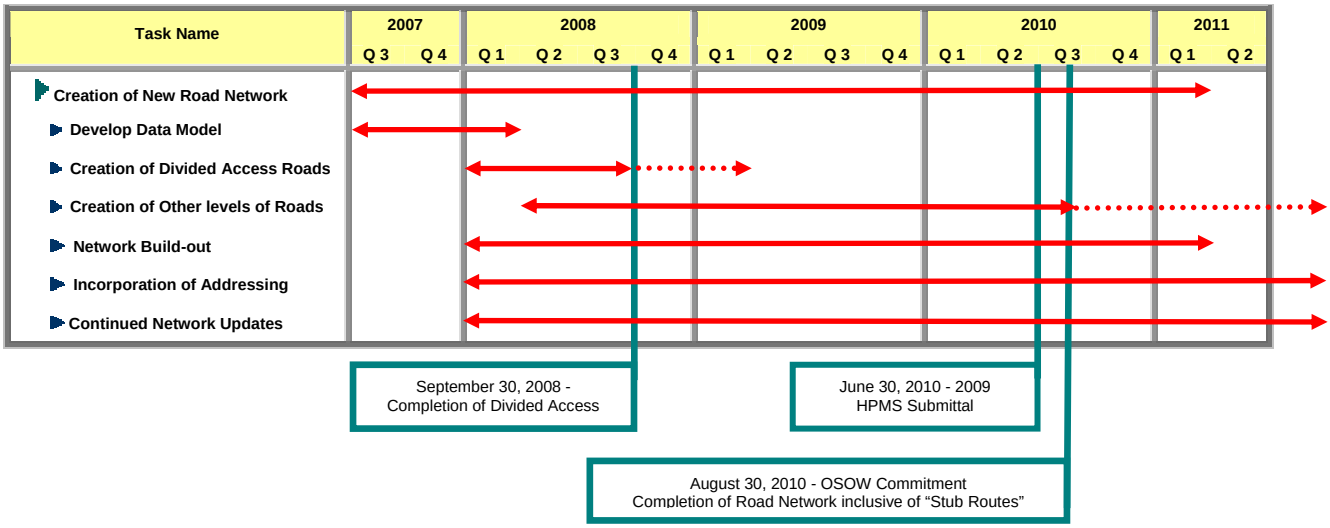
This implementation plan presents a practical set of objectives that can be achieved within the next few years. While the DOT and of DPS are each responsible for implementing components of data supporting this project, most of the proposed steps will be carried out by the GIS Development Section of DOT. The DOT will develop a comprehensive set of street centerlines and populate the attribution associated to transportation and the road segments, while DPS will handle the incorporation of the addressing attribution for each of the segments developed by the DOT.

Throughout 2007 and into 2008 DOT and DPS worked to cooperatively develop a road network data model, attend ESRI Network Analyst Training and developed a pilot project for the town of South Windsor.

Implementation of the Road Network is planned to be done in a phased approach. Beginning in January, 2008, DOT started developing the Interstates and divided access roadways with an anticipated completion date of mid to late summer of 2008. Creation of these roadways will be done from there origin within the State to their end and will be inclusive of the involved ramping, turning roadways and high occupancy vehicle (HOV) lanes. Concurrent

to this effort will be the implementation of the State, local, and private roads. This effort is expected to start in the second quarter of 2008 and will be developed on a town by town basis for topological and business process reasons. It will strive to include the areas surrounding the State's transportation corridors and urban centers. Every effort will be made to include the roadways required by the Federal Highway Performance Monitoring System (HPMS) 2009 submittal and the "Stub Routes" required for the successfully implementation of the OSOW Permitting System by a deadline of June 30, 2010. Beyond that time, additional incorporation of private roads and addressing information will continue with substantial completion by the first quarter of 2011.

The following high level Gant chart shows the major elements of the plan and estimated time frames as planned.



5.2 Implementation Issues

Several sources of base mapping and of information exist today to implement a new road network against such as the State's 2004 Orthoimagery, the DOT's Photo Log imagery and Roadway Inventory System (RIS) files, and the aerial and oblique photography currently available through commercial websites like Google Earth or Microsoft. Several concerns become evident to the usefulness of this data when considering developing the new road network:

- The current usefulness of the older somewhat outdated 2004 Orthoimagery is subject as newer changes or additions to the network are not evident.

- The 200ft scale accuracy of the 2004 Orthoimagery differs from the preferred 1:100 scale recommendations identified in the CGISC Strategic Plan.

- Although the DOT's Roadway Inventory System (RIS) files serve as the official source of State and local public roadways for Connecticut containing information on roadway type, ID, location, node mileages, mileage descriptions and roadway classification, the RIS System lacks information on reverse log mileages, private road inventories or geometry. The RIS system maintains the roadway information in differing tables for ramping, State and Local roads as well.

- Its local road information is not updated with any frequency unless changes are identified by the town, and the system only tracks information in either the north or eastbound log directions.

Even with the data issues put aside, there are still several other larger questions evident:

- Who will coordinate these activities with the regional and local governments?

- Who will be responsible to the various data sources into one comprehensive design?

- Who will be the identified Steward of the Street Centerline and Road Network programs?

- How will the information be shared and updated?

6 ANTICIPATED FUNDING

The CGISC's Strategic Plan offered funding requirements at $1.6 million to successfully implement a statewide centerline program, while the DOT costs to develop a new street centerline base and road network for Connecticut come in substantially less at only $750,000.

To develop DOT's estimates the following criteria were considered:

Initial Road Network Digitizing Efforts

Figured at 25,000 miles of public roads in Connecticut, digitized at a rough rate of 1.5 miles per hour would result in 16,667 hours of effort. Thus at a $45.00/hour rate, the resulting cost would be = $750,000

Roadway Segment Attribution

Figured at 25,000 miles of public roads in Connecticut, populated at a rate of 15 minutes per mile would result in 12,500 hours of effort. Thus at a $45.00/hour rate, the resulting cost would be = $140,625

Network Build & Topology Review

Figured at 500 hours. Thus at a $45.00/hour rate, the resulting cost would be = $22,500

The DOT project costs should be considered rough estimates and were considered for only the project roadway digitizing efforts. Justification of roadways mileages against the DOT roadway inventory and bridge databases and on-going maintenance, and support efforts would be in addition to the figures discussed above. The costs to coordinate with local sources for the private roadways, updates and attribution should also be considered and could run close to $400,000 to implement a web based municipal update process. Therefore, after consideration of these factors it is anticipated that the costs to develop a new statewide street centerline base would run close to 1.3 million.

7 RECOMMENDATIONS AND CONCLUSIONS

As a result of this discussion contained within this document several critical points and recommendations have been identified to implement a successful Street Centerline and Road Network Program.

- **Coordination and Oversight**
  To insure the coordination efforts occur, the CGISC's Data Inventory and Assessment Working Group, Transportation Subcommittee should be identified as the lead on this effort. The Subcommittee should be comprised of those interested stakeholders to the process and be chaired by the DOT. Additional Subcommittee members should include town and regional representatives, the State Department of Emergency Management and Homeland Security (DEMHS) and the DMV. The committee shall also look to coordinate activities with the State's Transportation Strategy Board and State's Transportation subcommittee of the

- **Data Stewardship**
  To set responsibility for development and maintenance of a common statewide set of street centerlines and an associated roadway network and to support and insure the coordination and involvement of all stakeholders, the Connecticut DOT shall be recognized through legislation as data steward for Connecticut's road centerlines and road network acting on recommendations of all stakeholders and statewide needs.

  The DOT shall continue as the lead for collecting and maintaining inventories of all publically funded roadways in Connecticut.

  The DOT shall continue to serve as the lead for all related federal, state, regional and local initiatives.

  Connecticut's Municipalities shall continue with their responsibilities for inventorying private roads.

To insure compliance with State, regional and local needs along with national initiatives, the program should closely model the needs of the NSDI and Transportation for the Nation initiatives.

8 GLOSSARY OF TERMS

A

Accuracy – The closeness of observations to true values or values accepted to be true. Accuracy relates to the quality of a result and is distinguished from precision, which relates to the quality of the operation by which the result is obtained. In common GIS practice, accuracy frequently refers to positional accuracy ("plus or minus X meters").

Address Points - Positional location of structures, landmarks or intersections consisting of numerical and text elements such as street number, street name and city.

Address Range - The range of house numbers along a specific street segment

Administrative Boundaries - Data which describe official boundaries of federal, state, local, governmental as reported to the U.S. Census Bureau by officials of each government.

Attribute – A descriptive characteristic or quality of a feature that can be assigned to one or more discrete values in a GIS. Data about geographic features usually stored as text in a database format.

B

Base data – Set of information that provides a baseline orientation for another theme of primary focus, e.g., roads, streams, and other data typically found on USGS topographic and/or planimetric maps.

C

Cadastral – Current, parcel based land information system containing a systematic description of land units within an area. This may include data on location, ownership, property outlines, and parcel identification.

CADD - Computer Aided Design and Drafting

CAP - Cooperative Agreements Program.

Cartographic - Representation of features on the earth graphically through maps or charts.

Census - Data providing baseline information related to a community in terms of population demographics, employment statistics, and general household composition. This data is sourced through household surveys and then statistically compiled.

Census Boundaries – Base map theme composed of polygons based on census mapping units (i.e. blocks and tracts) with attribute data containing demographic and socioeconomic information.

CLEAR - Center for Land Use Education and Research.

CI – Critical Infrastructure.

CGISC - Connecticut Geospatial Information Systems Council. Established by Executive Order, June 2005.

COG – Council of Governments.

Connecticut User to User Network - A voluntary association of individual and organizations in Connecticut that use GIS-base technologies and data.

Contour – a line connecting points of equal elevation.

Control point – A point in a horizontal or vertical control network that is identifiable in a data set or photograph and is used to correlate the dataset or photograph to actual ground coordinates.

Coordinate system – Reference frame or system that uses linear or angular quantities to designate the position of points within that particular reference frame or system. Coordinates are used to represent locations on the earth's surface relative to other locations or fixed references.

Critical Infrastructure – Base map theme that collects geographic locations and attribute information for a wide range of facilities in the transportation, energy, agriculture, telecommunications, chemical, defense, public health, and other sectors.

D

Data quality – Refers to the degree of excellence exhibited by the data in relation to the portrayal of the actual phenomena.

Dataset – Collection of similar and related information recorded in a common format.

Datum – A mathematical reference framework for geodetic coordinates defined by the latitude and longitude of an initial point, the azimuth of a line from this point, and the parameters of the ellipsoid upon which the initial point is located.

DEP - Department of Environmental Protection

DEM – See Digital Elevation Model.

Demographics - The statistical characteristics of a population such as age, income, birth rate, and race.

DEMHS – Department of Emergency Management and Homeland Security.

DSM - Digital Surface Model.

Digital data – Of or relating to information presented in the form of digits–data displayed, recorded, or stored in binary notation.

Digital Elevation Model – A file with terrain elevations recorded at the intersections of a grid (either 10- or 30-meters) and organized by quadrangle to be the digital equivalent of the elevation data on a topographic base map.

Digital Orthophoto Quarter Quad – An orthoimage clipped to fit a USGS quadrangle grid – typically 3.75-minutes (see *Orthoimage*) or one-quarter of the familiar 7.5-minute grid.

DMV - Department of Motor Vehicles

DOIT - Department of Information Technology

DOQ or DOQQ – See Digital Orthophoto Quarter Quad.

DOT - Department of Transportation

DPS – Connecticut Department of Public Safety.

E

Elevation Contours – GIS base map theme that depicts topographic relief as contour lines. Every point along a given contour line has the same elevation. Contour data are valuable to any application that is dependent on elevation.

F

Feature – An object that has a geographic location that can be represented by one or more points, lines, or polygons.

FEMA – Federal Emergency Management Agency.

FGDC – Federal Geographic Data Committee.

Framework - The framework is a collaborative community based effort in which commonly needed data themes are developed, maintained, and integrated by public and private organizations within a geographic area.

G

Geodetic Control – This base map theme depicts a network of points spread across the landscape where sturdy monuments have been placed in the ground, along with a high-accuracy positional value for each point. By referencing field survey measurements to this network, the survey data can be more gathered with more accuracy.

Geographic Information System – A computer based system for the input, editing, storage, maintenance, management, retrieval, analysis, synthesis, and output of geographic or location-based information. In the most restrictive usage, GIS refers only to hardware and software. In common usage, it includes hardware, software, and data. When organizations refer to their GIS, this latter usage is usually what they mean. For some, GIS also implies the people and procedures involved in GIS operation. In this document the common usage-hardware, software, and data is intended.

Geographic Names – GIS base map theme based on a tabular database with map coordinates of virtually every named place in Connecticut, such as towns, schools, parks, and creeks.

Georeference – to establish the relationship between raw coordinates of a geospatial dataset and known earth-based coordinates.

Geospatial data – Information that identifies the geographic location and characteristics of natural or constructed features and boundaries on the earth.

Geospatial metadata – Data about the content, quality, condition, and other characteristics of a geospatial dataset.

GIS – See Geographic Information System.

Global Positioning System – A satellite-based navigation system developed by the U.S. Department of Defense. GPS receivers can determine one's position on the earth's surface.

Governmental Units - Legally documented and attributed jurisdictional boundaries, such as city, census, or state boundaries.

GPS – See Global Positioning System.

H

Highway System – A series of public roads which comprise a network, designed for movement of a large volume goods and people throughout a state, region or country.

Hydrography – A representation of surface water features including all flowing water, water bodies, marshlands, springs, and water-related, man-made features such as canals, locks, and dams.

HSPI – Homeland Security Infrastructure Program

I

Imagery – A two-dimensional digital representation of the earth's surface. Examples are a digital aerial photograph, a satellite scene, or an airborne radar scan.

L

Latitude – Angular distance measured in degrees, minutes, and seconds, of a point north or south of the equator on the earth's surface.

Layer – See *Theme*.

Longitude – Angular distance measured in degrees, minutes, and seconds, of a point east or west of the Greenwich (Prime) Meridian on the earth's surface.

M

Map Projection – Mathematical model that transforms the locations of features on a curved surface (Earth) to locations on a flat surface (map).

Metadata – See Geospatial Metadata.

N

NAD83 - North American Datum of 1983

NAVD88 - North American Datum of 1988

NENA - National Emergency Number Association

Network – Collection of linework and points that form interconnectivity between two or more points.

NSDI – National Spatial Data Infrastructure. The technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve use of geospatial data.

O

OPM - Office of Policy and Management

Orthoimagery – An aerial photograph or satellite image from which displacements caused by terrain relief and sensor tilt have been removed. The result combines the image characteristics of a photograph with the geometric qualities of a map.

Orthophoto – See *Orthoimagery*.

OSET – Office of Statewide Emergency Telecommunications

P

Point data – Level of spatial definition referring to an object that has a location but no dimension, e.g., well or weather station.

Political Boundaries – Base map theme with polygons depicting common boundaries including counties, city limits, federal lands, and local and state parks.

Polygon – A closed area of space defining the spatial extent of a geographic feature.

Positional Accuracy – term used in evaluating the overall reliability of the positions of cartographic features relative to their true position.

R

Road Network – Comprised visually of linear and point based geometry, a digital centerline road network utilizes geographic information systems (GIS) technology to attach the roadway segments to attributes or intelligence maintained within a database and to insure road network topology or connectivity between the road segments.

RPA - Regional Planning Agency

RPO - Regional Planning Organization

S

Satellite Imagery *(also known as remote sensing imagery)* – This base map dataset is an index of images of the surface of the earth obtained by orbiting satellites using a digital remote sensing collection devices such as cameras, laser, or radar.

Scanning – An automated means of inputting data. When used in remote sensing applications, it refers to the imaging of the earth's surface.

Shape file – A digital spatial data format originated by Environmental Systems Research Institute and frequently used in GIS software packages.

Spatial data – Ssee Geospatial

Special Districts Boundaries – Base map theme depicts local and administrative zones, including but not limited to, U.S. Congressional, state legislative, other electoral districts, school districts, voting precincts, and other taxing and non-taxing districts.

SSDI - State Spatial Data Infrastructure

SPCS - State Plane Coordinate System

Street Centerlines - Lines representing the center of a street segment.

Standards – Exact value, a physical entity, or an abstract concept, established and defined by authority, custom, or common consent to serve as a reference, model, or rule in measuring quantities or qualities, establishing practices or procedures, or evaluating results.

Street Addressing – This is a proposed base map theme containing street names and address ranges, and may include point locations of inhabited structures with unique addresses. Street Addressing is typically used in conjunction with the transportation and the parcel index layers.

Surface Geology – Base map theme depicts the relative age, composition, and relationships among rocks and sediments at and near the earth's surface.

Surface Water – This base map theme depicts surface hydrographic features including rivers, streams, lakes, ponds, swamps, springs, and canals.

T

Terabyte – A measure of digital dataset size or computer storage capacity. A terabyte (1,000,000,000,000 bytes) is 1,000 gigabytes. Each gigabyte, in turn, is 1,000 megabytes.

Theme – A subset of a GIS database or map containing related spatial features. These can be visualized as "transparencies" which allow information to be viewed and analyzed selectively by theme. These themes are registered to each other by the common coordinate system of the database. Frequently referred to as data "layers" because multiple data themes are often stacked on top of each other using GIS software.

TIGER – "Topologically Integrated Geographic Encoding and Referencing" file. A digital map format and dataset developed by the U.S. Bureau of the Census. TIGER files contain all levels of census geography from block level to metropolitan areas and counties. Features such as roads and rivers are included since census geography if often defined by these features.

Topographic map – A map that represents the horizontal and vertical positions of features on the face of the earth. Elevations are usually depicted by spot elevations, contours, hill shading, or other symbology.

Transportation – Base map theme depicting road-based features including roadbed centerlines and associated attribute information on public roads. Other transportation networks such as railroads, trails, and utilities are not included.

U

UCONN - University of Connecticut

USACE – U.S. Army Corps of Engineers.

USGS – U.S. Geological Survey.

US Census Bureau - The federal agency charged with the collection and dissemination of demographic statistics.

USPS - U.S. Postal Service

V

Visualizing – The representation of data in a viewable medium or format. In GIS, visualization is used to organize spatial data and related information into layers that can be analyzed or displayed as maps, three-dimensional scenes, summary charts, tables, time-based views, and schematics.

W

Watershed – A base map theme showing the region drained upstream of a point selected along a stream or river. Watersheds vary in size and can be grouped to form larger basins. Watersheds are typically referenced by codes with two-digit watersheds representing very large regions drained by major rivers to 12-digit watersheds that cover much smaller areas.

Weather – A base map theme with real-time and historical weather data across Connecticut that are collected from a comprehensive weather sensor network and stored in a spatially referenced database.