



DURHAM, NEW HAMPSHIRE

APRIL 2019

Proposal

## Tax Parcel Mapping Project





April 5, 2019  
WP Project No. T15088

Mr. Jim Rice  
Assessor  
Town of Durham  
8 Newmarket Road  
Durham, NH 03824

**SUBJECT: Request for Proposals  
Tax Parcel Mapping Project**

Dear Mr. Rice,

Modern municipal government tax maps serve two purposes: they are a key part of data management for many municipal functions from Assessing and Code Enforcement to Public Works, and they also act as a gateway for the public to access many municipal services. Poorly drawn tax maps can represent the Town poorly to its residents. For these reasons, it is important that tax maps garner the confidence of both municipal employees and members of the public.

Wright-Pierce is an established engineering firm with extensive GIS experience, and our team of GIS professionals have been involved in municipal parcel mapping projects in many towns in New England. Our firm is currently working for Durham and have been involved in extensive engineering jobs in town for years, so we are confident that the quality of our work and our client service speaks for itself. As a full-service engineering company, we offer attention to detail and thoroughness that set us apart from some mapping firms that treat parcel mapping as a commodity.

If you choose Wright-Pierce for your tax map project:

- You will work with GIS Analysts that have built their GIS skills over many years on a range of GIS projects, on everything from parcel mapping, to utility mapping, to conservation;
- Your project will be managed by a GIS project manager who understands both project management and the specific necessities of tax mapping;
- The effort will be supported by a professional, successful engineering firm with an established work history in Durham, and offices in NH.

RECEIVED  
Town of Durham

APR 05 2019

Planning, Assessing  
and Zoning

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Town of Durham, Assessing Department

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I am confident that our proposal demonstrates that we have the skills and experience to provide you with the quality tax maps you require, and I know we can provide you with the responsive and personal client service you expect.

Thank you for your consideration, and I look forward to speaking with you more about this project.

Sincerely,

**WRIGHT-PIERCE**



Jeffrey M. Normandin, MA, GISP

GIS Manager

Jeff.normandin@wright-pierce.com

JMN/als

Enclosures

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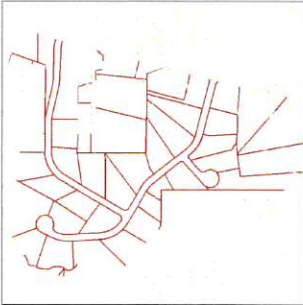


## Demonstrated Ability to Plan, Execute & Deliver

The scope of this project requires a specific skill set. Wright-Pierce has assembled a team with the goal of providing all of the required services collectively. Our team retains relevant project experience in every aspect required for the Town of Durham. The projects included below describe our team’s experience in developing and maintaining municipal tax maps.

### Parcel Edits

#### Old Orchard Beach, ME



Conducted parcel edits for the city of Old Orchard Beach annually for several years using surveys and deeds, as recorded by Assessor.

This effort involved a workflow that included maintaining all parcel boundaries as lines to allow for more granular metadata on sources of shared boundaries, as well as production of complete polygons for the final product.

#### Bill DiDonato

Town of Old Orchard Beach  
1 Portland Avenue  
Old Orchard Beach, ME 04064  
207.934.5714 X-1512

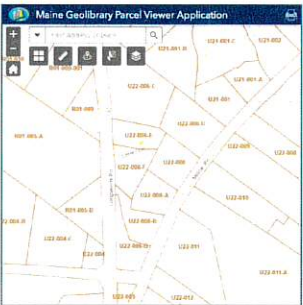
Reference for Jeff Normandin

#### Related Services

- ✓ Parcel edits
- ✓ Metadata collection
- ✓ Polygon production

### Georeferenced Parcels

#### Maine GeoLibrary Level II Parcel Contract



Created or updated georeferenced parcels for over 20 Maine towns as part of an effort to create state-wide GIS parcel coverage. For towns without digital parcels, the creation of parcels involved rubber sheeting hand-drawn tax maps over the digital orthophotos. For towns with existing digital parcels, updates for up to 5 years property changes were provided. The information was obtained from sketches, plans and deeds. The parcels met or exceeded the Maine Level II standards, which required the parcels to be in alignment with well-defined points on the orthophotos.

#### Judy Colby-George, GISP

Spatial Alternatives  
117 West Main Street  
Yarmouth, ME 04096  
207.846.2355

Reference for Christine Manderson

#### Related Services

- ✓ Parcel updates/creation
- ✓ State-wide GIS parcel coverage
- ✓ Level II standards

### Foreign Trade Zone

#### Midcoast Regional Redevelopment Authority (MRRA)



The Midcoast Regional Redevelopment Authority – formerly Brunswick Naval Air Station – was seeking to establish a “Foreign Trade Zone” as part of a business development project. This involved delineating the boundaries of the former air strip and adjacent parcels from new and old surveys, creating a new, larger parcel from metes and bounds, and building the substantial and comprehensive dimensional annotations.

#### Steve Levesque

Executive Director, MRRA  
15 Terminal Road, Suite 200  
Brunswick, ME 04011  
207.798.6512

Reference for Wright-Pierce

#### Related Services

- ✓ Boundary delineation
- ✓ Parcel updates/creation







# GIS Services for Planning, Utilities & Land Use Mapping

Wright-Pierce provides a wide range of customized Geographic Information Systems (GIS) services that are tailored to clients' needs and budget constraints. These services include data development, implementation, maintenance, map production and customized applications.

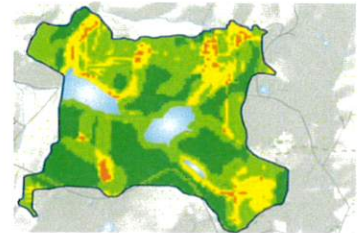
Our GIS packages are flexibly designed with current and anticipated needs in mind. We stress accuracy, value, and user-friendliness in all our GIS applications.

Wright-Pierce has used GIS in several planning projects, creating data and map products for the following:

- Parcel Mapping
- Land use planning
- Site planning
- Environmental assessment
- Infrastructure and assessment
- Trail mapping and planning
- Creation of visual aids and exhibits
- Use in public participation processes
- Mobile data collection and inspections

Wright-Pierce has created GIS infrastructure mapping for numerous municipal and private clients and employed GIS in planning projects for the following:

- Feasibility studies
- Siting of industrial facilities
- Groundwater studies
- FERC dam failure inundation mapping
- Watershed and stormwater planning
- Sewer system master planning
- Water system master planning











## Our Team Dedicated to Your Project

We have assembled a project team with many years of demonstrated practical experience completing similar projects. We understand that no one will know the requirements of this project better than you. To find the best solution, working together as a team will be essential, and our team is committed to working with you.

Jeffrey Normandin will be your dedicated Project Director for the Tax Parcel Map project. He has direct experience working on the Sewer System Mapping project for the Town of Durham, as well as extensive tax map experience.

The following introductions describe each of our key team members. Additional information about each team member and their experience can be found in their resume in **Section 5** of this submittal.




### PROJECT DIRECTOR


Jeff Normandin, GISP

### GIS ANALYSTS

Christine Manderson, GISP  
Tom Hamill, GISP

Team Member	Experience Overview	Relevant Experience
 <p><b>Project Director</b> Jeff Normandin, GISP <b>Experience: 15 years</b></p>	<p>Jeff is the senior GIS analyst at Wright-Pierce, working out of the Portsmouth, NH, office. He has 15 years of experience in both the public and private sectors. He has conducted spatial analysis, data collection, custom cartography, and managed geographic data on a wide range of topics in a wide range of industries.</p> <p>He has managed GIS data on water and sewer systems, created municipal parcel and zoning maps, evacuation plans, and conducted habitat modeling and conservation planning.</p> <p>Jeff is proficient with diverse hardware and software tools, including ESRI ArcGIS, ArcGIS Online, Spatial Analyst, 3D Analyst, Blue Marble's Global Mapper, and Trimble GPS. He is a skilled and detail-oriented technician, as well as a creative problem solver.</p>	<ul style="list-style-type: none"> <li>Parcel Map Updates, Old Orchard Beach, ME</li> <li>Parcel Mapping, Merrimack Valley Planning Commission</li> <li>Parcel Map Editing, Kittery ME</li> <li>Foreign Trade Zone Mapping, MRRRA</li> <li>Sewer System Mapping, Durham, NH</li> <li>GIS Services for Water Main Replacement, Stratham, NH</li> <li>On-call GIS Services, Water System Mapping, Online Mapping and Remote Documentation Access, Field Data Collection, Rye, NH</li> <li>MS4 Stormwater Management, Exeter, NH</li> </ul>

Team Member	Experience Overview	Relevant Experience
 <p><b>GIS Analyst</b> Christine Manderson, GISP <b>Experience: 14 years</b></p>	<p>Christine has over 10 years of experience in parcel work. She annually maintained parcels to Level III standards for the Towns of Falmouth, Gray and Cumberland, Maine for 10 years, using deeds, plans and markups to edit and split the parcels in ArcGIS.</p> <p>She worked on the Maine Geolibary Level II Parcel Contract to provide 100 Maine towns with a grant to update or create digital parcels, working towards statewide digital parcels. Christine was responsible for creating or updating georeferenced parcels for over 20 Maine towns. The efforts involved ranged from rubber sheeting hand drawn tax maps over the digital orthophotos, to updating the parcels with up to 5 years of edits, based on hand-drawn edits, plans and deeds. The parcels met or exceeded the Level II standards, which required the parcels to be in alignment with well-defined points on the orthophotos.</p> <p>Her continued ArcGIS experience includes 6 years of experience in a variety of civil, water and sewer projects at Wright-Pierce.</p>	<ul style="list-style-type: none"> <li>• Level III Parcel Updates, Gray, Falmouth, and Cumberland, Maine</li> <li>• Level II Parcel Creation, 5 Maine towns</li> <li>• Level II Parcel Updates, 10+ Maine towns</li> <li>• Tax Map Book Design and Creation, Maine</li> <li>• New Parcel Numbering Systems, Maine</li> <li>• Parcel Data Analysis, Maine</li> </ul>

 <p><b>GIS Analyst</b> Thomas Hamill, GISP <b>Experience: 18 years</b></p>	<p>Tom is a GIS/mapping analyst at Wright-Pierce. His responsibilities include data management, analysis, and generation of cartographic exhibits for marketing outreach and existing projects.</p> <p>He provides GIS expertise in spatial data presentation and analysis.</p>	<ul style="list-style-type: none"> <li>• Low-impact Development and Green Infrastructure Planning, Portland, ME</li> <li>• Comprehensive Plan Mapping, Old Town, ME</li> <li>• Low-Impact Development for Stormwater Management, Portland, ME</li> <li>• Zoning and Land Use Development Analysis, Exeter, NH</li> </ul>
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## Project Understanding

Maintaining an accurate parcel database can be challenging. The most obvious challenge might appear to be the creation of well-drawn linework that gains the confidence of residents, but that is far from the only one. In fact, the challenges include elements of database management, research, and documentation, as well as competent cartography. There are a number of important questions that someone doing parcel mapping must be prepared to answer:

1. Should a parcel with more than one owner (condominium) be represented with multiple parcel polygons?
2. What information should reside in a parcel database in the GIS system, versus the Assessing database?
3. How do you reconcile a shared property boundary that is shown differently on two surveys?
4. What do you do when a survey and a deed do not agree with each other?
5. Must a public road right-of-way always look even and smooth with a consistent width?

Some of these questions should be resolved by the GIS analysts and some should be decided by the Assessor, and it is important to know which, are which. It is also important that the consultant and the client have clear guidelines on how to address these issues.

Our GIS team has extensive experience working with municipal parcel data to meet State standards in both Maine and Massachusetts. The following Scope will outline our approach to overcoming the challenges of building a strong parcel GIS system.

## Scope of Services and Approach

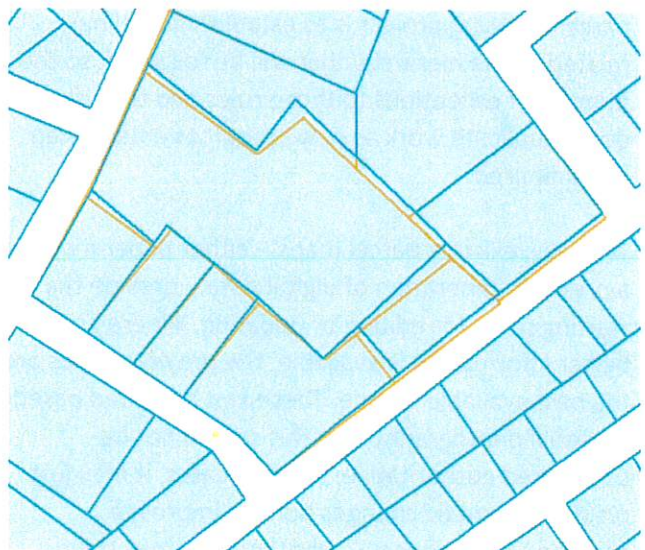
As per the Request for Proposal, the following is the scope of work for this project and our approach to each task.

## Overall Approach

While many towns choose to begin with digital tax maps derived from earlier previous paper maps then updated over time, we recognize that you are in a position to move beyond that phase and revise all your parcels at once. The challenge with this approach is that the research involved in trying to reach the same high level of accuracy for every parcel can be an insurmountable feat with the resources available to a small municipality. Title companies that conduct deed research will charge thousands of dollars to track down ownership of a single parcel. Lawyers could charge thousands to find rightful owners of individual properties with ambiguous ownership.

For these reasons, we feel it is impossible to guarantee that all 2600 parcels in Durham could be mapped in the GIS database with deed evidence to support the drawn boundaries, within the confines of any reasonable budget.

We recognize that your existing tax maps can be improved significantly at an attainable cost, but the necessity to provide deed research on every parcel, and the possibility of personal outreach to identify potential owners of any parcel with ambiguous ownership, could potentially lead to either unacceptable risk to us, or an unreasonable budget for you.





We believe the appropriate approach to advance your tax mapping is to work together to identify the areas of the highest concern, and to identify the sources of information – like registered subdivision plans – that allow for the greatest results for the effort spent. These areas would be worked on first. We would continue to progress through the town, updating tax maps in the areas where we can be most successful and productive. We propose working under a Not To Exceed contract, and we would offer frequent progress reports and maintain open channels of communication so that you can be confident our efforts are focused in the right places. This approach would allow you to see great improvements in your tax map database, without getting bogged down in research costs on a small number of parcels.

This effort would essentially maintain the typical philosophy for municipal to tax maps, which we also find relevant in our other GIS work: that it is best to work with what you have and improve over time as your resources allow.

#### Parcel Inventory

Creating and maintaining accurate parcel maps involves understanding a hierarchy of quality of source information and doing the work according to the highest level of information available for each parcel. While there may be some ambiguity in certain instances, the most efficient system for completing a parcel mapping project is to establish guidelines related to the hierarchy that will be followed, so the number of exceptions to those rules and the risk of doing duplicate work as new resources emerge can be minimized.

Typically, existing parcel maps – either paper maps or a previous generation of digital data – provide the starting point for editing or updating. Where no better information is available, the previous maps are the best available source. These can be edited based on aerial photography, but this should not be considered authoritative; in some cases, it may just result in cosmetic changes but not improved accuracy. This is because photography may show

what is ON the land, but it does not guarantee ownership. Many fences and walls have been built away from the legal property boundary, either accidentally or on purpose. These features visible in the photography can be used as guides, but it is important to note in the metadata that the source of those lines were drawn to match photography, and are not authoritative.

Digital survey data is the best source of parcel boundary information, because its accuracy is backed up by the licensed surveyor who provided it, and because digital data (CAD or GIS data) is the easiest to incorporate into the new municipal parcel map.

Paper surveys or PDFs or surveys are the next best source for parcel information. These surveys must be redrawn, but the survey allows for the shape of the parcel to be better understood, and the layout of the property in relation to adjacent parcels is usually clear. This will depend, though, on the quality, legibility, and age of the scan or plan.

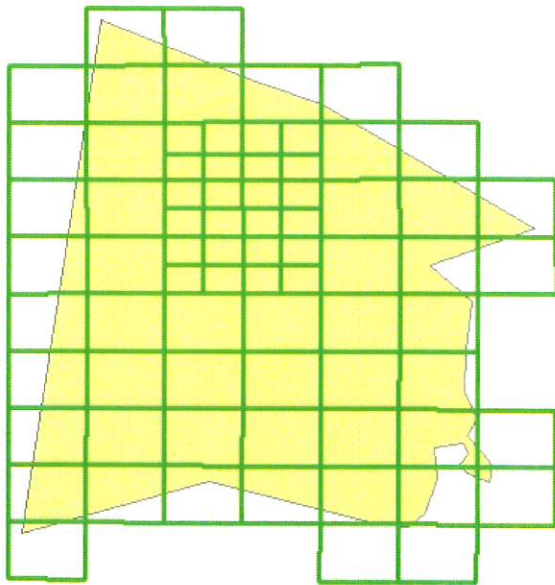
Finally, deeds contain authoritative descriptions of parcels that do not have surveys available. In some cases a deed will describe a property with language like “as shown on a survey recorded on Book x Page y at the Registry of Deeds”, which would be covered by the descriptions included above. But many deeds will describe the boundaries of the property with metes





and bounds, such as: “Begin at the pin on the northeast corner of the property on the south side of River Road, adjacent to the property now or formerly owned by Mr. J.M. Normandin. Proceed south 62.5° West for 178’...” While these descriptions are legal property descriptions, they provide many challenges. The first challenge with deed research is frequently just finding the property description, which may require looking through multiple deeds of increasing age. Once it is found, it is often difficult to determine the starting point for the property’s outline as described in the property description. For these reasons, deeds, and the research they require, are by far the most time-consuming source for updating parcels.

The first task for undertaking a comprehensive parcel update is to understand what information is available, then determine the workflow based on the available information.



### Pilot Area

Wright-Pierce will work with the Assessing department to choose a pilot area to conduct our initial demonstration of our methods. The pilot area should be representative of our typical workflow, involving a subdivision plan or other surveyed neighborhood, where we can demonstrate our

workflow, GIS editing, and overall methodology. We will review our results with you, and proceed with your consent. If you have any concerns about our results or methods, we will work with you to find a mutually agreeable way to move forward within the bounds of the contract.

### Parcel Renumbering

Many towns maintain older styles of parcel ID numbers, even after they have transferred their parcel mapping to newer GIS-based systems. Even though the physical paper map books may no longer be produced using the old map layout, there are often so many documents tied to the Map-Block-Lot (MBL) number that it is too valuable an ID to abandon completely.

We would work with you to determine the appropriate scale to produce newer grid-based tax maps, taking into consideration:

- The sizes of lots in different parts of town,
- The amount of detail required for your annotation.

The ideal scale necessary for a map to remain useful is always determined by looking at the balance between the amount of information you need to display, and the number of maps that would be acceptable. In the rural, outlying areas of Durham it would be possible to show the larger parcels in fewer maps while still showing the requisite lot information. However, the more dense subdivisions, particularly around the University campus, would require a much larger scale, not only to show the detail in the lot lines, but to fit the lot dimensions with a text size that would be legible. The best solution would likely be to use an irregular grid (see below), but there are many options for how to build that. The ID numbers for those parcels that fall within each grid cell would then be applied to the parcels that fall within it.

### Indexes and Reports

We understand that you require an index to be provided that lists each parcel by owner and by parcel ID. These are both reasonably easy tasks once the parcel data has been built. The indices by new and old



parcel ID would be the most straight-forward, since each parcel only has one ID (of each type) associated with it. The index by ownership is the slightly more complex task because of its reliance on the many-to-one relationship between owners and lots that exists in the case of condominiums. However, with proper data management, this is an easy challenge to overcome (see next section for more information). A report will be generated that shows the difference between assessed and calculated acreage. Assessed acreage will be taken from the Assessing database to be provided by the Assessor, and acreage for all parcels as drawn in the GIS will be calculated by the GIS system. Maintaining a calculation of the difference between those two values will be a simple matter, and we will export a report on all parcels above a threshold percentage of difference for review by the Assessor.

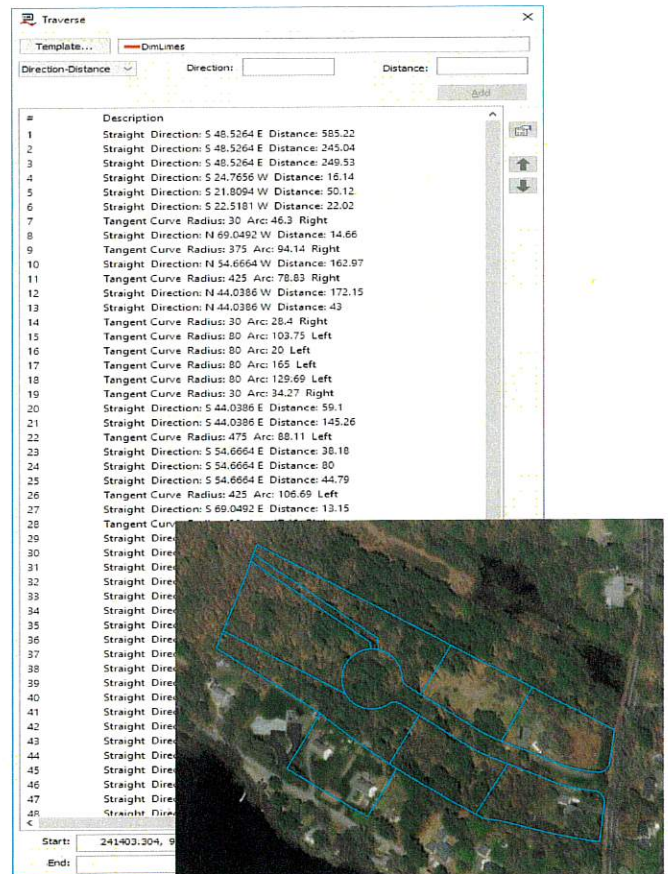
**Many-to-One**

Condominiums present a unique challenge in managing tax maps in GIS, but it is one that come be overcome by following with well-established procedures. Parcel databases should be maintained with an attribute table that includes a unique parcel ID, and a small set of attributes that do not change independently of the shape: area or perimeter, etc. All other information related to ownership and valuation should be maintained separately in an Assessor’s database that links to the GIS through the parcel ID. With this simple relationship between parcel attributes and Assessing attributes, it is possible to successfully manage parcels that have multiple owners.

For example, parcel 12-1 may be a single 4-acre lot with 16 owners. The parcel database should include only one record for lot 12-1, and the Assessing database should have 16 records, each identifying a separate owner, but all referring to lot 12-1. In this way, the Assessor database can be queried to find an owner’s parcel, and the parcel database can be used to find the owner(s) of a parcel.

**Data Integrity and Metadata**

Parcel data will be edited using Esri ArcGIS Desktop and/or ArcGIS Pro, and topology will be maintained to ensure no gaps or slivers. Topological reviews will highlight those problems for correction, and can be conducted regularly for quality control. When possible, large external boundaries will be drawn first, then parcels will be cut to maintain straight lines and clean corners, and reducing the likelihood of gaps and slivers that can accidentally be formed when vertices of adjacent parcels are snapped together. The Esri Traverse tool – part of the COGO toolbar – will be used to enter polygons from metes and bounds. The Traverse tool makes it easier to verify polygons close properly, and allows mistakes to be corrected more efficiently by reviewing and editing the numerical values that were entered (see below).



#### Annotation

Annotation will be created by labeling features automatically, converting the labels to annotation, then reviewing and editing the label locations to ensure legibility and logical placement. Parcel IDs and acreage values will be generated directly from parcel polygons. Property dimension values will be created from lines that are an integral part of the parcel fabric.

#### Other Data Layers

A road Right of Way polygon will be created within the parcel layer as the area that fills in the gaps, or the negative space, between parcels. Road annotation will be created based on labels, just as described with the parcel annotation. The road labels will be based on a road centerline layer provided by the town of Durham, or based on a road centerline file available from the NH GRANIT GIS database. Road annotation will be edited to ensure legibility, but the road centerlines themselves will not be edited or improved as part of this contract.

Cemeteries, wetlands, water bodies, buildings, and railroads will all be included on the printed maps, as available from datasets provided by the town or through NH GRANIT. Easements and subdivision common areas will be maintained in a separate feature class within the parcel geodatabase, where that information is available in the surveys or deeds used as source materials for parcel editing. Additional research will only be conducted to look for easement information at the direction of the town if the need arises, and within the time and cost terms outlined in the contract.

#### Printed Maps

Wright-Pierce will provide 1 draft set of paper tax maps consisting of sheets of 24x36" paper, with the number of sheets to be determined based on the index grid that will be established during the course of the contract. These draft maps will be provided for public comments, will be reviewed with the Assessor, and necessary changes will be incorporated into the GIS database.

A final set of tax maps will be delivered to the Assessor upon completion of the revisions.

The following information shall be shown on the tax maps:

1. Parcel boundaries and annotation on lot dimensions, ID, and acreage
2. Buildings
3. Easements, as available
4. Road annotation, from existing road data
5. Waterbodies and name labels, as available
6. Wetlands, cemeteries, and railroads, as available
7. Page index information
8. Coversheet and index pages

#### Public Review

Wright-Pierce will:

- Be available at a public review session to enable taxpayers to view the maps for accuracy.
- Collect that feedback and make necessary corrections.
- Provide revised sheets following the public review process.
- Provide the Town with a report of public review sessions including a list of attendees, feedback and records presented.





### Municipal Staff Training

Wright-Pierce GIS Analysts have conducted GIS training as part of many GIS projects with clients throughout New England, on topics ranging from mobile data collection to hydraulic modeling, to asset management. We will conduct a training session for current staff to ensure they are able to fully utilize and maintain the new tax maps. Training shall be held at mutually agreed upon times in person, in Durham.

### Other Deliverables

- Errata list(s) highlighting parcels with conflicting information sources
- Two (2) paper copies of each tax map and index maps, full size
- PDF file of all maps listed above
- A geodatabase containing feature classes representing:
  - Parcels, including ROWs
  - Annotation
  - Map index
  - Other GIS layers discussed above, based on available information
  - Metadata
- Three (3) indexes tables: one (1) sorted alphabetically by owner names, one (1) sorted numerically by new map/lot number, and one (1) sorted numerically by old map/lot number
- Public review sessions documentation, report, and action list
- Training materials for Town staff
- Parcel fabric and tax map management procedures and recommendations

**Project Schedule**

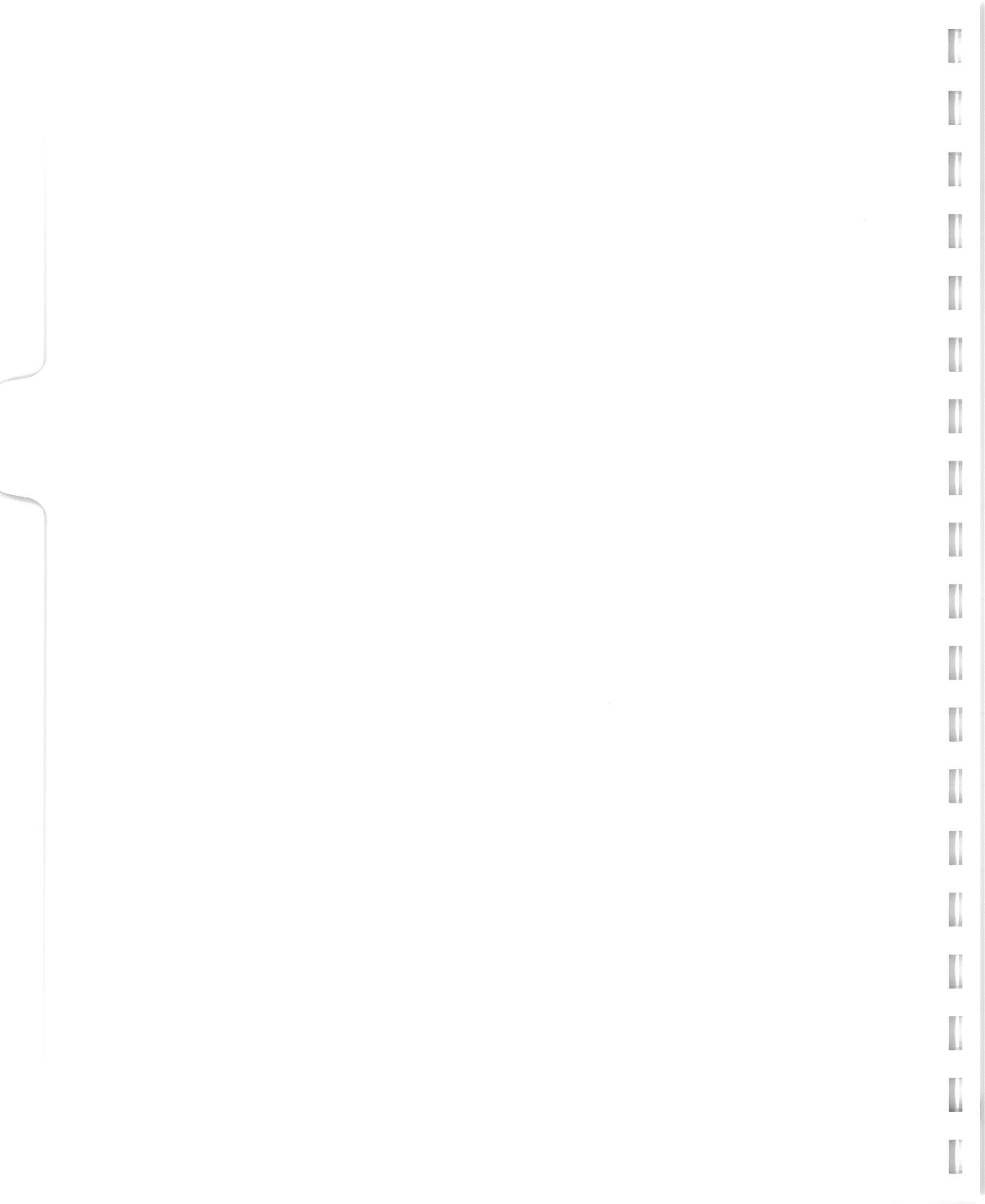
The project schedule can be adjusted based on your needs and the date of execution of the contract and notice to proceed. This schedule assumes a contract is in place before the start of work.

Task	2019							2020			
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Project Commencement	█	█									
Pilot Area		█									
Parcel Research		█	█	█	█	█	█				
Parcel Editing		█	█	█	█	█	█				
Data Review and QC							█	█			
Errata List Creation								█			
Index Map Creation								█	█		
Parcel ID Renumbering								█	█		
Draft Map Production									█		
Public Review									█	█	
Incorporate Comments										█	
Final Map Production											█
Final Data Delivery											█
Staff Training											█





# 4



## Proposed Fee

Wright-Pierce is a strong believer in the selection of engineers on the basis of qualifications, with an equitable fee negotiated between the selected firm and the client, based on a mutually established detailed scope of work. Your primary concern should be that the firm you select is fully qualified, with the skills and experience to complete the work at the level of quality you expect, and the client service to maintain a positive client relationship. Wright-Pierce does not plan to use any subconsultants in this effort. For the proposed scope of services, broken down by the tasks discussed in our scope of services section, we propose a **not-to-exceed fee of \$50,000.**

Our fee reflects a good understanding of the needs of the Town, as well as the reasonable expectation of the costs required to provide you with a quality result, with the understanding that work will proceed first in those areas that provide the most benefit, and will progress toward the most challenging issues last. This will ensure that the areas providing the most challenges do not impede the overall progress of the project, and work will proceed until either all parcel edits have been completed, or the total contract fee has been met. Open communication will ensure that you are made aware of any challenges early so mutually agreeable solutions can be found.

**We are flexible and willing to reconsider any aspect of our proposal if we can provide a more tailored level of service.**

## Not-to-Exceed Cost

Task	Hours	Dollars
Parcel Research & Editing (Based on estimate of approx. \$10/parcel)		\$27,320
Indexing and Reports	40	\$4,200
Pilot Area	40	\$4,200
Parcel Renumbering	16	\$1,680
Printed Maps	40	\$4,200
Public Review	16	\$1,680
Revisions	40	\$4,200
Training	16	\$1,680
Presentation to Town Council	8	\$840
<b>TOTAL</b>		<b>\$50,000</b>

*All costs presented are at an average billable rate of approximately \$105/hr. Future updates would proceed at that rate. The course of this project would help establish a more predictable cost/parcel for updates, based on the quality of the deeds and surveys and ease of parcel research in the Town.*

**Annual updates (data)**

Staff time / established average per-parcel time as determined during this project

**Annual updates (paper maps)**

Staff time / Materials Cost

**Future Training Rate**

Staff time (cost would vary with length of training).

RECEIVED



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# Jeffrey M. Normandin, GISP

## GIS MANAGER

Project Assignment: Project Director

### Education

M.A., International Development and Social Change, Clark University

B.A., Magna Cum Laude; International Development, Community and Environment. Specialization in GIS, Clark University

### Professional Registration

Certified Geographic Information Systems Professional (GISP)

### Experience

15 Years

### Joined Firm

2013

### Professional Affiliations

Treasurer, Maine GIS Users Group (MEGUG)  
Member, New England Chapter of Urban & Regional Information Systems Association (NEURISA)  
Member, NYWEA

### Research and Course Work

Remote Sensing, GIS for International Development, GIS for Local Planning, Development Project Management, Environmental Law, Business Law, Semester abroad in Zimbabwe. ESRI Virtual Campus training on several GIS topics

## Experience Summary

Mr. Normandin is the senior GIS analyst at Wright-Pierce, working out of the Portsmouth, NH, office. He has 15 years of experience in both the public and private sectors. He has conducted spatial analysis, data collection, custom cartography, and managed geographic data on a wide range of topics in a wide range of industries. He has managed GIS data on water and sewer systems, created municipal parcel and zoning maps, evacuation plans, and conducted habitat modeling and conservation planning. Jeff is proficient with diverse hardware and software tools, including ESRI ArcGIS, ArcGIS Online, Spatial Analyst, 3D Analyst, Blue Marble's Global Mapper, and Garmin GPS. He is a skilled and detail-oriented technician, as well as a creative problem solver.

## Relevant Project Experience

### Geographic Information Systems (GIS)

#### Utility Infrastructure Data Collection, Rochester, NH

Designed, implemented, and oversaw a large-scale data collection effort, using state of the art RTK GPS and mobile GIS tools to locate and record a wide range of municipal assets, including water, sewer, stormwater, and electrical assets. Designed the mobile GIS tools for data collection, web-based oversight tools for project management, an outfall inspection form for MS4 compliance, and built GIS database from the newly collected data.

#### Asset Inventory and Mobile GIS, Northfield Mount Hermon School, Gill, MA

Used GPS and online mobile GIS system to locate and map all utility assets from water, sewer, stormwater, electrical, and fiber optic systems within the campus. Implemented online GIS for ongoing data access and editing by Facilities staff, and trained them on the use of the system.

#### Mobile GIS Implementation and Expansion, Bath, ME

Implemented a mobile GIS system for use by Public Works staff, to allow for access to the GIS data in the field, mobile data collection, and enable easier sharing of information on municipal assets with City staff and the public. The system is used to assist operations related to sewer assets, public roads, sidewalks, and other assets.

#### Mobile GIS for Asset Management, Plymouth Village Water & Sewer, NH

Created utility GIS database. Scanned and georeferenced approximately 150 record drawings and as-built plans; digitized all sewer and stormwater features: pipes, pump stations, manholes, catch basins, and outfalls. Designed ArcGIS Online tools for data collection and inspection of water distribution system assets.



### **Presentations**

Normandin J, ““Cost-Effective Mobile GIS Solutions for Utilities”, NEWWA IT Fair, Holliston, MA, November 2017

“GIS and GPS for Asset Management”, GSRWA, Jaffrey, NH, November 2017

Normandin J. and Berg, C, “Asset Management in Rochester, NH”, NHWWA Technical Meeting, April 2017

Normandin J and Perkins, L, Using Data Within GIS for Risk Management, WEF Webcast, April, 2017

Normandin J and Berg C, GIS for Utilities: Asset Inventory with RTK GPS and Esri Collector”, NEWWA/RIWWA meeting, November, 2016.

Normandin, J., and Richardson, J., “GIS for Utilities”, Maine GIS Users Group Fall Meeting, Belfast, Maine, September, 2016

Normandin, J., “Asset Inventory and GIS Mapping”, Massachusetts Rural Water Association, Inflow and Infiltration Training, Amherst, MA and Millbury, MA, June, 2016

Normandin, J., “GIS for Asset Management”, JETCC Management Candidate School, Augusta, Maine, March, 2016

Normandin, J., “GIS for Asset Management”, JETCC Management Candidate School, Kennebunk, Maine, December, 2014

### **MS4 Stormwater Management, Exeter, NH**

Built and deployed a mobile GIS tool to allow for web-based data collection of outfall inspections, in accordance with federal MS4 regulations.

### **Sewer System Mapping, Durham, NH**

GIS mapping and data development of complete wastewater system GIS database. GIS data development/refinement. Georeferenced existing system drawings and as-built plans, digitized new features or edited existing features. Associated plans and drawings with GIS features and established links for document access through GIS.

### **GIS Mapping Related to Citywide CSO Mitigation Project, Lebanon, NH**

Provided GIS mapping services for multiple sewer projects in Lebanon.

### **On-call GIS Services, Water System Mapping, Online Mapping and Remote Document Access, Field Data Collection, Rye, NH**

Extensive map production, database development, data collection, and use of mobile GIS tools. Oversaw data collection in ArcGIS Online for fire hydrants and system valves, and prepared mobile maps for use by RWD staff. Provide on-call GIS services.

### **Roadway Stabilization Planning Maps, Salem, NH**

Created mapping to show completed roadway stabilization projects and future needs for planning purposes.

### **GIS Requirements for Permitting, Newmarket, NH**

Assisted with GIS requirements for permitting; GIS updates, map production, system statistics and analysis as part of a wastewater treatment facility upgrade.

### **GIS Services for Water Main Replacement, Stratham, NH**

Water main preliminary design; produced design in GIS.

### **Asset Management and Assessment Plan, WRBP, NH**

Assisted regional wastewater utility with evaluation and implementation of Asset Management software.

### **Asset Management Assistance, Claremont, NH**

Provided GIS services related to an Asset Management Plan, including data collection, GIS data development, software implementation, and training.

### **Sewer Mapping and Data Acquisition, South Windsor, CT**

Managed GIS data collection and integration processes, and lead GIS mapping efforts related to multi-year I&I project.

### **SSES Plan, Gainesville, FL**

Conducted sewer system asset inspection prioritization based on NASSCO guidelines. Sewers were evaluated based on a range of criteria, including asset attribute information and environmental considerations, to develop an overall Consequence of Failure score. Led goal-setting exercise with all stakeholders to determine the relative weights of each factor of the prioritization. Analysis provided ranking of all assets for multi-year sewer inspection program.



Normandin, J., "Solving Histories Mysteries with Spatial Technology", NEARC Fall Conference, Groton, CT, October, 2014

Normandin, J., "Evaluating Access to Maine Healthy Walks with GIS", Proceedings, Active Communities Conference, Bangor, Maine, September, 2014

Normandin, J. and Berg, C., "GIS & GPS for Asset Management", Granite State Rural Water Association, Raymond, NH August, 2013

### **GIS and Hydraulic Model, North Attleboro, MA**

GIS improvements to distribution system database, establishment of linked document management in GIS, creation of ArcGIS Online mobile data platform.

### **GIS Improvement/Hydraulic Model integration, Burlington, MA**

Data improvements and management of water distribution network GIS for hydraulic modeling. Led training on best practices in GIS.

### **Sewer Separation Project Planning Maps, Fitchburg, MA**

Perform GIS mapping tasks and data analysis in support of SSIS, I&I project, including map production and analysis related to smoke testing and manhole inspections. Assisted in asset management software evaluation.

### **GIS for MS4 Compliance, PVPC, MA**

Created a combined stormwater asset database for a regional coalition of towns, to assist in MS4 compliance. Assessed existing GIS data from each municipality, designed a new geodatabase to house all municipal stormwater data from each community, in accordance with federal MS4 reporting requirements. Worked with the participating communities to build mobile GIS tools to assist in data collection and inspection requirements of the MS4 permit, and trained the member communities to implement these tools.

### **Utilities Master Plan, Gloucester, MA**

Overseeing all GIS activities associated with a multi-year Utilities Master Plan, including risk analysis of wastewater and stormwater assets, mobile GIS to facilitate inspections of assets, map production, database development, and other related tasks.

### **Asset Management Assistance, Fall River, MA**

GIS Services associated with an Asset Management Plan, including gap analysis, and AM software evaluation.

Provided GIS support on a CSO mitigation and reduction engineering project.

### **Merrimack Valley Planning Commission, MA\***

As GIS technician, conducted GIS analysis, map creation, and data management for 15 towns within northeastern Massachusetts. Responsibilities included parcel mapping for member towns, zoning maps, municipal infrastructure and utility mapping, emergency planning, and other GIS tasks at municipal and regional level.

### **Maine Natural Gas, Augusta, ME**

Conducted extensive edits to GIS data and conversion from CAD, created combine GIS database of natural gas lines, provided links to record drawings, and established a cloud-based mobile GIS application for asset management.

### **Mobile GIS for Municipal Tree Inventory, Bath, ME**

Provided ongoing GIS mapping services to the Public Works Department, including sewer system updates, conversion to ArcGIS Online, linked documents, mobile data collection and data access tools, and linked plans and CCTV video files.

## **Jeffrey M. Normandin, GISP**

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Provided mobile GIS data collection tools for inventory of municipally owned trees within the city.

### **Drainage System Mapping & Evaluation, Cranston, RI**

Provided GIS services to assist with a flood mitigation project, including hydrographic analysis, watershed delineation, and stormwater infrastructure mapping.

### **Water/Wastewater CIP, Bristol County, RI**

Performed mapping to assist in water and wastewater capital improvement planning.

### **GIS Analysis for Sewer Inspection Prioritization, Burlington, VT**

Conducted sewer system asset inspection prioritization based on NASSCO guidelines. Sewers were evaluated based on a range of criteria, including asset attribute information and environmental considerations, to develop an overall Consequence of Failure score. Led goal-setting exercise with all stakeholders to determine the relative weights of each factor of the prioritization. Analysis provided ranking of all assets for multi-year sewer inspection program.

### **Pipe Integrity Program, Champlain Water District, VT**

Conducted risk assessment of regional water transmission utility assets based on a multi-factor Likelihood of Failure and Consequence of Failure analysis. Evaluation based on a range of criteria, including asset attribute information and environmental considerations, ability to repair, pressure, and others. Led goal-setting exercise to determine the relative weights of each factor of the prioritization.

### **Axis GeoGraphics\***

As owner/GIS consultant, provided GIS mapping services and consulting. Specialized in the needs of small businesses, local governments, and non-profit organizations. Data creation, thematic mapping, geographic analysis and GIS training. Clients included:

- Southern Maine Regional Planning Commission: Open Space planning for the Town of South Berwick, Maine
- Town of Kittery, ME: GIS support to Public Works and other departments, including data creation, data management, and mapping of infrastructure, utilities, parks, and others.
- Town of Old Orchard Beach, ME: Assessor's tax map editing, Comprehensive Plan support, MS4 requirements, etc.
- Town of York, ME: Watershed delineation and analysis, harbor mooring data collection and mapping.
- KPM Marine/AT&T: underwater transmission cable mapping
- Kennebunkport, ME: mooring database creation and mapping.
- Mountany Pond Club, ME: Parcel mapping and environmental assessment for property management.

### **Maptech, Inc.\***

As technical support specialist, provided technical support for Maptech's complete line of digital map/chart products, including 6 software packages, digital charts, and

## **Jeffrey M. Normandin, GISP**

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the complete hardware and software of the Sea Ray Navigator/I3 navigation system, and associated electronics. Conducted private training sessions on Maptech software, and received several letters of praise for outstanding service from customers.

### **Audubon Society of New Hampshire\***

As GIS and data management specialist, conducted all GIS management and geographic analysis for statewide conservation organization. Led training sessions on uses of GIS and GPS. Created maps, conducted environmental research, created and managed data.

\*Experience from previous employer







# Christine L. Manderson, GISP

## GIS ANALYST

### Project Assignment: GIS Analyst

#### Education

B.S., Computer Science,  
Boston University

#### Professional Registration

Certified Geographic  
Information Systems  
Professional (GISP)

#### Experience

18 Years

#### Joined Firm

2013

#### Professional Affiliations

Board Member, Maine GIS  
Users Group (MEGUG)

#### Research/Course Work

GIS Web-Based Maps and  
Applications  
ESRI training on Building and  
Editing Geodatabases

## Experience Summary

Ms. Manderson is the GIS Analyst at Wright-Pierce. She has 14 years of experience in GIS and an additional 10 years working with custom programs and data management for utilities. She has conducted spatial analysis, data collection, custom cartography, and managed geographic data for a variety of customers. She has managed GIS data in water and sewer networks, created municipal parcel and zoning maps, and customized entry forms for GIS data management. She is proficient with diverse hardware and software tools, including Esri ArcGIS, ArcGIS Online, Spatial Analyst, 3D Analyst, and Trimble GPS.

## Relevant Project Experience

### Geographic Information Systems (GIS)

#### Proposed Force Main, Jay, ME

Georeferenced several tax maps in order to create the GIS parcels for the properties which abut the proposed 3.5 mile pipeline in order to create a map and spreadsheet for notifications.

#### Shoreland Zoning Map, Lisbon, ME

Developed final shoreland zoning map for the town of Lisbon, approved by the Maine DEP.

#### Pump Station Upgrade Study, Hebron, CT

Conducted analysis of parcel, zoning and assessing data to compile data for sewer pump station upgrade study. Each parcel was evaluated for sewer use and potential build-out to create a detailed spreadsheet of current and potential sewer needs.

#### Sewer Asset Prioritization, Burlington, VT

Conducted sewer system asset rehabilitation prioritization based on NASSCO guidelines. Sewers were evaluated based on a range of criteria, including asset attribute information and environmental considerations, to develop an overall consequence of failure score. A city-wide index grid and mapbook were developed to showcase detail areas of rehabilitation recommendations.

#### Corridor Connector Road Study, Wiscasset, ME

Used spatial analysis to demonstrate feasibility of alternative proposed connector road and commercial development plans.

#### Field Data Mapbook, Camden, ME

Created dataset for ArcGIS Online for Field Smoke Testing project and generated a mapbook for field workers highlighting each work area on separate pages.

**GIS Mapping Support, Trumbull, CT**

Provided GIS services to the town, including a sewer system area map and an Office of Policy Management map.

**West Falmouth Sewer Master Study, Falmouth, ME**

Provided support for the sewer study, including analysis of parcel and terrain data in conjunction with existing and proposed sewer infrastructure. Designed a series of detailed index and mapbook illustrating recommendations for presentation.

**Village Master Plan Maps, Standish, ME**

Developed a series of maps which depict the existing conditions for the village master plan.

**West Falmouth Sewer Master Study, Falmouth, ME**

Provided support for the sewer study, including analysis of parcel and terrain data in conjunction with existing and proposed sewer infrastructure. Designed a series of detailed index and mapbook illustrating recommendations for presentation.

**Fire Services Map, Whiting, ME**

Generated five-mile travel radius from fire station using road network. Prepared map of fire company service area, including fire company assets and area conditions

**Sewer Line ROW Clearing Project, The Metropolitan District, Hartford, CT**

Analyzed GIS data to compile information on parcels abutting 250,000' of sewer lines and produced maps for field work displaying the ROWs with parcel, road and wetland data.

**Inflow and Infiltration Evaluation, Claremont, NH**

Designed a mobile application using ArcGIS Collector to record the results of the night-flow, flow meter monitoring for infiltration and inflow evaluation. Generated maps depicting results.

**GIS Data Support, Maine Natural Gas, Brunswick, ME**

Developed GIS database from existing and new data. Established links to documents and CAD drawings. Created ArcGIS Online mobile data platform for field workers. In addition, created Collector form for valve inspections, results submitted to PUC.

**GIS for MS4 Compliance, Pioneer Valley Planning Commission, MA**

Created a combined stormwater asset geodatabase for a regional coalition of towns to assist in MS4 compliance. Worked with the participating communities to build mobile tools to assist in the collection of stormwater data and inspection forms to meet MS4 requirements.

**CCTV Results, Rockland, ME**

Developed a Python app to create GIS location data from CCTV results in Access database. Generated map book showing detailed CCTV results for each sewer pipe.

**Sewer Service Laterals, Waltham, MA**

Utilized a Python app and other tools to create new GIS service lateral data from taps identified in a CCTV Access database.



**Water Supply Master Plan, Yarmouth Water District, ME**

Produced a set of maps which illustrated the condition and future needs of the water system.

**CMOM Study (Capacity, Management, Operation & Maintenance), Torrington, CT**

Analyzed sewer asset data, natural resource features, and existing city facilities and infrastructure, and generated a series of factors which could be used to prioritize sewer assets.

**Sewer System Evaluation, Medford, MA**

Created a set of maps to illustrate the rehabilitation recommendations resulting from the sewer system evaluation.

**Water Supply Master Plan, Greater Augusta Utility District, ME**

Produced a series of maps depicting assets and conditions for water district master plan overview.

**Water and Sewer Improvements, Plymouth, NH**

Developed alternate scenarios for new force main. Reviewed parcel data and created potential sewer expansion areas. Prepared detail maps for designated improvement projects.

**Flow Meter Data Evaluation, Leominster, MA**

Analyzed city sewer data and created sewer basins for installation of flow meters. Summarized data for IDM calculations and created maps to depict the flow meter results.

**Sewer System Evaluation, Fitchburg, MA**

Generated a series of twenty maps depicting sewer system rehabilitation priorities from results of sewer evaluation field study.

**Sewer Expansion Study, Deland, FL**

Analyzed existing city sewer and septic information, along with watershed and assessing data to identify potential areas for sewer expansion.

**Wastewater Collection System Study, Bath, ME**

Created a series of maps to show the results and recommendations from the south end collection system study.

**Facilities Plan Upgrade, Londonderry, NH**

Updated GIS data for sewer system. Provided new data for sewer analysis. Designed new maps for the final report. Performed data analysis for system evaluation.

**West Falmouth Sewer Master Study, Falmouth, ME**

Provided support for the sewer study, including analysis of parcel and terrain data in conjunction with existing and proposed sewer infrastructure. Designed a series of detailed index and mapbook illustrating recommendations for presentation.

**Round Pond Inundation Study, Rochester, NH**

Used the HEC-GeoRAS software in order to provide GIS data for flood inundation

models at Round Pond for varied scenarios. Developed data and maps for final report.

**Flow Metering Evaluation, The Metropolitan District, Hartford, CT**

Provided maps to illustrate alternatives for proposed meter replacement recommendations.

**Sewer Study, Rockland, ME**

Created field maps for smoke testing and flow monitoring study. Integrated data from previous inspections and create maps depicting recommendations.

**The Metropolitan District Dividend Brook Interceptor Design Profiles, Hartford, CT**

Created sewer profiles for proposed interceptors with corresponding aerial maps.

**Bathymetric Analysis of Ponds, Salem, NH**

Used elevation data to create 3D views of ponds and analyze water level scenarios.

**Sewer System Data Creation, Durham, NH**

GIS mapping and data development of complete wastewater system from existing data and plans.

**Sewer System Data Creation, Lebanon, NH**

Created detailed data of sewer and drainage systems from plans including sewer lines, manholes and lateral detail.

**Environmental Impact Study, Farmington, CT**

Created map depicting area sewer systems and other features with impact on the environment.

**Greater Augusta Utility District Sewer System Assessment Maps, Augusta, ME**

Created maps for assistance with field work on a variety of projects in Augusta and Hallowell.

**House Survey Map, Medford, MA**

Created complex map depicting results of detailed house sewer survey.

**Proposed Back Cove Storage Maps, Portland, ME**

Created series of maps for Back Cove storage facility proposal showing existing and proposed sewer features.

**Sewer System Mapping and Database Management, Orleans, MA**

GIS mapping and data development of sewer system and creations of numerous maps for field work and reports depicting various aspects of the system.

**Spatial Alternatives, Yarmouth, ME\***

As GIS analyst, provided GIS mapping services and consulting for a variety of clients, specializing in management of GIS data for small towns and utility districts. Projects included:

- Brunswick Sewer District, ME: GIS data management, including creation of custom data entry screens for sewer features, including manholes and sewer



## **Christine L. Manderson, GISP**

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lines.

- Town of Gray, ME: GIS support to the town, including parcel data. Created system for parcel re-numbering of parcels, performed the proposed re-numbering and created indexes which cross-referenced old and new parcel numbers.
- Town of Falmouth, ME: GIS data management and annual parcel updates, utility pole data collection and trail maps.
- Town of Cumberland, ME: GIS support to the town, including parcel data, utility data.
- State of Maine: Contract with the Maine Office of GIS to create parcel data for over 100 towns in Maine and submit in standard format for online publication.

### **City Computer Programmer, Fort Collins, CO\***

As a computer programmer, worked with the Fort Collins Utilities on management of electric and water data, including designing a database with complex interconnections and billing for multiple customer types.

### **Northern Data System Computer Programmer, Falmouth, ME\***

Specializing in municipal financial and utility billing applications.

\*Experience from previous employer

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# Thomas Hamill, GISP

## GIS ANALYST

### Project Assignment: GIS Analyst

#### Education

M.A., GIS, Clark University  
B.A., Geography, Clark University

#### Experience

8 Years

#### Joined Firm

2012

#### Professional Affiliations

Maine GIS User Group  
Association of American Geographers

#### Publications

Runfola, D.M., Hamill, T.,  
Pontius, J.G. Jr., Rogan, J.,  
Ratick, S., Giner, N.M.,  
Decatur, A. Forthcoming  
2014. "Using Fine Resolution  
Orthoimagery and Spatial  
Interpolation to Rapidly Map  
Turf Grass in Suburban  
Massachusetts,"  
International Journal of  
Geospatial and  
Environmental Research  
(IJGER).

Gao, Y., Marpu P., Niemeyer,  
I., Runfola D.M., Giner, N.M.,  
Hamill, T., Pontius, J.G. Jr.  
2011. "Object-based  
classification with features  
extracted by a semi-  
automatic feature extraction  
algorithm – SeaTH,"  
Geocarto International  
26(3):211-226

#### Presentations

Hamill, T., "Evaluation of  
methods for prediction of  
fine green vegetation by  
census block group: The case  
of Plum Island Ecosystems  
and Boston 2005", presented

## Experience Summary

Mr. Hamill is a GIS/mapping analyst at Wright-Pierce. His responsibilities include data management, analysis, and generation of cartographic exhibits for marketing outreach and existing projects. He provides GIS expertise in spatial data presentation and analysis.

## Relevant Project Experience

### Oyster Pond Comprehensive Wastewater Management Plan, Falmouth, MA

Provided GIS support for the needs assessment, alternatives analysis, and comprehensive wastewater management plan for watershed nitrogen removal.

### Low-Impact Development and Green Infrastructure Planning, Portland, ME

Designed maps to depict proposed green infrastructure improvements including tree box filters, curb inlet infiltration swales, raingardens, pervious asphalt, bio swales, and subsurface detention storage throughout residential and mixed-use areas in Back Cove (West).

### Sewer Extension Planning, Watertown, CT

Generated municipal zones for existing, future, immediate, and limited sewer service area within a rural residential area.

### Sewer Service Area Mapping, Fairfield, CT

Developed a parcel-level sewer service area boundary based on municipal records for properties connected to public sewer, properties with septic systems, and vacant or undeveloped properties.

### Municipal GIS Upgrades – CCTV Inspection Video Streaming, Bath, ME

Designed and implemented functionality for storing and accessing extensive (40GB) archive of sewer inspection CCTV videos.

### Route 1 Complete Street Planning, PACTS, ME

Created cartographic products for Route 1 transportation planning.

### Wastewater Planning, Windham, ME

Integrated municipal zoning and assessor's data with parcel-level consumptive water use data to project wastewater flows and support groundwater modeling needed for collection system extension planning.

### Comprehensive Plan Mapping, Old Town, ME

Prepared fourteen maps depicting a variety of economic, natural, cultural, and infrastructure themes for the Old Town's comprehensive plan update in 2015.



at the Association of American Geographers (AAG) Annual Meeting, New York, NY, February 24, 2012

Hamill, T., "Application of Interpolation Methods to Estimate Lawn Cover," presented at the Association of American Geographers (AAG) Annual Meeting, Seattle, WA, April 15, 2011

Hamill, T., "Cross-resolution analysis to prepare information of land cover for a hydrological model in the Plum Island Ecosystems study area in northeastern Massachusetts," presented at the Association of American Geographers (AAG) Annual Meeting, Washington, DC, April 16, 2010

**Mobile Data Collection, Bath, ME**

Designed two mobile applications using ArcGIS Collector and ArcGIS Online that enable Bath's public works department to conduct asset management on several town utilities.

**Low-Impact Development for Stormwater Management, Portland, ME**

Assisted in cartographic and design efforts of LID Stormwater for amenities that will manage stormwater flows contributing to the Back Cove West storage conduit.

**Portland Back Cove South Storage Conduit, Portland, ME**

Created data layers and maps to support modeling and design efforts of engineers.

**FACTS Multimodal Complete Corridors and Centers, Portland, ME**

Developed regional and sub regional maps for use in the Portland area comprehensive transportation system planning.

**Aquatic Base Flow Estimation, Surry, ME**

Generated statistics pertaining to the base flow estimation of Patten Stream for use in the design of a weir fishway.

**Topsham Fair Mall Stream Stormwater Inspection Mapping, Topsham, ME**

Prepared a series of maps representing parceled stormwater system features for site inspection conducted in summer 2013.

**Utilities Mapping, Augusta, ME**

Designed a large-extent service area map to depict the spatial distribution of existing district utilities, future MDOT construction, and anticipated gas main installations in the Greater Augusta Utility District.

**Utilities Mapping, Brunswick, ME**

Developed aerial base maps of electric, gas, and water utilities within the Brunswick Naval Air Station for Maine Resource Recovery Association (MRRA) permit applications.

**Data Collection, Lisbon and Topsham, ME**

Collected and organized data for display in preliminary zoning and environmental constraint maps of the Route 196 corridor plan.

**Database Maintenance, Kennebunk, ME\***

Updated and maintained an extensive spatial database of water mains, valves, and hydrants in the 200-mile water system of the Kennebunk, Kennebunkport, and Wells Water District. Collected GPS points to improve the spatial accuracy of mains in a 25-mile utility service area.

**Pump Station Inspections and Surveys, Norwalk, CT**

Developed and implemented a mobile/GPS wastewater pump station inspection form for field technicians.

**Sewer Main Extension, Watertown, CT**

Developed a series of carto-graphics to explore cost-effective alternatives for routing proposed sewers as part of a four-phase water and sewer main extension project in Watertown.

**Wastewater Management Planning, Old Say brook, CT**

Generated three alternative sewer layouts for illustrating advanced treatment upgrades that were needed to address aging and failing conventional, individual, and on-site septic systems.

**Manhole Inspection Mapping, South Windsor, CT**

Constructed a series of maps to illustrate completed inspections and identify areas for improvements and future construction.

**Park and Trail Layout, Waterbury, CT**

Assisted in the preliminary trail design and park layout improvements of Scott Road Park.

**Inundation Mapping, Housatonic River, CT**

Modeled and mapped more than 30 linear mile's worth of river channel peak-maximum flooding through twelve towns using 10-Ft spatial-resolution elevation data.

**Future Flow Projections and Hydraulic Modeling, Apopka, FL**

Integrated over 25,000 water billing records for five different time periods with population rates and land use data for the service area to support future sewer capacity analyses.

**Wastewater System Criticality Assessment, Gainesville Regional Utilities, FL**

Prepared data and conducted analysis on a regional wastewater system to identify deficient mains for rehabilitation.

**Sewer and Storm Criticality Analysis, Gloucester, MA**

Developed spatial data, configured environmental factors, and enumerated pipe segments with scores to facilitate the prioritization of future rehab and construction for coastal sewer and storm utilities in northeastern Massachusetts.

**Level 2 NASSCO MACP Manhole Inspections, Spencer, MA**

Constructed a NASSCO Level 2 manhole inspection form within ESRI Survey123 to support large field work and data collection efforts.

**Hydrant Condition Assessment and Mapping, Lexington, MA**

Resolved conflation among disparate datasets of hydrant inspection information.

**Water Capital Improvements Planning, Lexington, MA**

Constructed data and developed maps to depict business risk exposure for a town-wide water system. Analysis was based on likelihood/consequence of failure and other quality measures.

**Fall River Drainage Project, Fall River, MA**

Supported engineers in the design of stormwater management and drainage



improvements within the city.

**FEMA Letter of Map Revision, Fitchburg, MA**

Generated revised 100-Year flood plain for North Nashua River reach adjacent to the Fitchburg Easterly Wastewater Treatment Facility needed in order to assess requirements to update flood proofing.

**Comprehensive Wastewater Management Plan, Middleborough, MA**

Developed town wide data to integrate various land use datasets and created cartographic exhibits for future wastewater management planning.

**Comprehensive Water Resources Management Plan, Sandwich, MA**

Constructed aerial and thematic maps of social and environmental factors to examine and depict nitrogen loading in a collection of sub-watersheds.

**Sewer Asset Management, Farmington, NH**

Streamlined organization and management of sewer field data by generating one authoritative feature service of asset information.

**MS4 Mapping, Exeter, NH**

Conducted research, reviewed utility networks, developed citywide data, and designed a 60-page map book to visualize relationships between more than 100 stormwater outfalls/utilities and stormwater basins.

**Watershed Mapping, New Hampshire Rivers Council, NH**

Determined current and future annual pollution loadings based on land use, land cover, hydrologic response units, and sub-watersheds.

**Salem Water System Capital Improvement Planning, Salem, NH**

Developed data and constructed model layers to map business risk exposure for a town-wide water system.

**GIS Database Development, Plymouth, NH**

Contributed to the development of a sewer and stormwater utility GIS using the ESRI local government model and georeferenced maps.

**Development Analysis, Exeter, NH**

Integrated zoning, land use, assessor's, and parcel-level water use data in order to create an estimate of potential future wastewater flows needed by Wright-Pierce engineers to design a wastewater treatment facility.

**Hydrological Modeling, Rye, NH**

Generated sub-watershed-level estimates of land cover proportions within present hydrologic soil categories for town-wide hydrological modeling as part of a stormwater analysis.

**Water System Mapping, Somersworth, NH**

Assisted in development of cartographic products and a spatial database to represent a municipal water system network.



**Drainage Study, Cranston, RI**

Prepared thematic maps showing proposed storm drainage improvements based on study results of several areas experiencing drainage deficiencies.

**Water Distribution Criticality Analysis, Champlain Water District, VT**

Generated risk factors, performed analyses, and developed results maps to show likelihood of failure, consequence of failure, and business risk exposure for pipe segments throughout a regional water system.

**Wastewater System Criticality Assessment, Burlington, VT**

Analyzed a combined sewer and stormwater system for development of 5-year CCTV inspection and rehabilitation plan.

**Census Data Mapping, Boston, MA\***

Constructed classification tree to create 0.5-meter spatial resolution land cover maps of census block groups in Boston, Massachusetts.

**OBIA, Plum Island Ecosystems, MA\***

Produced 0.5-meter spatial resolution land cover maps of several towns in northeastern Massachusetts for the Plum Island ecosystems (PIE) long-term ecological research (LTER) program using object-based image analysis (OBIA). Formulated and conducted individual honors research to visualize residential lawn area growth in a 26-town study region.

**GPS Products, Delorme Maps\***

Classified new roads and updated positional accuracy of roads in several United States counties for consumer mapping and GPS products. Performed accuracy assessment on roads database using TIGER maps.

\*Experience from previous employer









# Project Examples

## Groveland, MA – Complete Town-Wide Parcel Map Creation

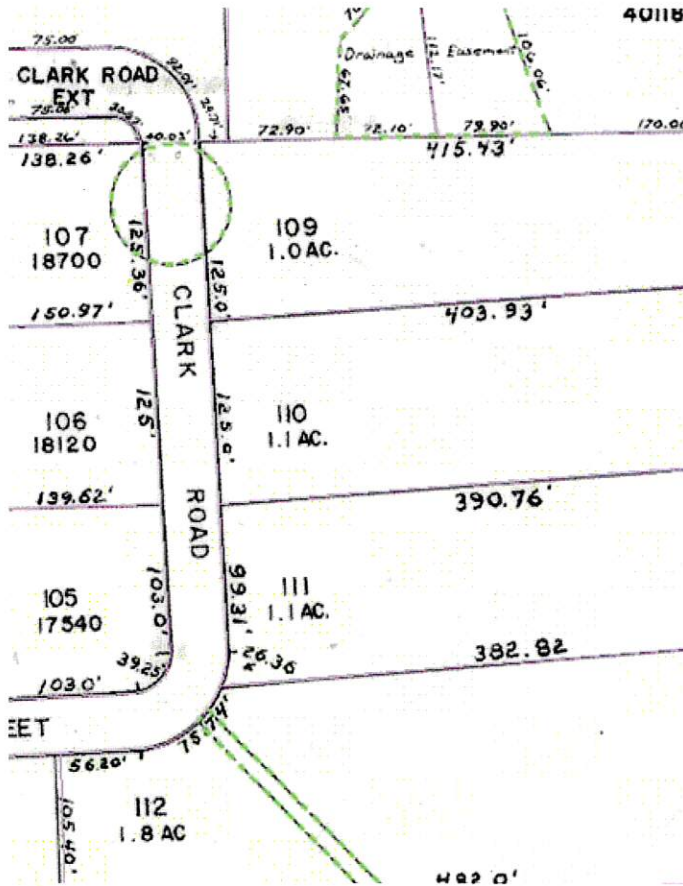
The town of Groveland had an existing GIS parcel database, but they were unhappy with the quality and wanted every parcel corrected. While it would have been possible to edit every individual parcel, in most cases it was easier to re-draw from scratch than it would be to edit existing vertices. Re-drawing also allowed for more accurate linework where individual parcels were cut from a larger subdivision. This method ensures that outer boundaries remain straight and parallel, where that would be much

harder to achieve when drawing each individual parcel separately.

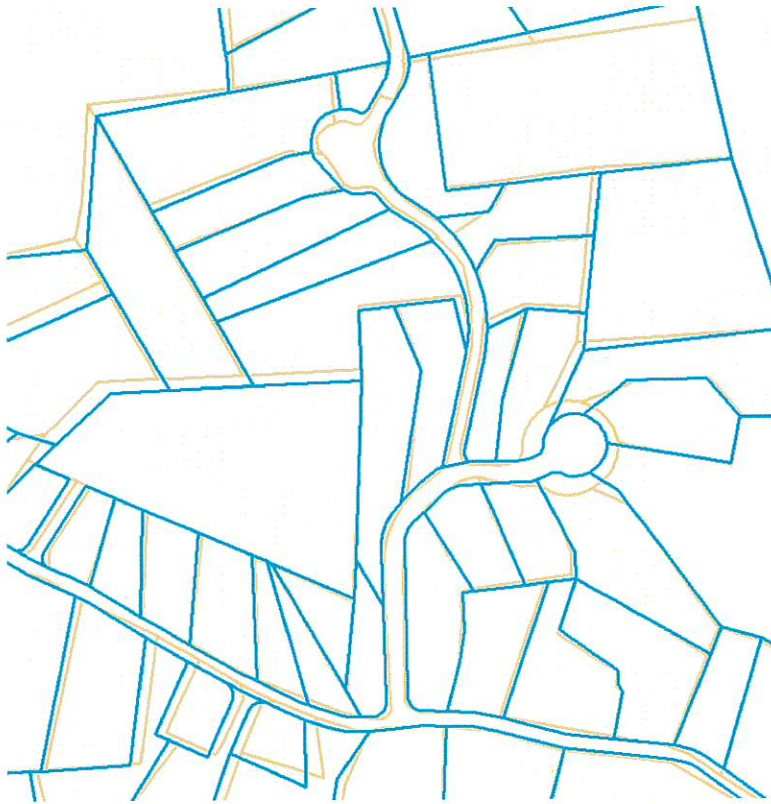
Parcels for the entire city were drawn from the source paper tax maps. Then adjustments were made based on aerial photography, deeds, and surveys, when available. The final map was then annotated with lot dimensions for each segment.

In accordance with Massachusetts’ Level 3 parcel standard, we also created a separate feature class representing easements, which properly followed contiguous parcel boundaries when appropriate.

### Examples:



Scans of paper tax maps were georeferenced based on aerial photography, then draft property lines (purple) and easements (green) were drawn based on those scans.



*Digital and paper surveys, as well as deeds, provided metes and bounds that were entered to draw improved property lines wherever those sources existed. The less accurate lines from hand-drawn maps (orange) were replaced by the surveyed lines (blue).*



*Where easements were present, those lines were drawn in accordance with the descriptions provided in deeds, either following metes and bounds, or as positions described relative to property lines.*

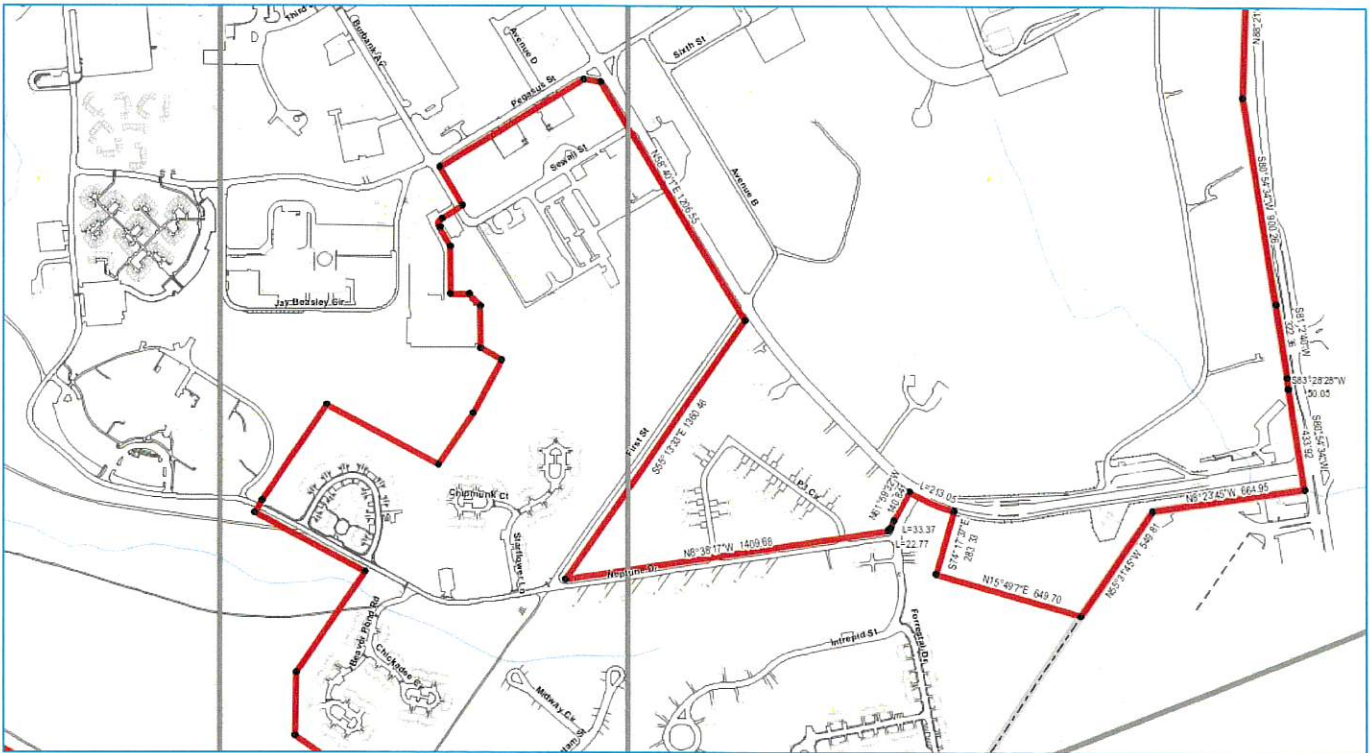


## Maine Rural Redevelopment Authority – Foreign Trade Zone

The Maine Rural Redevelopment Authority, formerly Brunswick Naval Air Station, is an independent organization that oversees the master plan for redevelopment of the former military base and encourages economic development in Maine’s Mid-Coast region. MRRA, a long-time client of Wright-Pierce, hired us to assist with the mapping of a new proposed Foreign Trade Zone on the property they oversee. This project involved drawing new property boundaries for the proposed FTZ by combining existing parcels, as well as creating new lot lines. While this was not a full municipal parcel effort, the tasks involved were the same, and the mapping effort established new property boundaries around an area encompassing over 1800 acres of land, so the drawing of the metes and bounds was no small task. The final product was a map of the property that included property boundaries overlaid with surveyed planimetric data, as well as delivery of digital data of the parcels. A small part of the boundary map is shown below.

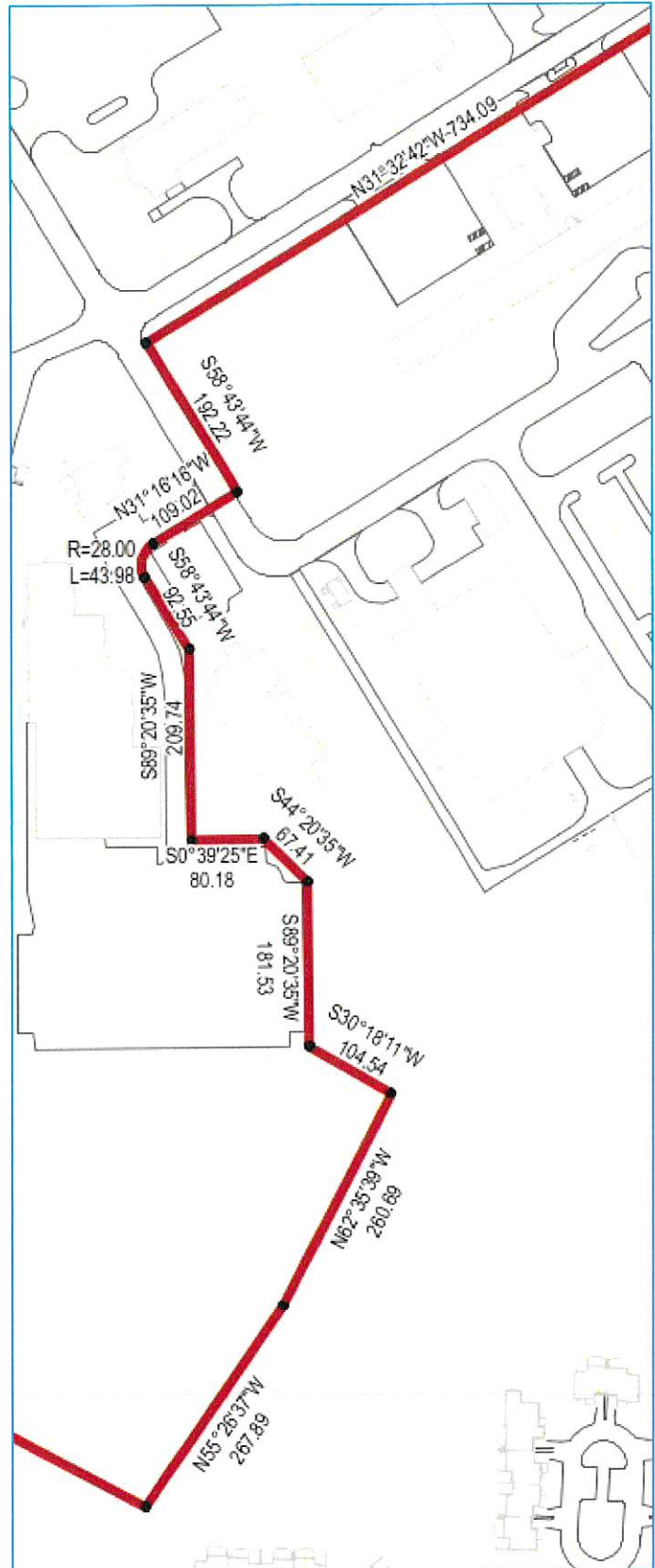
### Examples:

*This image shows one small piece of the final map of the proposed Foreign Trade Zone property. A detailed view can be seen on the next page.*





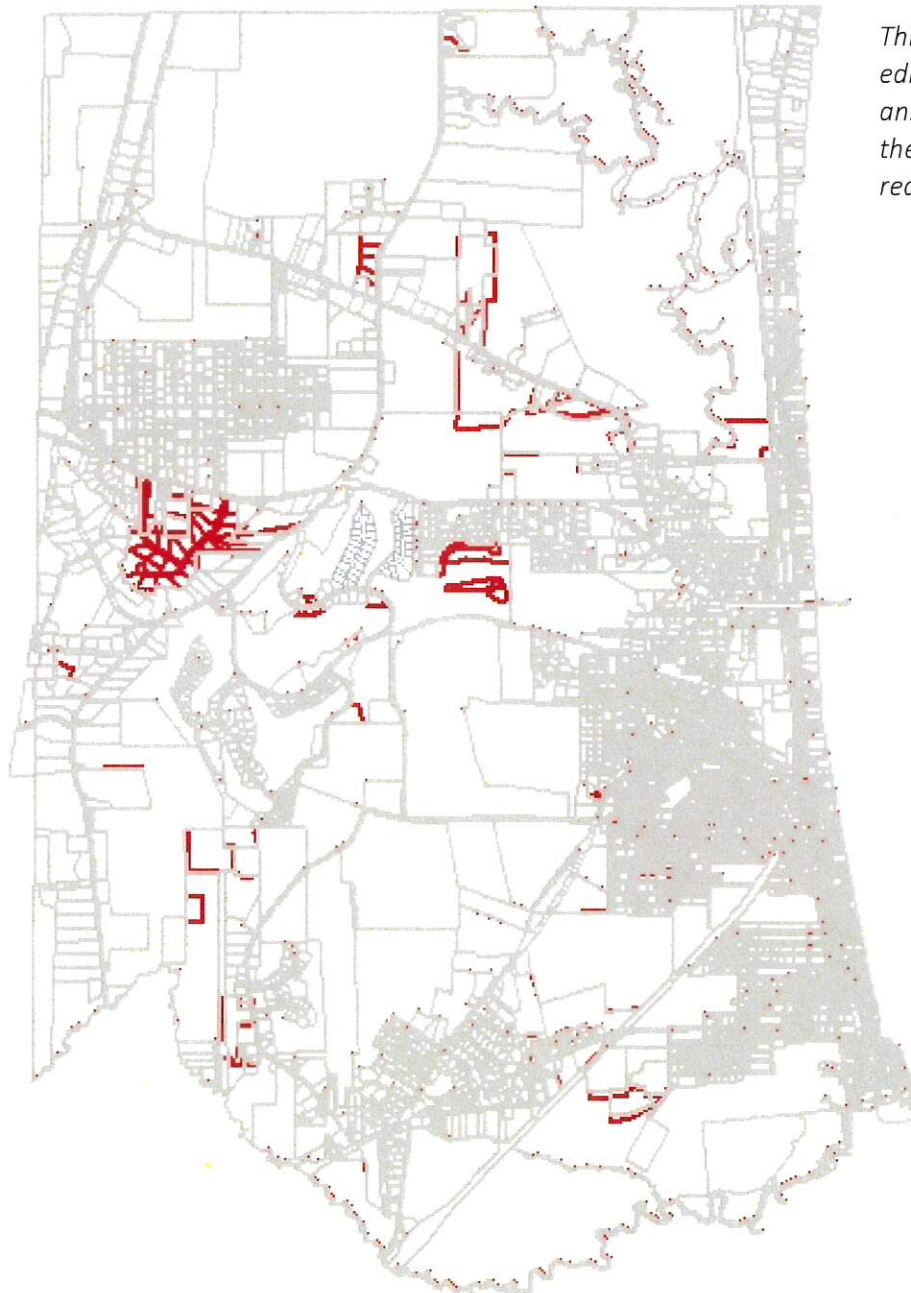
This inset of the property line shows the dimensional annotation that was used to draw the new property line, and which was also converted to annotation on the map. Straight segments are shown with distance and bearings, and curves are labeled with the arc radius and arc length.



## Old Orchard Beach, ME – Tax Map Updates

Over the course of several years, the annual tax map updates for the town of Old Orchard Beach were addressed in their GIS system. The Assessing department provided materials on all property boundary changes that had taken place since the previous revision, in the form of plans, surveys, or deeds. Those materials were used to edit the existing property boundaries, and abutting lots were adjusted to match the newer, more accurate boundaries.

### Examples:



*This map shows the extent of tax map edits that were processed in one annual update. Gray lines represent the unedited parcel boundaries, and red lines represented edited parcels.*

*This detail map shows the edits made to a major subdivision, which was created by joining several properties then dividing the lot according to a new survey.*

