



Methods for Mapping Stormwater Infrastructure

GIS Day 2018

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Who is AppGeo?

- Boston based, full service geospatial IT consulting firm
- 27 years of experience in helping local government deploy GIS infrastructure
- Experienced in Esri tech and more so that we can offer the best solution to our clients



I am in our regional office in Windsor, CT



Why map stormwater?

What do I need to know before I start?

Why - the States Municipal Separate Storm Sewer System (MS4) General Permit that requires a municipality that owns and operates a storm sewer system in an Urbanized Area comply with the MS4 permit to discharge stormwater into CT water bodies. The three main requirements:

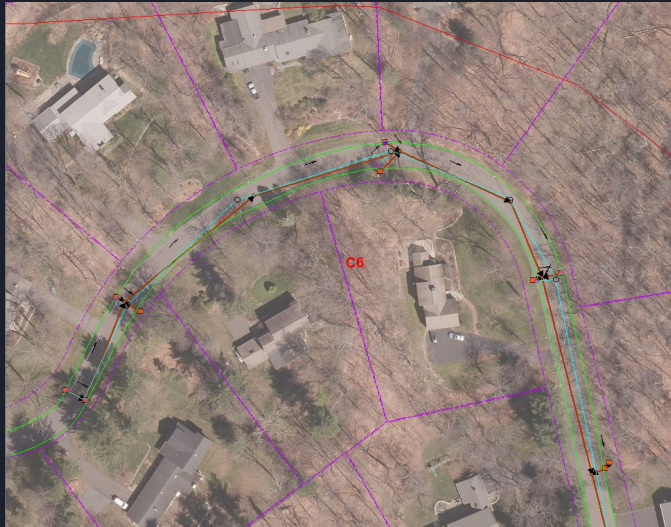
1. *Submit a **Stormwater Management Plan** identifying 6 minimum control measures that a municipality will undertake to prevent and/or treat polluted runoff;
2. Submit **Annual Reports** to DEEP indicating the progress with implementing that plan; and
3. **Monitor the quality** of water bodies.

Other than the MS4 permit compliance, having municipality utility data mapped out can be very beneficial when there is a problem reported, when digging/ construction takes place and dealing with **Call Before You Dig**.

What to do before you start: Plan out the project, what does municipality already have for data? How recent is the imagery available to you and at what quality? Plan out a schema before processing. Have a schema in place be sure to include metadata fields to know where the feature came from.

Not sure where to start - focus on outfalls then work on the upstream connections. Focus on areas with high density/impervious cover. Developments, downtown areas, etc.

Method One: Convert CAD to GIS



How has the CAD data been maintained? Current and up to date or has not been updates in years?

Has a standard been set within CAD? - if so it would help with the conversion to GIS. If not things convert kinda messy and unorganized. Takes more time to go through and manually check and make corrections. Sometimes it better to start from scratch and just use the CAD as a reference to help decide where your focus areas are.

Method Two: Capturing visible features from Imagery



Catch Basins are the primary feature that can be captured from the imagery. Manholes can be seen from some imagery, but the problem is that it is very difficult to differentiate between a sanitary sewer manhole and a drainage manhole.

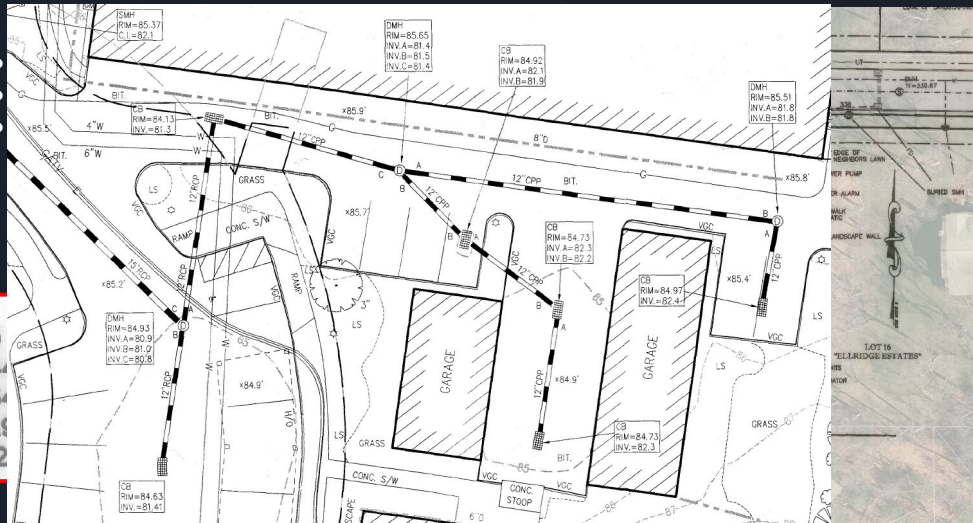
Method two: Additional Sewer Information



*Move the photos to see the text under image if not in presentation mode.

If sewer data is available it can be very helpful when trying to identify which manhole on the imagery is for stormwater. Also using Google Street view to see the different manholes cover labels is a second validation. Sometime they are labeled with the type of utility they belong to but that isn't always true. In my experience out in the field, they do not match and the cover usually says sewer. If you are in the field trying to determine the MH if sewer or storm, surveyors will mark them with colors. I typically see green for sewer and orange for stormwater.

Method Three: Processing from As-Builts



*Move the photos to see the text under image if not in presentation mode.

Steps to processing an as-built:

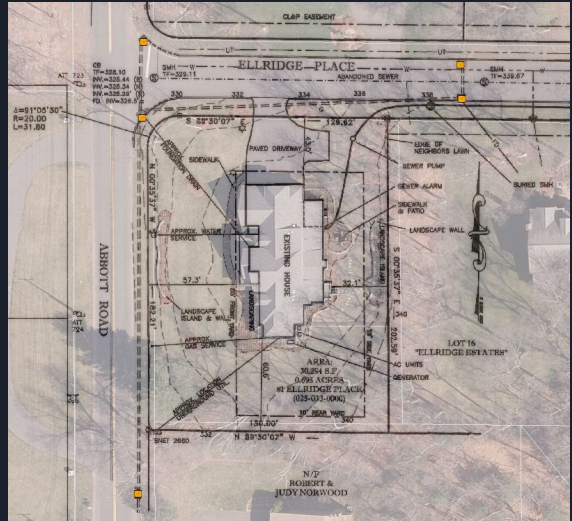
1. Georeference - Scale and place image into map to process
2. Digitize - capture features off plan
3. Attribute - any information for features should be captured and added into the data.

Most as built do not show just one type of utility, they will show drainage and sewer or drainage and water or a combination of all three depending on what systems exist in that area.

Not everyone has as built, some have proposed drainage, which then needs reviewed by the town to verify things were actually built.

Method Four: Combination of Imagery and As-Builts

- Capturing the visible features (catch basins) from the imagery then filling in the gaps with the as-builts
- Filling in attribution

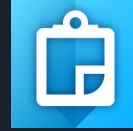


Georeferencing is not necessary - time consuming so if you can see the features on the imagery, just fill in the gaps (drain lines) then attribute features.

Something that we do at AppGeo in our attribution for utility data is have a field for the metadata as a location and as attribution. So the location metadata would be from 2016 ortho imagery but the attribution could be from this as-built. Indicating two sources were used for this area.

Method Five: Field Collection

- A. GPS features in the field
- B. Web application on a mobile device
 - a. ArcGIS Collector
- C. Using "field maps"



Slides after this go into more detail on each.

Method Five:

A. GPS features in the field - Trimble



AppGeo used a Trimble GeoXT unit to verify outfalls for two towns, West Hartford and Essex. The nice thing about the unit we used, we had set up our schema to include a photo field so when we were in the field we could use the camera on the unit itself when at an outfall to capture its current condition. The GPS would save it directly into the data, so when you transferred the data from the GPS back to the computer you would bring over the photos with the field filled in with the photo name.

As you can see one town we used a whiteboard and the other a blackboard. When photographing the outfalls, we liked to have some type of ID in the photo in case there was ever an issue with the photos and the transfer process. We found that when using the whiteboard, on sunny days would cause a glare and we would not be able to read the outfall number written, so the second town that we went out to verify, I changed it up and used a chalkboard to see if that would resolve my issue and it did.

Method Five:

B. Web application on a mobile device - Collector App

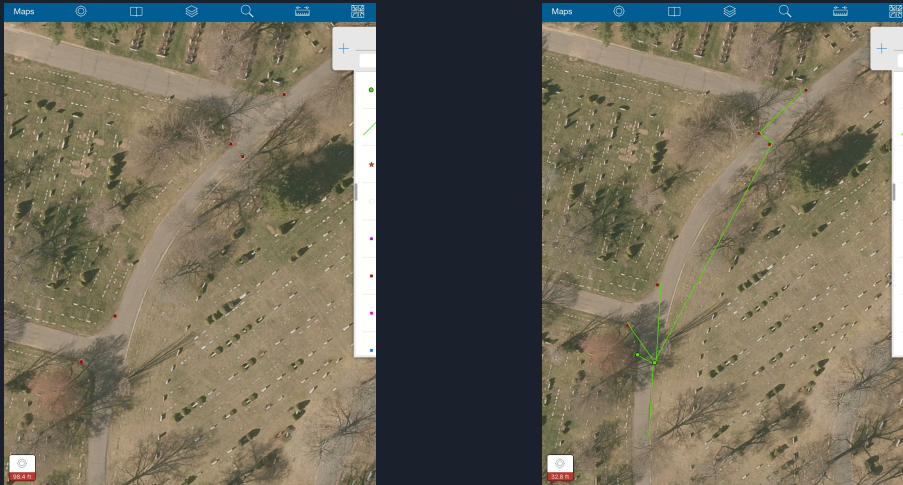


Image on the left shows what we were able to capture from Method one (just using imagery to capture visible catch basins). The town had no surveys for this area so field work was needed. While in the field found another cb that was in the shadow of the trees and a MH. To determine the connection between catch basins, look inside to see in what direction the pipe is going in.

The way that I used Collector, I created an empty point and line features to do all of my field edits on instead of making edits directly to the data. The down side to Collector, features do not snap which is why I used blank features to make my edits, that way when I come back into the office I just export those features and manually add them into the data. It works as a sanity check to the data to make sure everything looks right from how it was in the field. Occasionally it does create more questions than answers, but just make the changes and mark it that it needs more review for the next time I go in the field.

Method Five: C. Using “field maps”

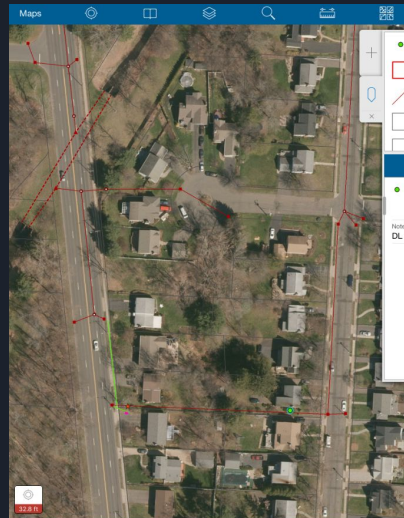
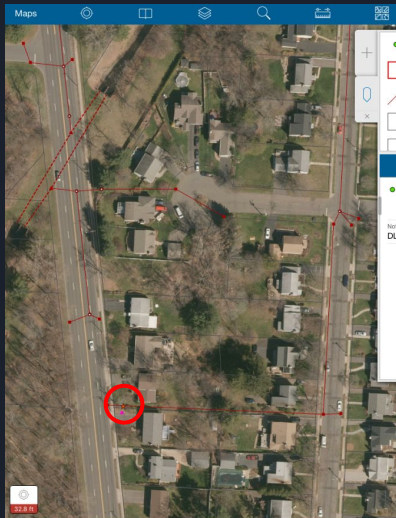


*There are three images so if you are not in presentation mode, you will need to move them to see each.

The Town of Ellington did all of the work themselves in the field and just passed what they found out in the field back to us using these field maps.

The first bottom image shows what we provided to the town. Using their map index grid, we went through and if we could see stormwater features on the ground we would create “verification areas”, those yellow polygons with labels, to indicate there is most likely a stormwater system. This gave them focus areas to start off their stormwater data development project. The town would mark up those field maps with points and lines - see second (middle) image. Then we would process that and add it into their GIS top image.

Method Six: All methods merged together



This is also the last step in building out the stormwater system and answering any questions, making final connections. In the red circle there is a star, that indicates a question point (Errata Point)

This is again shown in the Collector App as I was in the field verifying these final questions. Another downside to collector, it cannot symbolize lines based on their direction like in ArcMap, but this line that goes behind the houses is flowing to the west while the rest of the system on the east street flows north. I went in the field with the town to review this, the first thing we did was look inside the catch basin to see if a drain line was going west. There was no pipe going to the west from that catch basin, so in the picture to the right there is a green point where I have noted that. But there was still a question remaining on the west street for where that pink (private) catch basin connected and provide connection to the other catch basin in the road. The green lines indicate where the connection from the catch basin to the existing system.

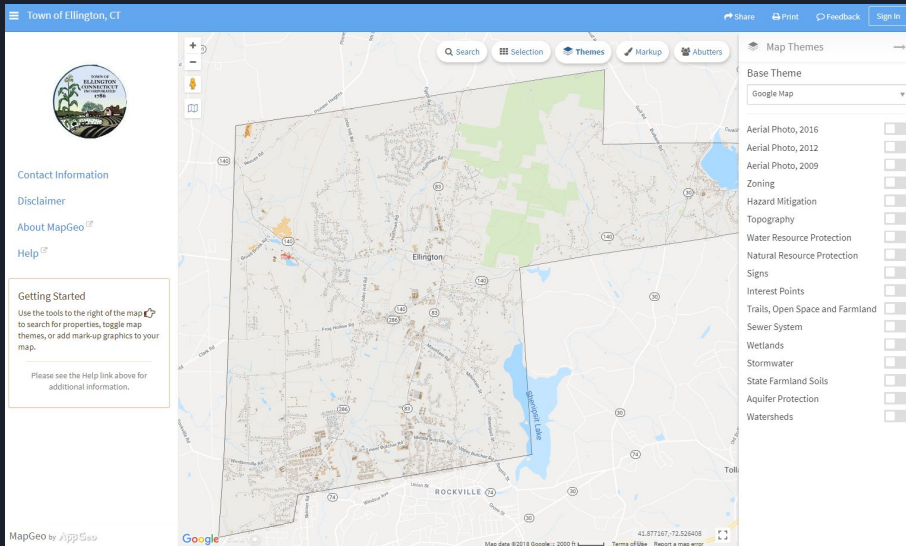
Data Maintenance

MapID	ErrataID	ErrataStatus	FeatureClassType	IssueType	IssueDesc
	E4	EP_E4_40	OPEN-PENDING-CB	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	E4	EP_E4_38	OPEN-PENDING-CB	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	E2	EP_E2_21	OPEN-PENDING-CB	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	H10	EP_H10_28	OPEN-PENDING-DMH	CONFIRM-FEATURE-TYPE	
	H10	EP_H10_33	OPEN-PENDING-DLINE	PROVIDE-CONNECTION	Should there be a manhole here?
	H10	EP_H10_30	OPEN-PENDING-DLINE	PROVIDE-CONNECTION	provide inlet
	H10	EP_H10_29	OPEN-PENDING-DLINE	PROVIDE-CONNECTION	
	E5	EP_E5_21	OPEN-PENDING-CB	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	E5	EP_E5_16	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	H11	EP_H11_11	OPEN-PENDING-DLINE	PROVIDE-CONNECTION	provide inflow
	G5	EP_G5_66	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	G5	EP_G5_72	OPEN-PENDING-CB	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	G5	EP_G5_68	OPEN-PENDING-CB	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	G5	EP_G5_63	OPEN-PENDING-CB	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	G5	EP_G5_60	OPEN-PENDING-CB	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	H12	EP_H12_34	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	H12	EP_H12_33	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	H12	EP_H12_32	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	H12	EP_H12_28	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	H12	EP_H12_27	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
					This location is likely an Interconnection between W/L Hartford, and / or MD. validate that interconnection exists provide more information.
	H10	EP_H10_31	OPEN-PENDING-IC	VALIDATE-POTENTIAL-INTERCONNECTION	
	D11	EP_D11_10	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	D11	EP_D11_12	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	D11	EP_D11_11	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	G9	EP_G9_31	OPEN-PENDING-CB	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	G9	EP_G9_41	OPEN-PENDING-CB	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	G9	EP_G9_15	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	G9	EP_G9_13	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	G9	EP_G9_10	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	G9	EP_G9_9	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	
	G9	EP_G9_8	OPEN-PENDING-DMH	CONFIRM-FEATURE-EXISTENCE-NOT-VISIBLE-ON-ORTHO	



Google Drive was used to communicate back and forth with the town on question areas in town. This spreadsheet was provided the town with the Map ID and an errata ID to identify the location of issues. The errata status, type of issue/question, which feature class the question is associated with and any notes that we have for the town to clarify the issue more. Town was provided review maps as PDFs but also had a theme on their MapGeo site - I will talk about next. But using Google drive the town was able to review the questions, go look for surveys or as built to answer our questions. Or was marked that more info needs to be found and possibly field work would need to be done.

MapGeo



On Ellington's MapGeo site showing their stormwater system. They can toggle the layer on and off to see the features on the ground or see which property an outfall is located on. Take some time to play around changing the base maps and walking around to see their system built out.



Work level comparison

West Hartford

22.3 sq miles

Density per square mile = 2,800/sq
mi

Municipal Outfalls = 433

Municipal Catch Basins = 6,707

Miles of Drain Lines = ~174

days in field ~30

Who was in field - Two AppGeo or

One AppGeo and Town Staff

Field collection method: Trimble

(Outfalls) and Collector App

Ellington

34.6 sq miles

Density per square mile = 379/sq
mi

Municipal Outfalls = 366

Municipal Catch Basins = 2,752

Miles of Drain Lines = ~62

Who was in field - Town Staff only

Field collection method: Field Maps

General work comparison.

Both projects at this point are about 95% complete and just maintenance will need to be done to keep it updated at time goes on.

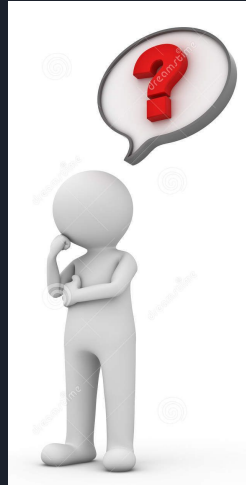
Closing notes & lessons learned



1. Just about all methods can be done in the office - this saves on the amount of time spent in the field as time adds up and costs a lot of money.
2. Be aware of when field work is done. Fall/winter and spring are the best time to go out when leaves are off the trees. Fall you need to worry about ticks. Wear boots that are waterproof.
3. Always make sure to have a safety vest when working in the field.
4. Have a name tag and business cards - to give to homeowners that you need to walk on their property to get to an outfall or verify a feature as some care more than others.
5. Make sure any device you are bringing into the field is fully charged. For example: When using collector app on the Ipad, having the imagery on for a basemap can suck up a lot of battery. Close the app when not being used. Have a backup - paper maps
6. Stay organized - create a plan of attack for field day. When it was just AppGeo staff in the field with no town staff, we did not know the area so I compiled a list of addresses that I could quickly put in a GPS that was closest to the feature that needed verification.
7. Always bring plenty of water and snacks for the day.



Questions?





Thank you!!

Happy Mapping