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Sewer System Asset Data Collection with ESRI Mobile Apps

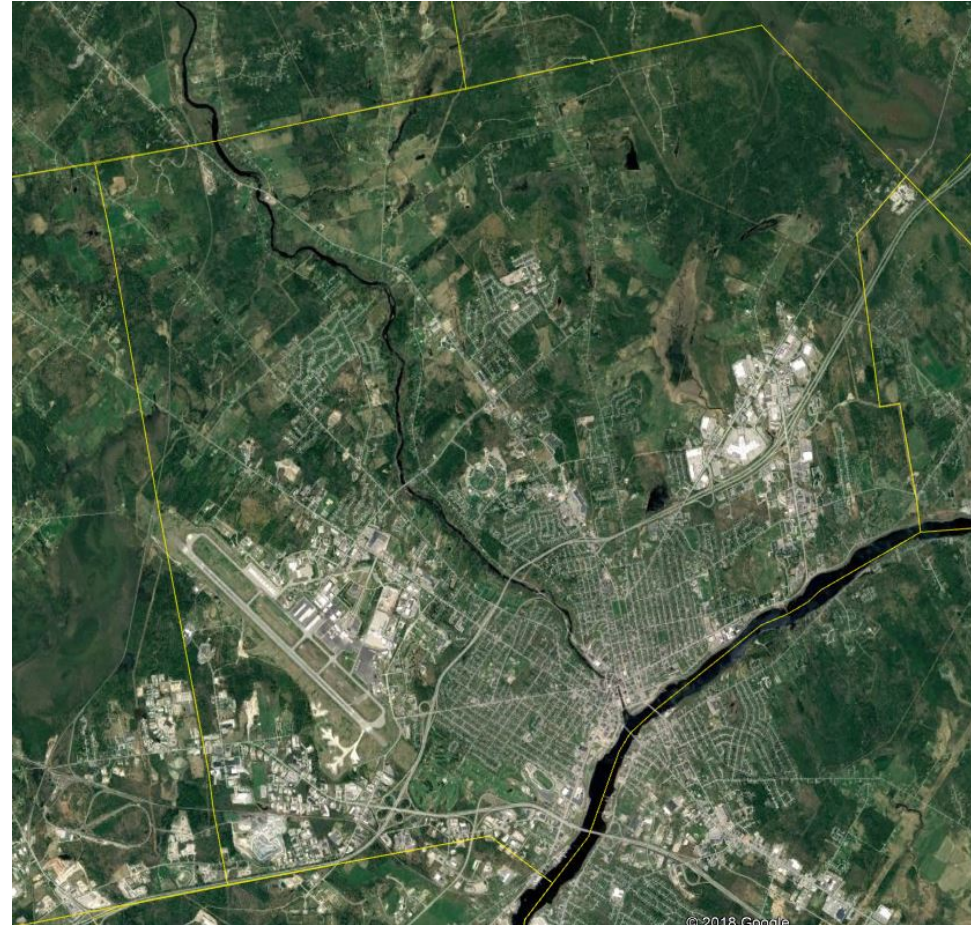
Peralie Burbank – Engineer
Patrick Cowan – GIS Administrator





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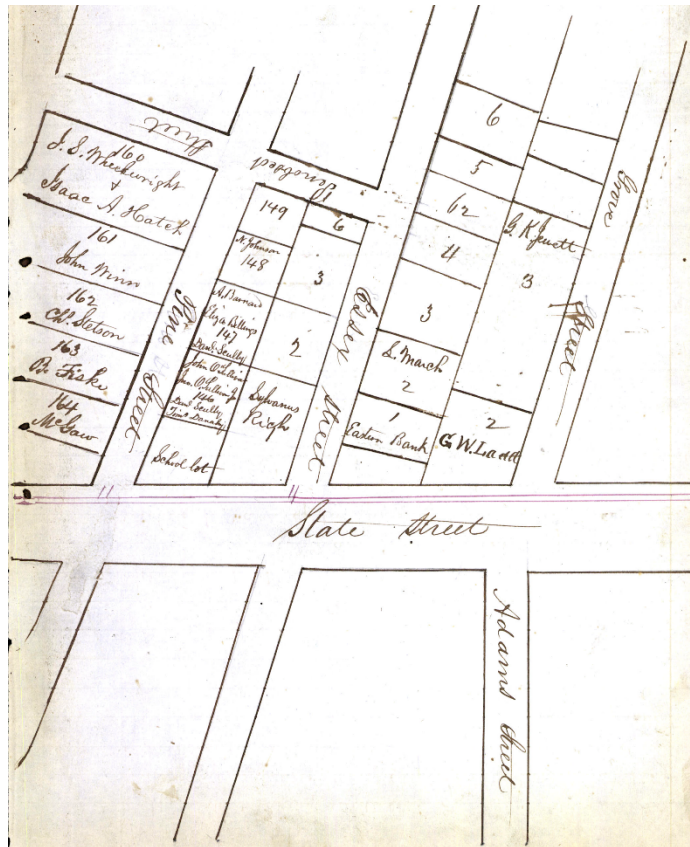
The City



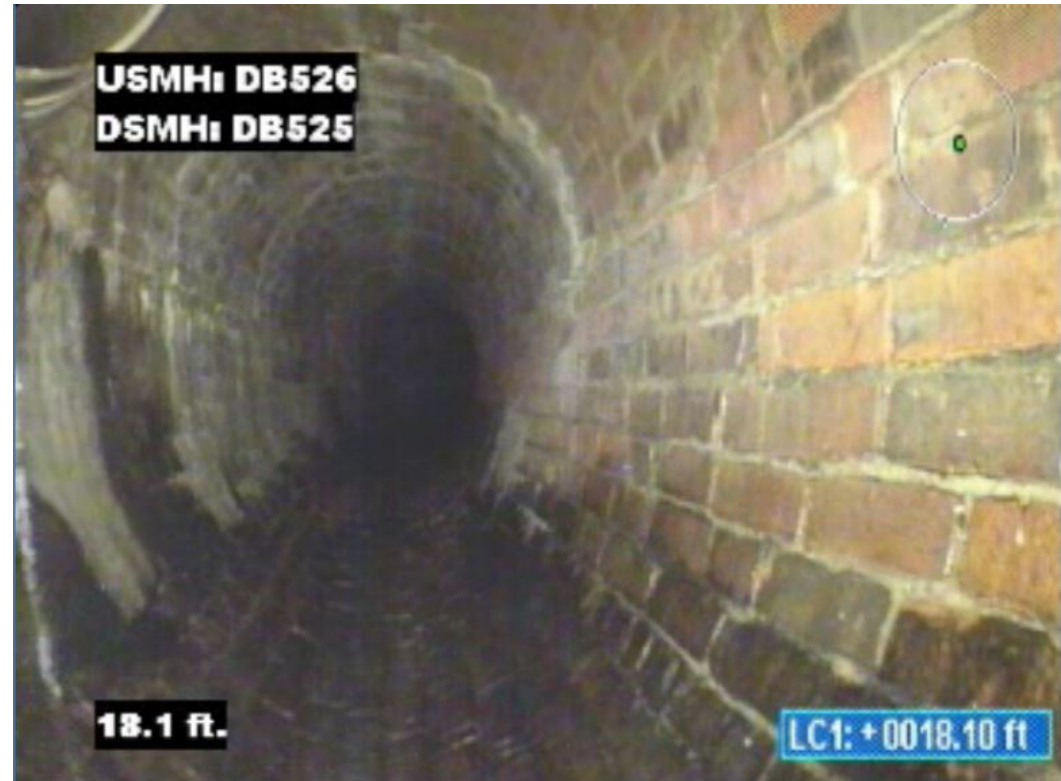


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Historical Sewers



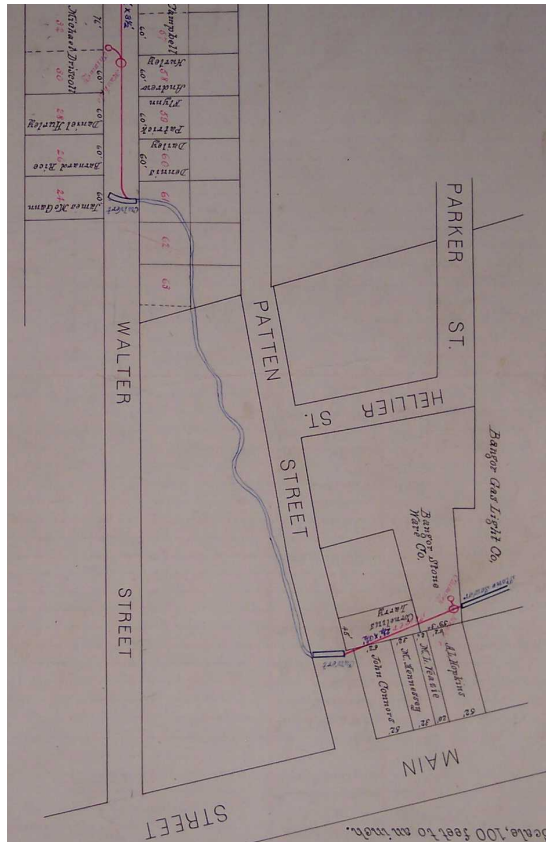
1850



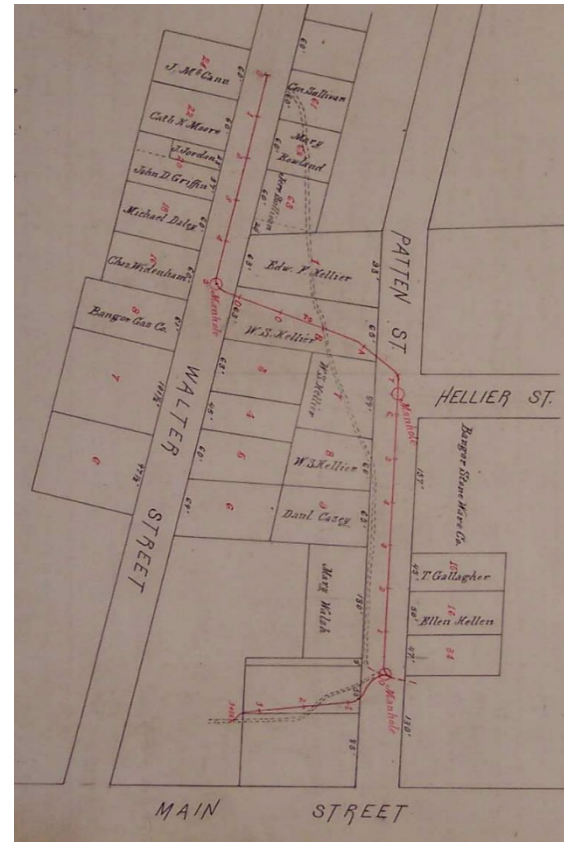


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Historical Sewers



1883



1886



today

Sewer Statistics



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146 miles of pipe

3,300 manholes

30% combined (by length)

31 subsections

8 CSO outfalls

3 CSO storage facilities

Age (yrs)	Miles	%
0 – 25	29	20
26 – 50	51	34
50 – 75	31	21
75 – 100	7	5
> 100	21	15
unknown	7	5
TOTAL	146	



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Sewer Statistics

53 miles of PVC (36%)

34 miles of VCP (23%)

9 miles of brick pipe

350 feet of stone sewer





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Progress

WWTP built in 1968 with 9 miles of interceptors

1987

22 CSO locations

58% combined system

2017

9 CSO locations

32% combined system

Consent Decrees in 1987 and 1991 for plant upgrades and CSO abatement

Consent Decree in 2015 for CSO abatement



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2015 Consent Decree

Annual Requirements for Collection System:

CCTV 10% of system

Flush 10% of system

Inspect 10% of the manholes





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Stone Age To The Digital Age

Paper maps and plans dating back to 1850

2010/2011 - GIS built from plans

- 3 years to build out
- Many assumptions were made

Stormwater and Sewer as layers in GIS





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Collection Process History

Paper inspection forms until 2016

- Hard to analyze
- Prone to errors
- Inefficient

GoFormz 2016

- First digital process
- Still was not easy to integrate into GIS

ESRI mobile apps 2017 to present

- Results can be directly linked to GIS and analyzed
- Effective and efficient

Manhole Inspection

Level 1 Inspection

- ▶ General
- ▶ Cover
- ▼ Adjustment Ring (Riser)
 - Adjustment Ring Type *
 - Adjustable
 - Solid
 - None
- ▼ Frame
 - Frame Condition *
 - Sound
 - Cracked
 - Broken
 - Missing
 - Corroded / Pitted / Worn
 - Frame Seal I&I *
 - None
 - Infiltration Dripper
 - Infiltration Gusher
 - Infiltration Runner
 - Infiltration Stained
 - Infiltration Weeper
- ▶ Chimney



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Considerations

Easy to use

Improve safety

Low cost

Integrated with GIS

Improves data collection

Easily analyzable





ESRI Apps

ESRI Explorer

- Maps without editing capabilities (view only)
- Connected to ArcGIS Server

ESRI Collector

- Maps with editing capabilities
- Connected to ArcGIS Server

ESRI Survey123

- Used to capture data in a form
- Connected to the cloud and/or a portal

The screenshot shows a mobile application interface for 'Cross Country Inspections'. The form includes the following fields and options:

- Manhole ID ***: WL018
- Inspection Date**: Friday, January 4, 2019 (with a time dropdown set to 3:08 PM)
- Inspection Team ***: A list of team members with checkboxes. Patrick Cowan is selected (checked).
- Are There Signs of Discharge Around Manhole? ***: Radio button options: No (selected), Yes, Unable to Verify. A note below states: 'All manholes must be inspected for signs of discharge (paper, debris, indication of water flow, visible voids, etc)'
- Are There Visible Issues with Connecting Lines? ***: A note below states: 'All connecting lines must be walked and inspected for visible issues (depressions, sink holes, etc)'

The interface also shows a map on the left side and a green checkmark at the bottom right, indicating a successful submission.



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Sewer Apps Developed

Manhole Inspections

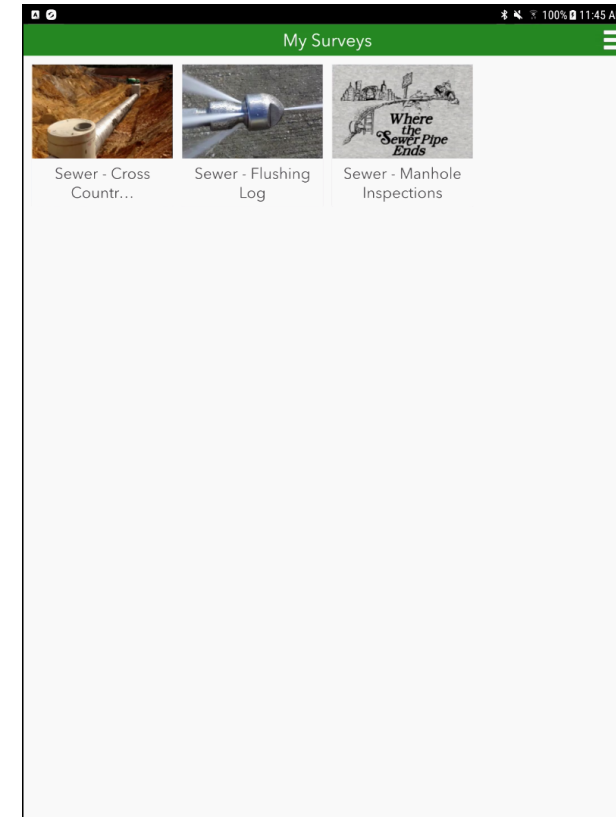
- Very important
- Hybrid of NASSCO manhole inspection

Cross Country Inspections

- Done 3 times a year
- On-the-fly status for field crews
- Identify issues

Flushing Logs

- Track flushing in a digital format





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Using Technology

Tablets

- Samsung Galaxy Tab S2 tablets with Hotspots
- Samsung Galaxy Tab Active2 tablets with modems

GoPro Cameras

- GoPro Hero 6 cameras
- Handlebar mount and painter's pole

Software

- ESRI mobile apps on tablets
- Enterprise geodatabase hosted via ArcGIS Server





Manhole Inspection - Levels

- Level 1
 - Newer than 40 years old and/or a pre-cast structure
- Level 2
 - Older than 40 years old and/or not a pre-cast structure

i

Level 1 – General Info

- General
- Cover
- Frame
- Chimney
- Cone
- Wall
- Channel
- Bench
- Notes
- Topside Photos

i

Level 2 - Measurements

- Rim to Invert
- Rim to Grade
- Grade to Invert
- Chimney Depth
- Cone Depth
- Wall Depth

i

Level 2 - Materials

- Chimney
- Cone
- Wall
- Bench
- Channel
- Step

i

Level 2 - Pipes

- Direction
- Material
- Invert Measurements
- Shape
- Height
- GoPro Photos of Pipes



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Manhole Inspections - GoPro Camera Pipe Photos

Inexpensive

Waterproof

Light attachment

Picture is worth a thousand words

Remotely controlled via the tablets

Grade rods for pipe measurements

Historic documentation

Safer! Limits confined space entries





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Manhole Inspections – Workflow

Done with every CCTV inspection

GoPro Images

- Images taken of connecting pipes
- Upload to tablet

Collector

- Used to select manhole for inspection and launch Survey123

Survey123

- Used to collect the inspection information
- Downloaded GoPro photos are directly attached to the inspection

Cloud

- All data is saved in “the cloud”





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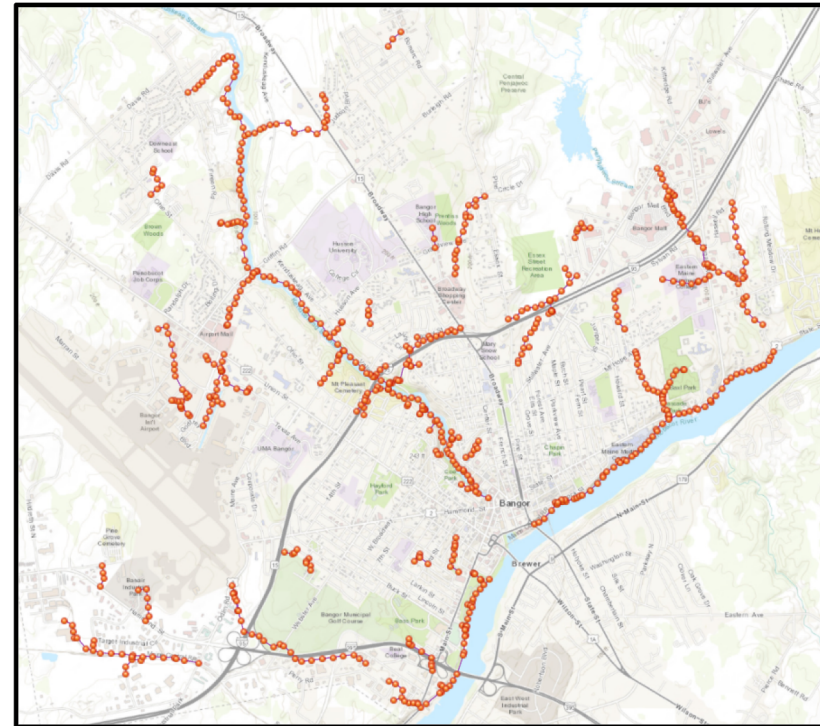
Cross Country Inspections

Done 3x a year (spring, summer, fall)

Need to check approximately 621 manholes and 673 pipe segments (10.9 miles) for signs of overflows or issues

Previously had limited documentation on inspections

Summer of 2018 – moved to digital format





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Cross Country Inspections - Workflow

Collector map used for identification and to launch a survey in Survey123

Survey123 used to capture information about inspection

- Survey Team
- Problems noted (if present)
- Photos

Flagging refresh and easement maintenance needed tracking

- Allows to build backlog of off season work to be done

The screenshot shows the Survey123 mobile application interface for 'Cross Country Inspections'. The top bar is green with the title 'Cross Country Inspections' and a hamburger menu icon. Below the title, there is a dropdown menu for 'Inspection Date' set to 'Monday, January 7, 2019' and a time dropdown set to '11:05 AM'. The 'Inspection Team' section is titled 'Inspection Team *' and includes the instruction 'Select all members of the inspection team'. It lists several team members with checkboxes: Ryan Barnard, Eric Curry, Jeremy Linscott, Tobi Smith, Travis Roberts, Matt Levesque, Kevin Merrill, Logan Tompkins, Jamie Brooker, Patrick Cowan (checked), Chip Swan, Jim Grant, and Tracy Laurie. Below this, there are two questions with radio button options: 'Are There Signs of Discharge Around Manhole? *' (options: No, Yes, Unable to Verify) and 'Are There Visible Issues with Connecting Lines? *' (options: No, Yes, Unable to Verify). The bottom of the screen has a green bar with a white checkmark icon.



Building Forms in Survey123

Can be built two ways

- Online form builder
- Excel spreadsheets
 - Provides more functionality and flexibility

Either format is very simple to use and build

Changes can be rolled out in a matter of minutes

Build logic into questions

	A	B	C	L	M	N	
1	type	name	label	relevant	calculation	choice_filter	repe
2	begin_group	level1	Level 1 Inspection				
3	begin_group	generalgroup	General				
4	hidden	inspectionlevelimport	Inspection Level Import				
5	select_one_inspectlevel	inspectionlevel	Inspection Level Needed		if(selected(\${inspectionlevelimport}, 'Level 2 Required') or selected(\${inspe		
6	select_one_users	surveyedby	Surveyed By				
7	text	certificatenum	Certificate Number		pulldata('nassc		pe, \${surveyedby})
8	dateTime	datetime	Inspection Date and Time				
9	geopoint	location	Location				
10	text	streetnamen	Approximate Street name and		pulldata("@ge		rcode.address.Street", "http
11	text	city	City				
12	text	manholenum	Manhole Number				
13	select_one_purpose	purpose	Purpose				
14	select_one_preclean	precleaning	Pre Cleaning				
15	select_one_weather	weather	Weather				
16	select_one_runoff	potentialforrunoff	Potential for Runoff				
17	select_one_inspection	inspectionstatus	Inspection Status				
18	select_one_yes_no	evidencesurcharge	Evidence of Surcharge				
19	select_one_manholema	manholematerial	Manhole Material				
20	select_multiple_yesonly	conditionok	Condition and I&I OK				
21	end_group						
22	begin_group	covergroup	Cover				
23	select_one_covershape	covershape	Cover Shape				
24	integer	coversize	Cover Size Height (in)				
25	integer	coversizewidth	Cover Size Width (in)				
26	select_multiple_coverty	covertype	Cover Type				
27	select_one_coverholes;	holediameter	Vent Hole Diameter		selected(\${covertype}, vented)		
28	integer	holenum	Number of Vent Holes		selected(\${covertype}, vented)		



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Survey123 Web Interface

Data can be accessed through a web interface

- User friendly design
- Custom reports
- Quickly viewable results

Survey data stored in hosted feature dataset

- Can be loaded into the GIS
- Easy to analyze
- Design QC and update routines

Inspection Level Needed	Surveyed By	Certificate Number	Inspection Date and Time	Street Name and Number	City	Manhole Number	Purpose	Pre-Cleaning	Weather
Level 1	Eric Curry	U-1016-07005749	Jan 17, 2019, 7:40 AM	1498 Hammond St	Bangor	HP802	Routine Assessment	No Pre-Cleaning	Dry
Level 1	Ryan Barnard	U-214-06020386	Jan 17, 2019, 8:06 AM	23 Cottage St	Bangor	FS601	Routine Assessment	No Pre-Cleaning	Dry
Level 1	KevinHerrill	U-1018-0703003320	Jan 16, 2019, 12:24 PM	waterfront	Bangor	P0103	Routine Assessment	No Pre-Cleaning	Dry
Level 2	Ryan Barnard	U-214-06020386	Jan 16, 2019, 7:05 AM	8 Bolling Dr	Bangor	AP311	Routine Assessment	No Pre-Cleaning	Dry
Level 1	Eric Curry	U-1016-07005749	Jan 15, 2019, 10:38 AM	75 Central St	Bangor	CS001	Routine Assessment	No Pre-Cleaning	Dry
Level 1	Eric Curry	U-1016-07005749	Jan 15, 2019, 7:43 AM	95 Central St	Bangor	CS003	Routine Assessment	No Pre-Cleaning	Dry
Level 1	KevinHerrill	U-1018-0703003320	Jan 14, 2019, 1:45 PM	1 Bennett St	Bangor	HP223	Routine Assessment	No Pre-Cleaning	Dry



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The Future

Migrate results from ArcGIS Online to self hosted ArcGIS Portal

Automate more QC steps

Transition more processes away from paper and towards digital

Updating GIS with results from surveys





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Any Questions?

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