



Automating beforeUdig requests using ArcGIS Pro, Python, and FME

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Agenda

1. What is beforeUdig?
2. Previous beforeUdig workflow
3. Automation in 1, 2, 3, 4!
4. New automated beforeUdig workflow



beforeUdig
Saving lives, cables and pipes

Home Excavators Utilities & Members Home owner Safety Supporting Services News & Events Contact

BEFOREUDIG
Saving lives, cables and pipes

SUBMIT AN ENQUIRY NEW USERS EMERGENCY CONTACTS

11
Years preventing damage

172,000
enquiries lodged in 2018

672,000
notifications to asset owners

162
utility and assets owners nationally

beforeUdig is an online service which enables anyone undertaking excavation works to obtain information on the location of cables, pipes and other utility assets in and around any proposed dig site, helping to protect themselves and valuable assets during these works. In most cases it provides a 'one stop shop' for contractors to communicate about their planned activities with member utilities and authorities.

What is beforeUdig?

- An online service for locating underground utility assets
- Typically used for construction or design
- Councils, utilities, or other organisations are notified



beforeUdig™ .co.nz

Welcome to beforeUdig, New Zealand
Protecting Lives, Cables and Pipes

rory.mcperson@wellingtonwater.co.nz , Rory McPherson : Wellington Water

Enquiry Details | Location | Summary

Save | New | Settings | Account | Home

Step 1: Search for dig site location

Search Type: Street

Street: 25 Victoria Street Petone Lower Hutt Wellington 5012

Search | Reset

Step 2: Draw your dig site

The cross-hair indicates the centre of your search. You will need to mark out your dig site using the drawing tools provided.
Circle diam (min 25m - max 5.05km), Line (max 1km), Area (max 20km²)

Step 3: Confirm your dig site

Notes/Description of Works

Confirm your entered details are correct

By submitting, you agree that this enquiry, including the address, the location of the drawn dig site, and all other enquiry details are accurate and correct.

Submit

100 @ 2019 GeoSmart Measure: X: 174.86316, Y: -41.22135

Help

Privacy Policy | Powered By PelicanCorp OneCall | Copyright © 2001-2018 All Rights Reserved | Product By PelicanCorp | Website [(PCP v4.7.6+10)] | Map | Feedback and error reporting | e-mail

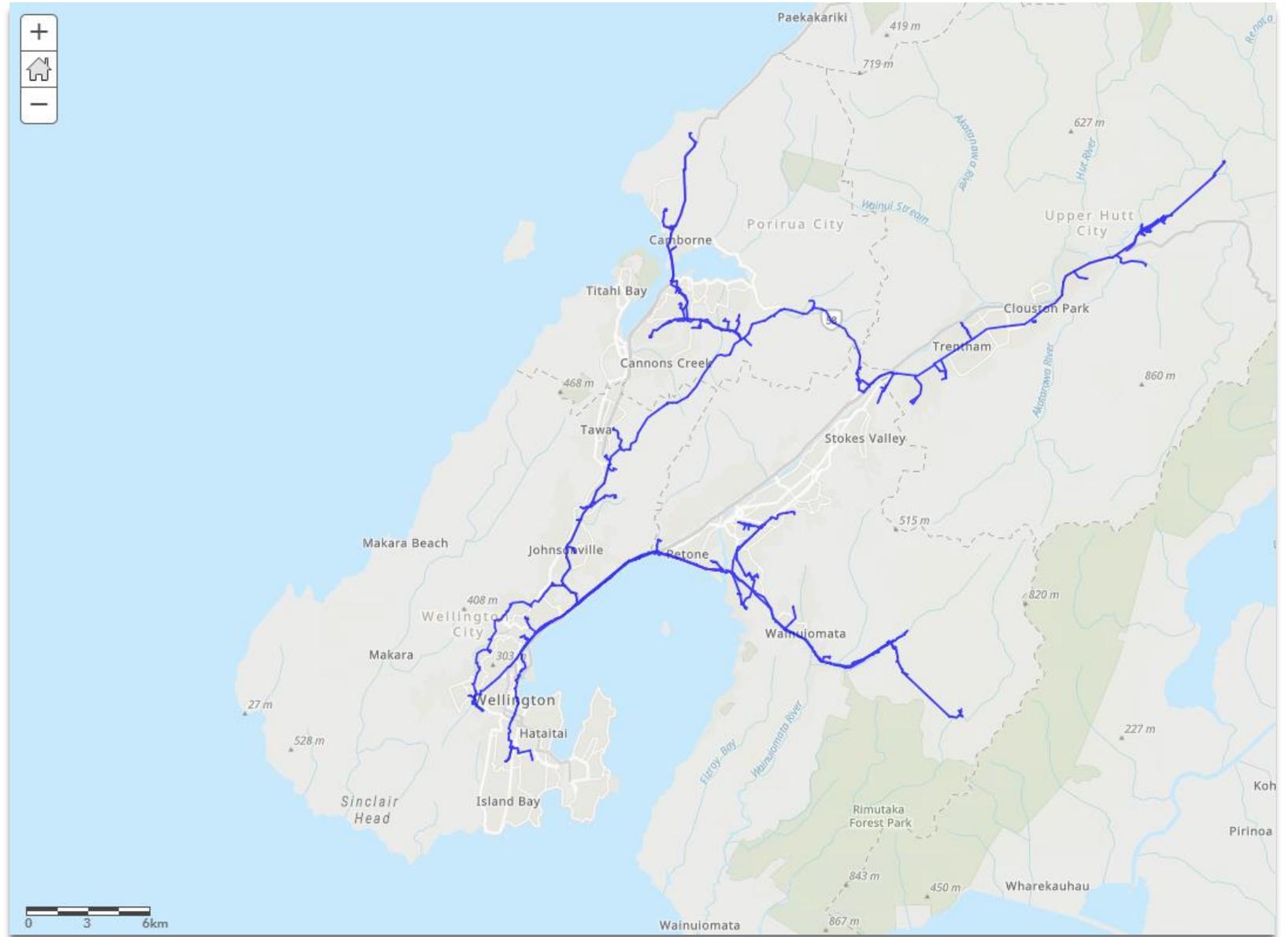
How beforeUdig works...

- Asset owners provide a dataset or WFS of their underground assets
- Users sign in to beforeUdig and...
 1. Create a job
 2. Enter job details
 3. Draw working area on map
 4. Submit
- Assets owners notified



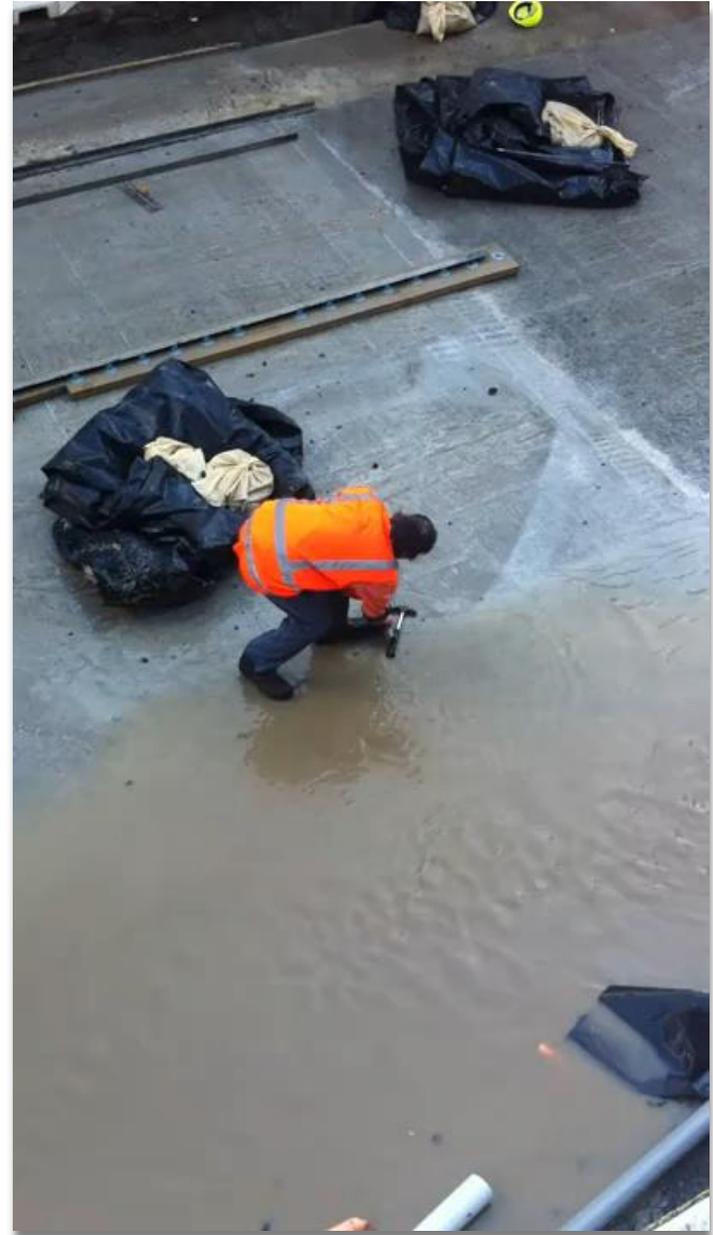
Bulk water network

- Approx. 185 km of pipes
- Services +400,000 residents across Upper Hutt, Lower Hutt, Porirua, and Wellington



Why bother?

- One-stop shop
- Protect people working on site
- Protect underground assets



Previous beforeUdig workflow

According to the documentation...

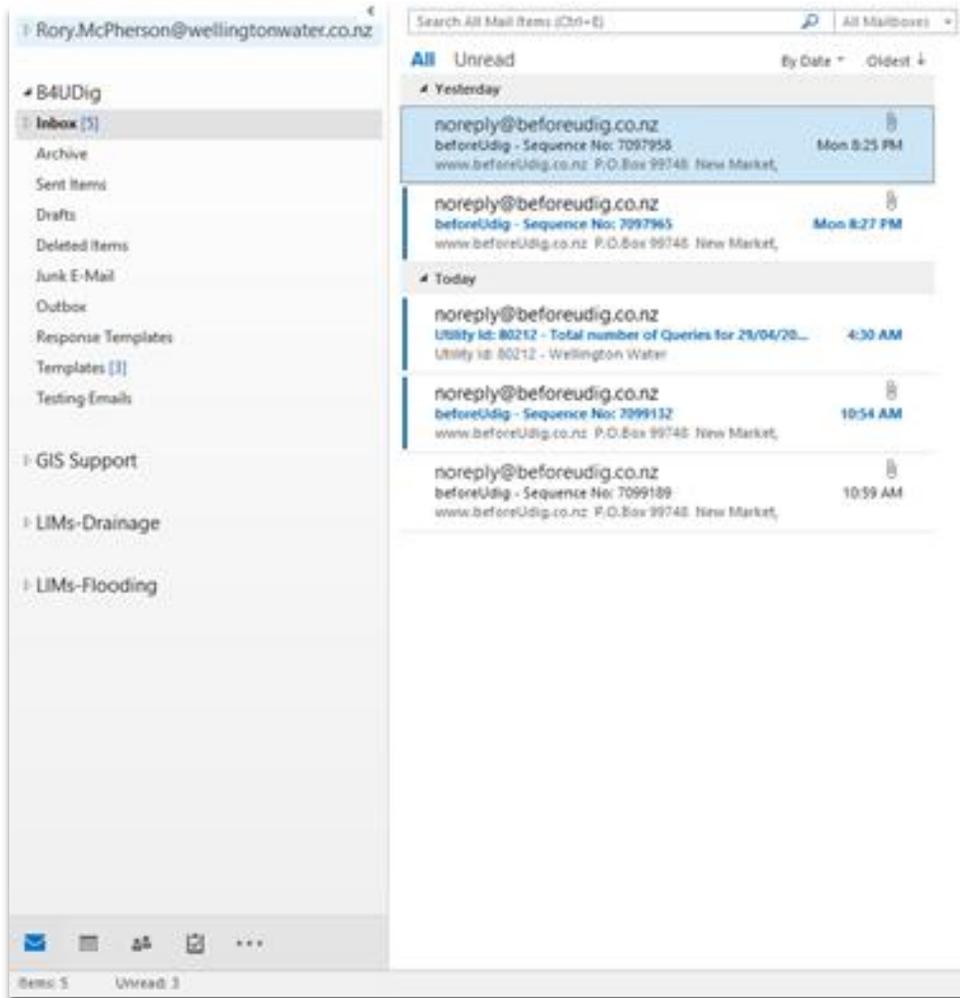


Sequence Notice Response
Process Documentation

Previous beforeUdig workflow

According to the documentation...

1. Monitor incoming emails





beforeUdig™

Sequence No 7258698

Ph: 0800248344
www.beforeudig.co.nz

Utility Details

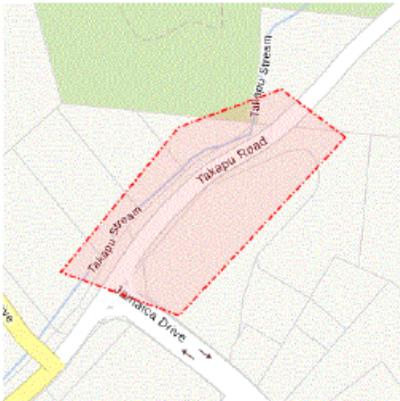
Please be advised the person below has requested information about underground assets in your jurisdiction. You are required to respond within 2 working days and reference the Job Number, Sequence Number and the User Reference (where supplied).

To: Information Development Team	Enquiry Date:
Utility ID: 80212	Priority Type: Normal
Utility Name: Wellington Water	Enquiry Medium: Web
Email: b4udig@wellingtonwater.co.nz	

Customer Details

Customer ID:	Contact:
Company:	Phone:
Address:	Mobile:
Email:	Fax:

Proposed Site Location



WARNING: The adjacent map displays the extent of the proposed dig site as specified and confirmed by the beforeUdig customer.

User Reference:

Not Supplied

Working on Behalf of:

Private

Start Date: 10/07/2019	End Date: 10/07/2019
----------------------------------	--------------------------------

Address:

50 Takapu Road
Grenada North Wellington 5028

For Planning:

Yes

Asset Locate:

No

Workplace Location:

Both

Nature of Works:

Plans Requested:

Yes

Preferred Locate Date:

Not Supplied

Location in Road:

CarriageWay, Footpath, Berm

Major Earthworks Cutting/Fill

Additional Work Site Notes:

Plans only please

Previous beforeUdig workflow

According to the documentation...

1. Monitor incoming emails
2. Review beforeUdig PDF

noreply@beforeudig.co.nz | B4Udig
beforeUdig - Sequence No: 7099189

7099189.PDF 91 KB
7099189_80212_30_04_2019.GML 1 KB

COMPLETION DATE= 31/05/2019
WORKING FOR AUTHORITY= Wellington City Council

[CALLER DETAILS]
CUSTOMER ID=
CONTACT NAME=
COMPANY=
ADDRESS=
SUBURB=
TOWN/CITY=
POSTCODE=
TELEPHONE=
MOBILE=
FAX NUMBER=
EMAIL ADDRESS=

[LOCATION DETAILS]
ADDRESS=
SUBURB=
TOWN/CITY= Wellington
REGION= Wellington
POSTCODE= 6011
ACTIVITY CODE= 105
ACTIVITY DESCRIPTION= Minor Earthworks/Filling
GPS X COORD= 174.771719
GPS Y COORD= -41.276699
PRIVATE/ROAD/BOTH= Road Reserve
JOB NUMBER= 1419880
MESSAGE= Digout between Tinakori st and Parliament
NZMESSAGE=

Previous beforeUdig workflow

According to the documentation...

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...

[Back to main site](#) ↑

Online Conversions - basic

Convert between pre-selected [geodetic datums](#) and [projections](#) using default input and output parameters.

Use the [vertical datum conversion](#) to convert between New Zealand vertical datums - see [instructions](#) for more information.

Use the [detailed online conversion](#) to choose from a wider range of [datums, projections and height systems](#) (including bulk options) that are more suited to users with an understanding of coordinate systems.

Input coordinate system

New Zealand Geodetic Datum 1949

Output coordinate system

New Zealand Transverse Mercator Projection

Conversion options

Conversion date Specifies the date at which the conversion applies. Many conversions, for example, are based on the date. The date can be entered either as a decimal year (eg 2000, 2013.5) or the word "now" for the current date.

Previous beforeUdig workflow

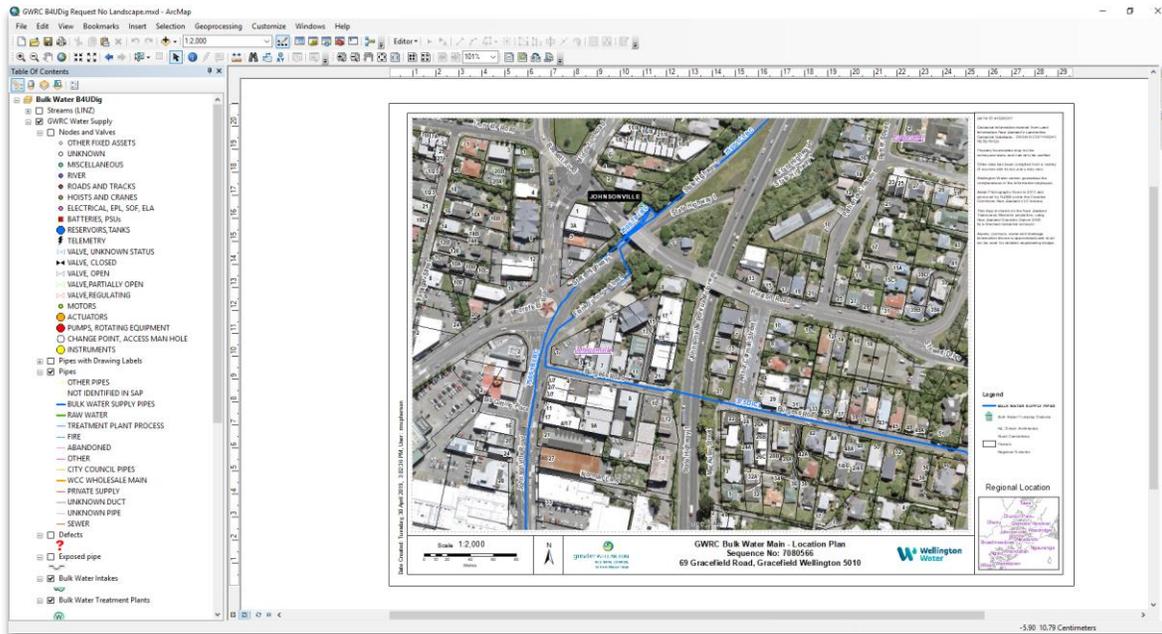
According to the documentation...

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...
4. Convert coordinates to NZTM

Previous beforeUdig workflow

According to the documentation...

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...
4. Convert coordinates to NZTM
5. Open map document



Examples

Bulk Supply within Proposed Site Location

In this example, the Bulk Supply main passes through the Proposed Site Location along Main St. Additionally, the Location in Road mentions the Carriageway and Footpath which is where this particular main lies.



WARNING: The adjacent map displays the extent of the proposed dig site as specified and confirmed by the beforeUdig customer.

User Reference:

Not Supplied

Working on Behalf of:

Private

Start Date:

21/04/2017

End Date:

21/04/2017

Address:

92-102 Main St, Princes St, 17-19 Geonge St, 879-897 F Upper Hutt Central Wellington 5018

For Planning:

Yes

Plans Requested:

Yes

Asset Locate:

No

Preferred Locate Date:

Not Supplied

Workplace Location:

Both

Location in Road:

CarriageWay, Footpath, Berm

Nature of Works:

Major Earthworks Cutting/Fill

Additional Work Site Notes:

Plans only please.



Previous beforeUdig workflow

According to the documentation...

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...
4. Convert coordinates to NZTM
5. Open map document
6. Assess site location for assets

Previous beforeUdig workflow

According to the documentation...

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5. Open map document
6. Assess site location for assets
7. Make a map (or map series)



Woogle Home Search Drawings

Wellington Water

Council
GWRC

Drawing Series
All
BS - Bulk Water Supply

Drawing Type
PL - Pipeline As Built drawings
STD - Standard Drawing

Drawing Date
From
To
Refine Clear
Modified date
One Year Ago Today
All

7000

Everything eDocs FileCM Drawings QPulse ...

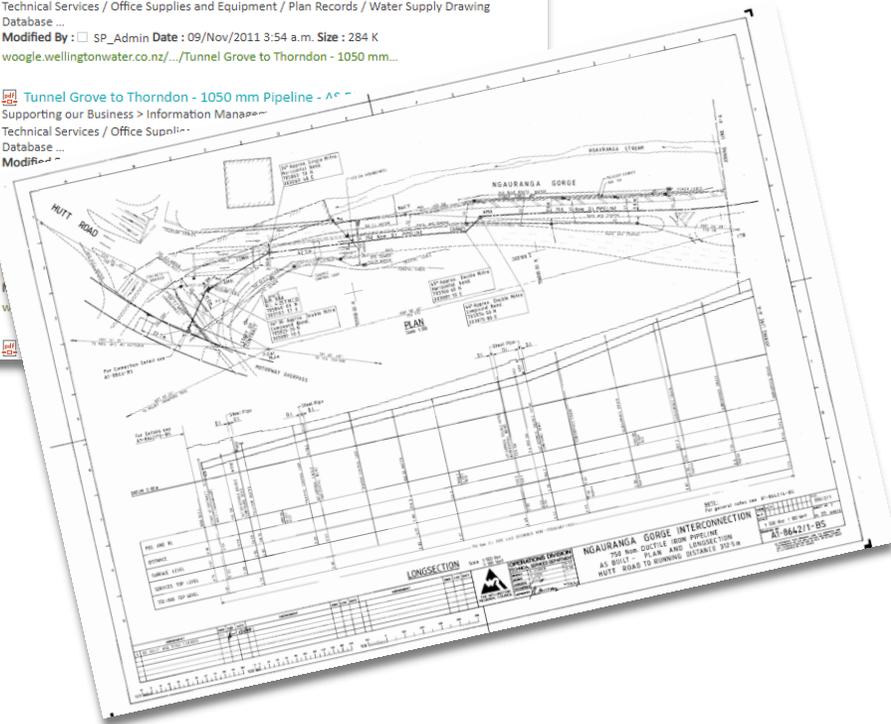
Relevance

Drawing Number: "7000"

Tunnel Grove to Thorndon - 1050 mm Pipeline - AS BUILT Wainu...
Supporting our Business > Information Management > Drawings
Technical Services / Office Supplies and Equipment / Plan Records / Water Supply Drawing Database ...
Modified By: SP_Admin Date: 09/Nov/2011 3:54 a.m. Size: 216.5 K
woogle.wellingtonwater.co.nz/.../Tunnel Grove to Thorndon - 1050 mm...

Tunnel Grove to Thorndon - 1050 mm Pipeline - AS BUILT Wainu...
Supporting our Business > Information Management > Drawings
Technical Services / Office Supplies and Equipment / Plan Records / Water Supply Drawing Database ...
Modified By: SP_Admin Date: 09/Nov/2011 3:54 a.m. Size: 284 K
woogle.wellingtonwater.co.nz/.../Tunnel Grove to Thorndon - 1050 mm...

Tunnel Grove to Thorndon - 1050 mm Pipeline - AS BUILT Wainu...
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Previous beforeUdig workflow

According to the documentation...

1. Monitor incoming emails
2. Review beforeUdig PDF
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5. Open map document
6. Assess site location for assets
7. Make a map (or map series)
8. Find and download as build drawings

Name

- Standard Clearances Letter - Wellington Water.pdf
- Wellington Water BeforeUDig Sequence No 6120982 - 120 Hutt Park Road - DRAWINGS.zip
- Wellington Water BeforeUDig Sequence No 6120982 - 120 Hutt Park Road.pdf

Previous beforeUdig workflow

According to the documentation...

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...
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6. Assess site location for assets
7. Make a map (or map series)
8. Find and download as build drawings
9. Package everything up for customer



Standard clearances to wholesale water supply pipelines

1. If excavations for services are close to a wholesale water pipeline, the pipeline is to be located by our Pipelines team before work commences. Direct contact details are as follows:

- Frank O'Keeffe 021 426 951
- Mark Poehls 021 486 594

2. Minimum clearances are as follows:

- Parallel to the pipeline 1,000mm in plan
- Minimum clearance over or under the pipeline 150mm

All crossings of the pipeline are to be at or near right angles.

3. High voltage electrical cables (greater than 400 volts) to be installed parallel to a water pipeline over a length greater than 100m require a low frequency induction assessment and specific approval from Wellington Water.

4. Our Pipelines team is to be advised when excavation is to begin at least two days prior to work beginning. When the pipeline is exposed in excavations, care shall be taken to ensure that the protective coating is not damaged. Excavation shall be with hand tools when working within 500mm of the pipe.

5. The pipe shall be exposed and monitored when drilling is within 1,000mm of the pipeline.

6. Backfilling material placed around the pipe shall be clean and free from organic material, large stones and soft silts and clays. Crusher run or river run, 10mm down in size or less, are suitable materials.

Hand compaction all around the pipe is necessary, taking care not to cause damage either to the pipe or the protective coating. A minimum cover of 600mm shall be placed before any large mechanical compacting equipment is used.

Staff from the Pipelines team will inspect the pipe before backfilling commences and will be present during backfilling around the pipe.

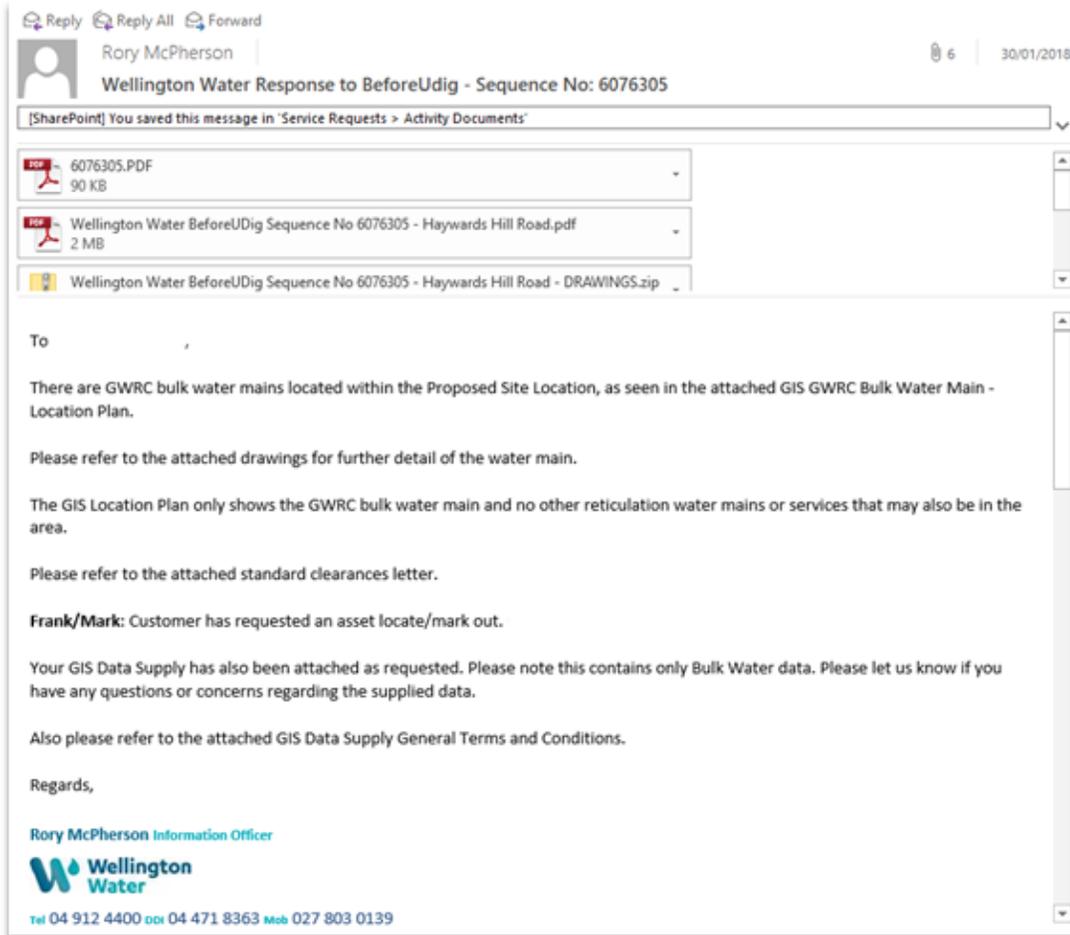
Prepared by:

Information Directorate
Wellington Water

Previous beforeUdig workflow

According to the documentation...

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...
4. Convert coordinates to NZTM
5. Open map document
6. Assess site location for assets
7. Make a map (or map series)
8. Find and download as build drawings
9. Package everything up for customer
10. Email customer with response, maps, as build drawings, and required letters



Overall...

- Manual, tedious process
- Very repetitive
- Could take up to 15 min. or longer



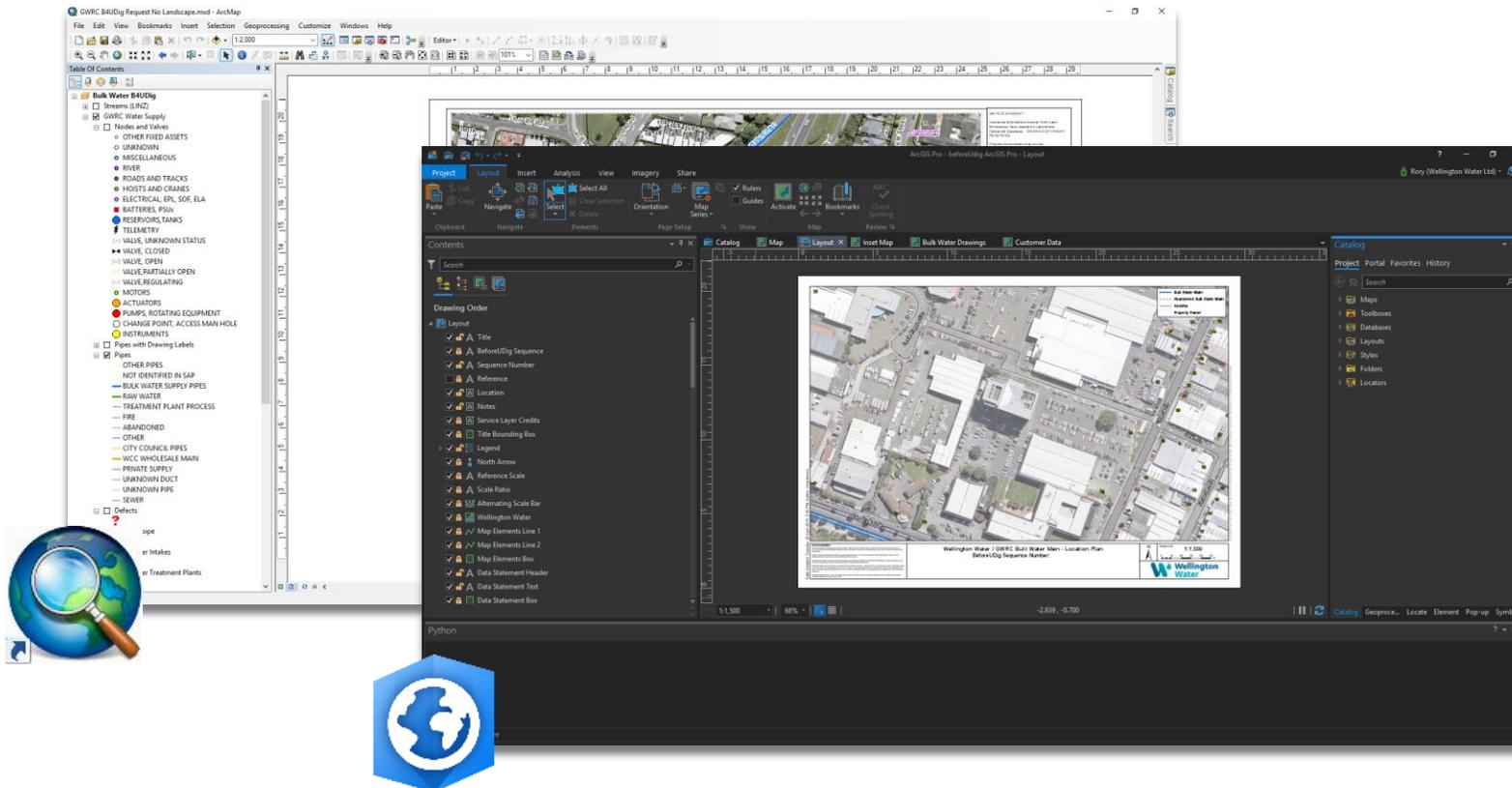
Choosing the right tools for the job...

⚙️ Task: Improve beforeUdig map document

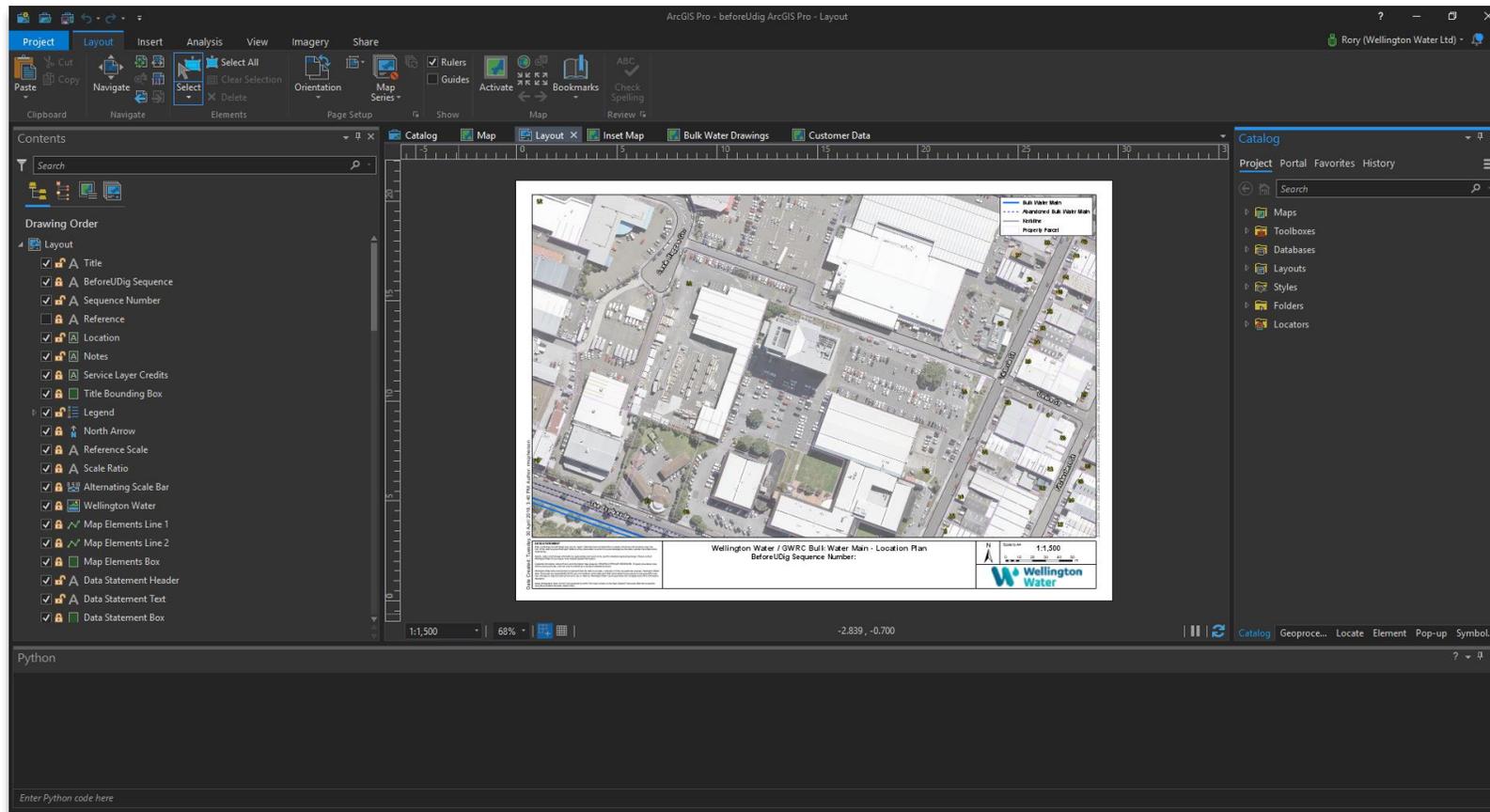
✓ Solution: ArcGIS Pro

Automation: Step 1

✓ ArcMap to ArcGIS Pro



Choosing the right tools for the job...



Automation: Step 1

- ✓ ArcMap to ArcGIS Pro
- Single working project
- Supports Python 3
- Dark theme

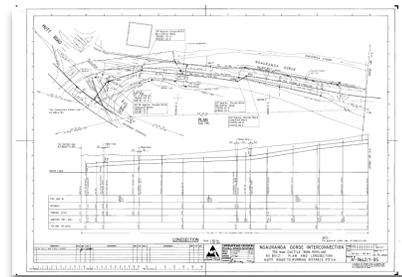
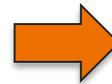
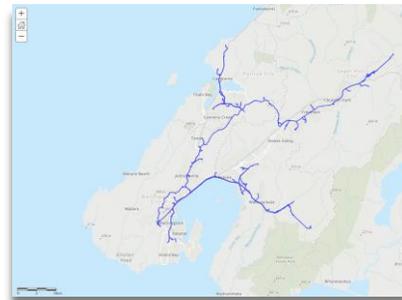


Automation: Step 2

- Applied buffer to pipes
- Georeferenced as build drawings and schematics
- Ta da! A new 'Bulk Water Supply Drawings and Schematics' layer

Find drawings by location...

- ⚙️ Task: Locate as build drawings and schematics via GIS
- ✓ Solution: New drawings and schematics feature layer





Automation: Step 3



```
2
3 class Room(object):
4     def __init__(self, inventory, desc, short_desc):
5         self.inventory = inventory
6         self.__n = None
7         self.__s = None
8         self.__e = None
9         self.__w = None
10        self.__desc = desc
11        self.__short_desc = short_desc
12        self.__gate_n = None
13        self.__gate_s = None
14        self.__gate_e = None
15        self.__gate_w = None
16
17        if not isinstance(desc, str):
18            raise TypeError ("the input provided is not a string.")
19        elif not isinstance(short_desc, str):
20            raise ValueError ("the string provided is empty.")
21
22        # these set the gates
23        # they set the opposite gates, with checks to avoid recursion loops
24        def set_n(self, other):
25            if not isinstance(other, Room) or not other:
26                raise TypeError ("room is not None or an instance of Room!")
```

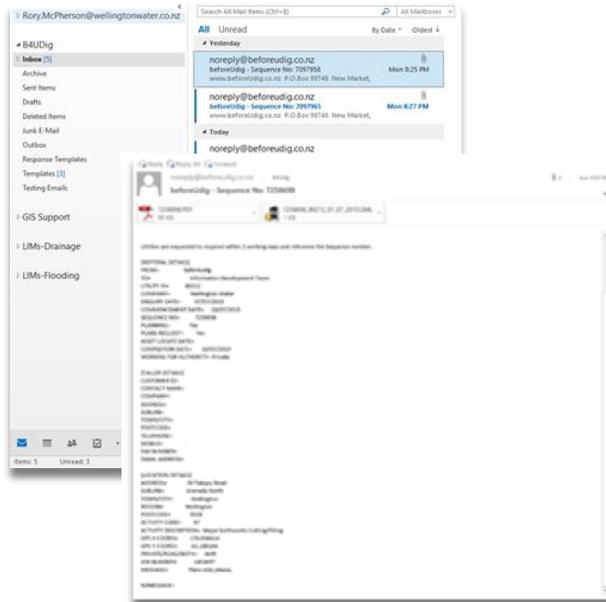


Why read emails? Just a bit of code can do it for you.

⚙️ Task: Reading, writing and sending emails

✅ Solution: Exchangelib

- <https://github.com/ecederstrand/exchangelib>



```
for email in beforeUdigAccount.inbox.all().order_by('datetime_received')[:1]:
    if email.subject.startswith('beforeUdig - Sequence No'): # filter beforeUdig
        beforeUdigEmail = str(email.body.replace("\r\nwww.beforeudig.co.nz\r\n"))
        emailBodyList = email.body.split('\r\n')
        sequenceNum = emailBodyList[18][:-9:-2]
        contactName = emailBodyList[27][23:].title()
        company = emailBodyList[28][23:]
        emailAddress = emailBodyList[36][23:]
```

💡 Save credentials as environment variables

```
emailUser = os.environ.get('EMAIL_USER')
password = os.environ.get('PASSWORD')
myCredentials = Credentials(emailUser, password) # set access
beforeUdigAccount = Account('B4UDig@wellingtonwater.co.nz',
```

Automation: Step 3



✓ Emails



Don't bother creating anymore working folders yourself.

⚙️ Task: Create project directory

✓ Solution: Os and Shutil

- <https://docs.python.org/3/library/os.html>
- <https://docs.python.org/3/library/shutil.html>

```
# create beforeUdig directory
folderDir = r'G:\Information Directorate\Data Inquires\B4UDig\Bulk Water BeforeUDig\'
requestFolder = sequenceNum + ' - ' + contactName + ', ' + company # name of folder to be created
drawingsFolder = r'\Drawings' # name of drawings folder
beforeUdigFolder = folderDir + requestFolder # set directory
os.makedirs(beforeUdigFolder) # create directory folder(s)
os.makedirs(beforeUdigFolder + drawingsFolder) # make drawings folder
shutil.copy(r'G:\Information Directorate\Data Inquires\B4UDig\Bulk Water BeforeUDig\Standard Clearances Letter -
```

Automation: Step 3



✓ Emails

✓ Files / Folders

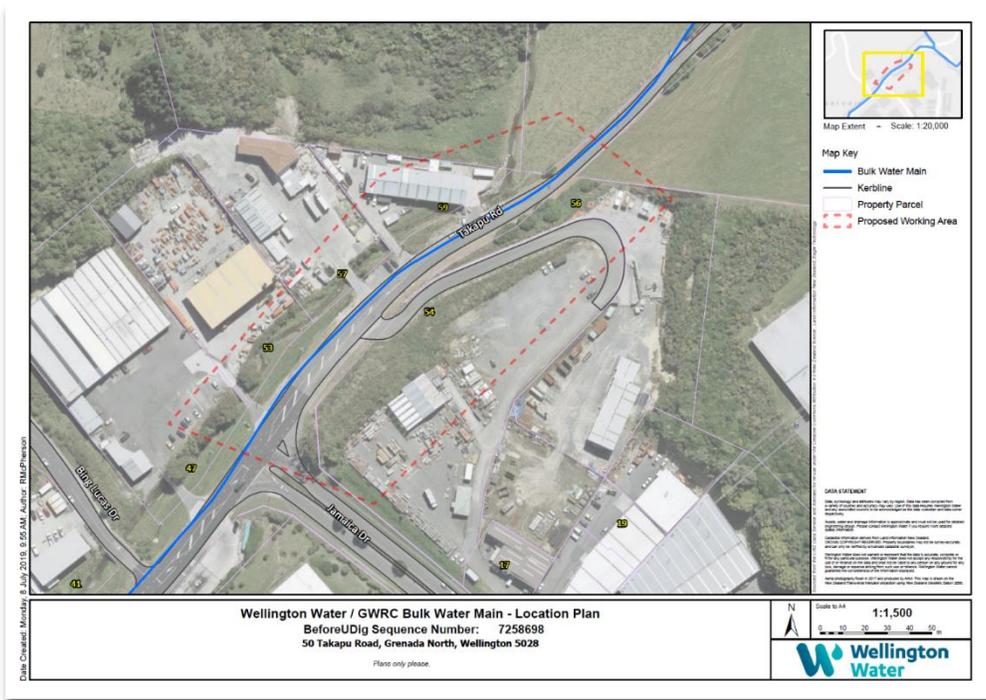


Automatic map production!

⚙️ Task: Make a map

✓ Solution: ArcPy

- <https://pro.arcgis.com/en/pro-app/arcpy/main/arcgis-pro-arcpy-reference.htm>



Read the online documentation



Symbology class

Computers *can* make beautiful maps!



Camera class

Combine with `math.ceil` to get that perfect scale!

Automation: Step 3



Emails



Files / Folders



Make a map

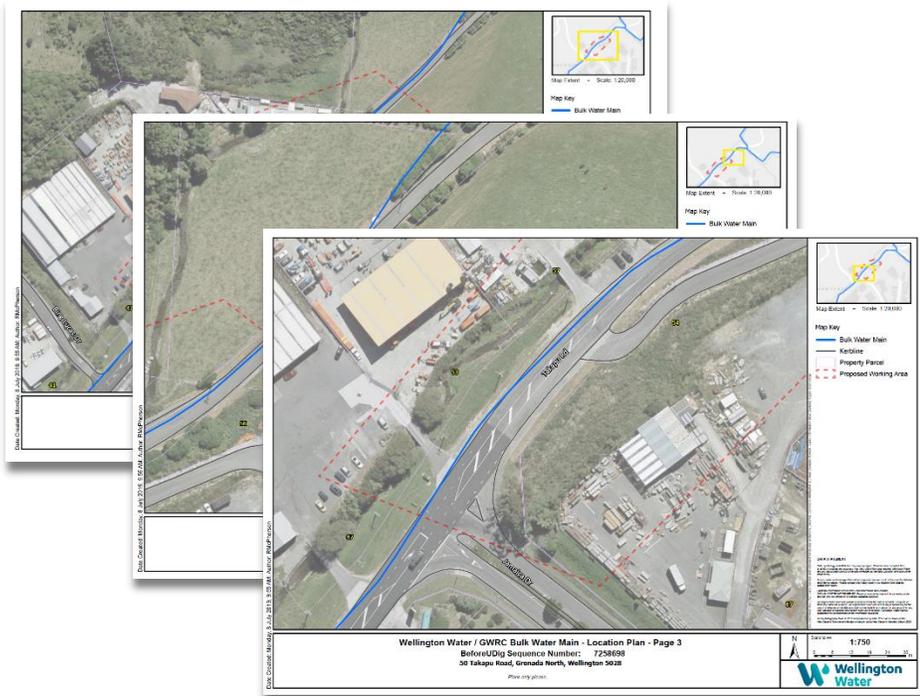


Automatic map production!

⚙️ Task: Make a map series

✓ Solution: ArcPy

- <https://pro.arcgis.com/en/pro-app/arcpy/main/arcgis-pro-arcpy-reference.htm>



💡 GridIndexFeatures

💡 Memory workspace

Write geoprocessing outputs to memory!

💡 SearchCursor

Works with regular expressions!

Automation: Step 3



✓ Emails

✓ Files / Folders

✓ Make a map

✓ Make a map series



A bit of geoprocessing...

⚙️ Task: Assess site location for assets

✓ Solution: ArcPy

- <https://pro.arcgis.com/en/pro-app/arcpy/main/arcgis-pro-arcpy-reference.htm>



SelectLayerByLocation



Describe function

Returns an object's properties, such as data type, fields, indexes, etc

```
prox = arcpy.Describe(pipeBuffer)
if prox.FIDSet == '':
    proximityResponse = 'OUTSIDE PROXIMITY'
else:
    proximityResponse = 'IN PROXIMITY'
```

Automation: Step 3



- ✓ Emails
- ✓ Files / Folders
- ✓ Make a map
- ✓ Make a map series
- ✓ Assess site location



Give me all the drawings!

⚙️ Task: Find and download as build drawings

✓ Solution: ArcPy and Requests

- <https://pro.arcgis.com/en/pro-app/arcpy/main/arcgis-pro-arcpy-reference.htm>
- <https://2.python-requests.org/en/master/>
- <https://2.python-requests.org/en/master/user/authentication/>



Authentication

Find which authentication method works for you.



SelectLayerByLocation



SearchCursor

Automation: Step 3



- ✓ Emails
- ✓ Files / Folders
- ✓ Make a map
- ✓ Make a map series
- ✓ Assess site location
- ✓ As build drawings



Automation: Step 4

Sorting out your data...

⚙️ Task: Convert from GML to shapefile

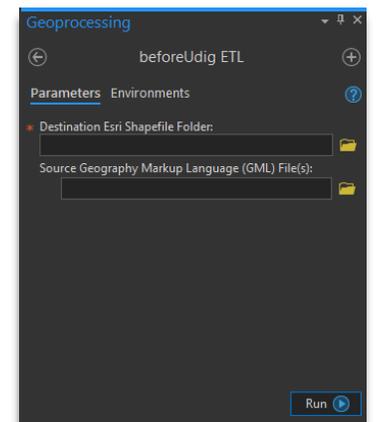
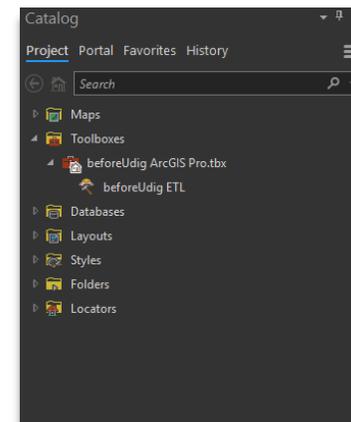
✅ Solution: FME

- <https://pro.arcgis.com/en/pro-app/help/data/data-interoperability/create-an-esri-spatial-etl-tool.htm>

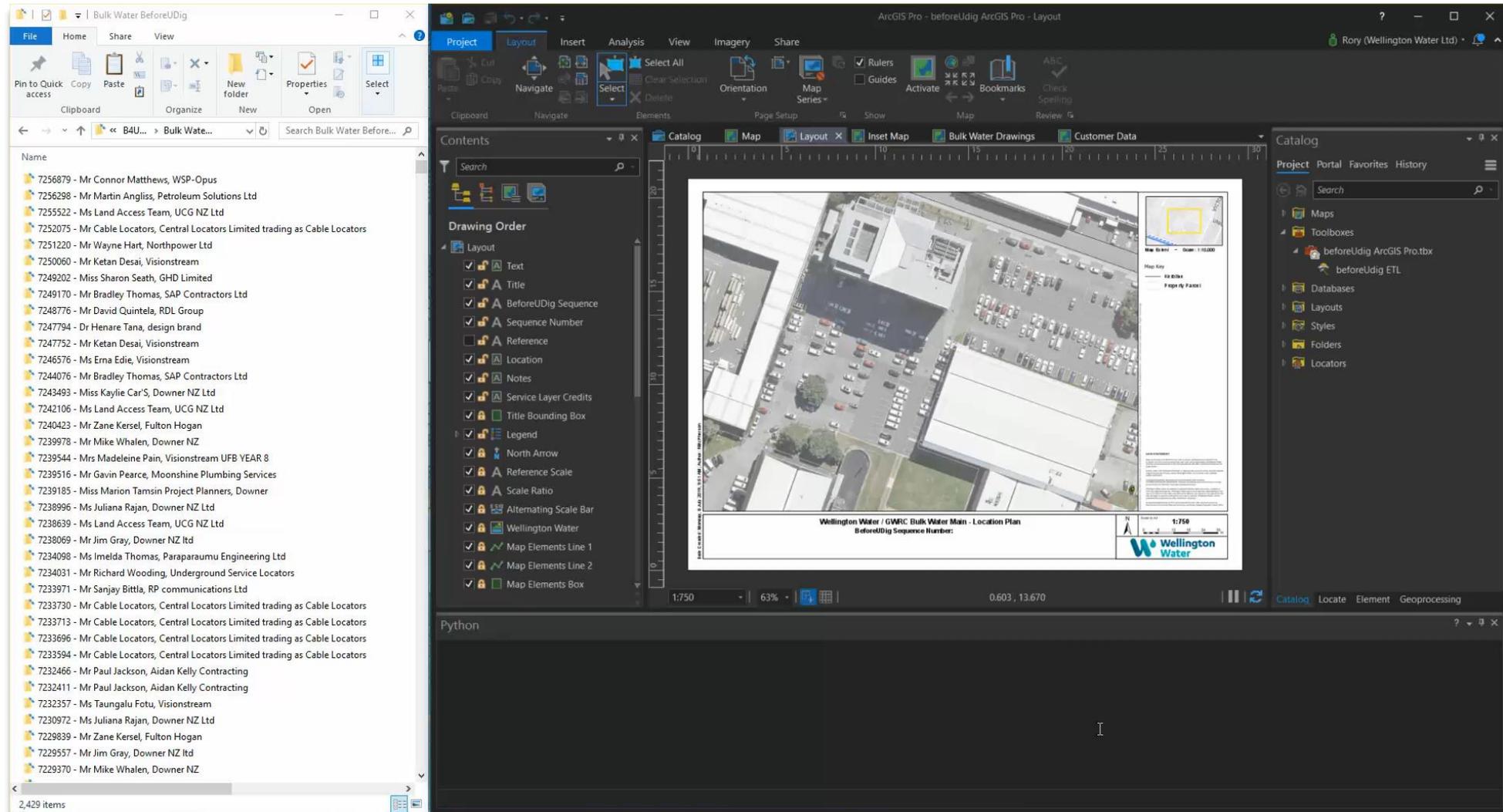


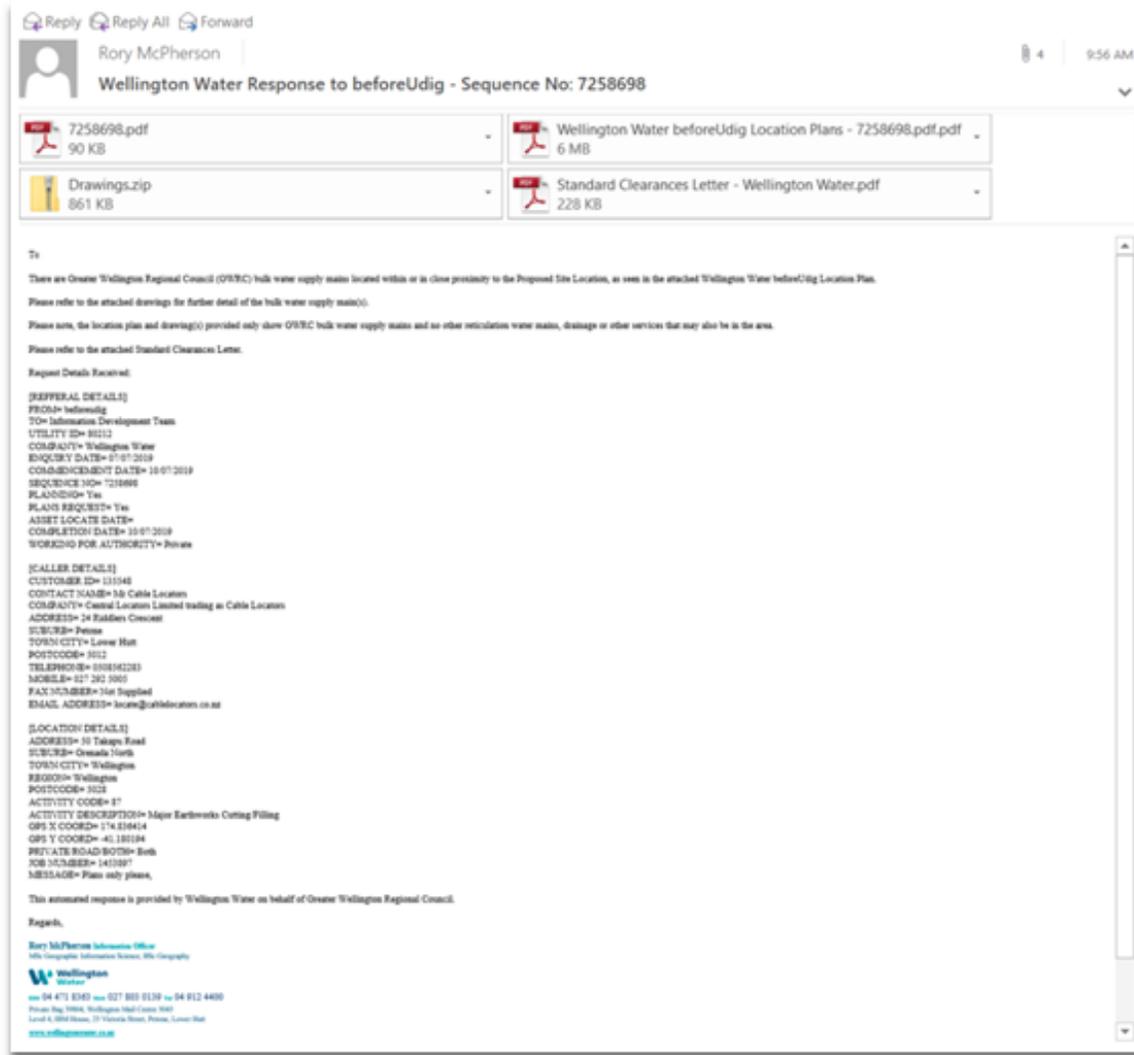
Spatial ETL tool

Add your FME workbench to your toolbox in ArcGIS Pro!



The new automated beforeUdig workflow





What does the customer get?

- Nicely formatted email with:
 - Specific customer response
 - Original job request information
 - Locate Services Team (cc'd if requested by customer)
- Original PDF
- Map document (Location Plan PDF)
- Zipped drawings folder
- Standard Clearances Letter

The end result

- Mostly automated process
- Very fast – can complete in less than a minute
- Huge savings in time and costs



Automating beforeUdig requests using ArcGIS Pro, Python, and FME

Questions?

Rory McPherson
GIS Analyst

✉ rory.mcpherson@Stantec.com

