Data Verification Tools

Scottish Water and Trident

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Data Verification Tools

Introduction

An innovative application that streamlines and enhances data verification processes during Model Maintenance (MM)
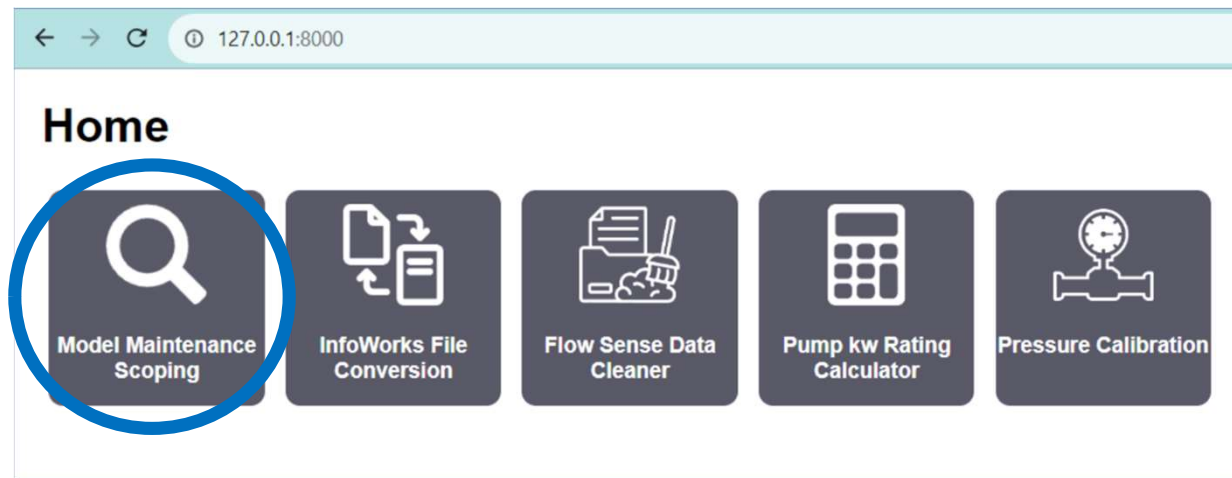
Overview

- Current app contents
- MM Scoping App - Analysis
- MM Scoping App – Current use
- Future applications

Data Verification Tools

Current app contents

A cloud-based web app containing a suite of applications that is currently being built upon
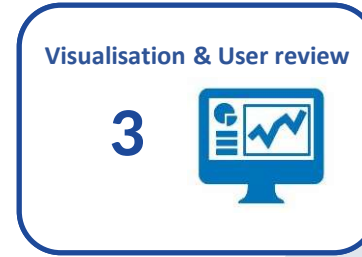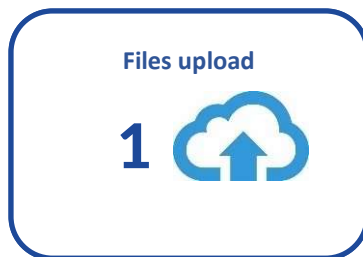
MM Scoping App

1. Files upload
- Telemetry flows
- Model data
- DMA structure
- SR Depths
- LMCs
- PRV database

2. Data Analysis
- Telemetry data analysis
- Model/telemetry data comparison
- DMA data analysis
- Identification of LMCs and PRVs

3. Visualisation & User review

4. Reports produced for the modeller to download

Files upload	Data Analysis	Visualisation & User review	Reports Exported
1	2	3	4

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MM Scoping App

Analysis Objectives/Restrictions

- Classify if various bits of data look correct or not
- Develop an algorithm with adaptability to various types of data and quality of data
- Produce good results even with limited data
- Develop a system that uses a modeler in the loop approach
- Produce an output interpretable by the modeler

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MM Scoping App

Analysis Outcomes

- Statistical pattern recognition approach

- Works on 4 weeks of data

- Adaptable to any flow meter (doesn't require retraining)

- Tuned to have a higher recall (very low false negative rate)

- Savings on computational resources and improved efficiency

- Cheaper and faster system compared to existing method

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MM Scoping App Telemetry analysis

Analysis performed on the initial 3 weeks data

4th week compared to the initial 3

Up to date verification to verify if meter is working / valid

Modeller can override classifications using the list on the left

Model Maintenance Scoping

Telemetry | Model | DMA | Depth | LMC | PRV | Create Balance | Summary

Incorrect Meters

BURGIR HILL NEW TWS BURGIR HILL MAG FLOW IN	move
BURGIR HILL NEW TWS DL0013 AI0003 SR OUTLET FLOW TO UPPER ONSTON DMA	move
CAR NESS TWP 2012 HY461132 DISCHARGE FLOW	move
CAULDHAME TWS FLOW IN	move
CAULDHAME TWS FLOW OUT	move
HATSTON IND EST FLOW FROM LINTY BRAE FLOW	move
LINTY BRAE DSR 1961 HY402070:DL2670:AI0003-SR INLET FLOW	move
LINTY BRAE SUPPLY TO HEATHFIELD FARM FLOW	move
QUEENA BOOSTER TWP QUEENA FLOW OUT 10	move
QUEENA BOOSTER TWP QUEENA FLOW OUT 6	move
SANDY HILL TWS FLOW IN	move
SANDY HILL TWS FLOW OUT	move

Correct Meters

AYRE ROAD DMA	move
BOARDHOUSE WTW 1989 HY269254 - A:CWT - PUMPED OUTLET FLOW TO RAVIE HILL TWS 1hr	move
BOARDHOUSE WTW CWT PUMPED OUTLET FLOW TO RAVIE HILL TWS	move

CAULDHAME TWS FLOW OUT

Telemetry Data Chart
Week 1 | Week 2 | Week 3 | Week 4

Flow (l/s)
10 8 6 4 2 0 -2

01/07/23 00:00 03/07/23 19:15 06/07/23 14:30 09/07/23 09:45 12/07/23 05:00 15/07/23 00:15 17/07/23 19:30 20/07/23 14:45 23/07/23 10:00 26/07/23 05:15
Time

Reset Zoom

Telemetry Data Chart
Week 4 | Week 3 | Week 2 | Week 1

Flow (l/s)
10 8 6 4 2 0 -2

01/07/23 00:00 01/07/23 17:00 02/07/23 10:00 03/07/23 03:00 03/07/23 20:00 04/07/23 13:00 05/07/23 06:00 05/07/23 23:00 06/07/23 16:00 07/07/23 09:00
Time

Reset Zoom

Save Comment

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MM Scoping App Telemetry analysis

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4th week compared to the initial 3

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Model Maintenance Scoping

Telemetry Model DMA Depth LMC PRV Create Balance Summary

Incorrect Meters

Correct Meters

AYRE ROAD DMA	move
BOARDHOUSE WTW 1989 HY269254 - A:CWT – PUMPED OUTLET FLOW TO RAVIE HILL TWS 1hr	move
BOARDHOUSE WTW CWT PUMPED OUTLET FLOW TO RAVIE HILL TWS	move
BOARDHOUSE WTW CWT RAVIE HILL OUTLET FLOW TO NORTH ZONE	move
BOARDHOUSE WTW CWT RAVIE HILL OUTLET FLOW TO SOUTH ZONE	move
BOARDHOUSE WTW CWT RAVIE HILL OUTLET FLOW TO WEST ZONE	move
BRIG OWAITHE BOOSTER TWP BRIG FLOW	move
BURGIR HILL NEW BURGIR TO LINTI FLOW	move
BURGIRHILL NEW TWS BURGIR TO ORPHIR FLOW	move
GREENTOFT DSR 1962 HY566071 DL2853 AI0002 INLET FLOW 6	move
GREENTOFT DSR 1962 HY566071 DL2853 AI0005 OUTLET FLOW 4	move
GREENTOFT DSR 1962 HY566071 DL2853 AI0007 OUTLET FLOW 2	move
HAMMARHILL TWS DL0017 AI0005 SR HAMMARHILL INLET FLOW	move
HAMMARHILL TWS FLOW OUT	move
KIRBISTER WTW 1863 HY368071 – A:FINAL	move

BOARDHOUSE WTW CWT RAVIE HILL OUTLET FLOW TO NORTH ZONE

Telemetry Data Chart

Week 1 | Week 2 | Week 3 | Week 4

Reset Zoom

Telemetry Data Chart

Week 4 | Week 3 | Week 2 | Week 1

Reset Zoom

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MM Scoping App
Model analysis

Days of data compared

Spells out if model data is within 2 standard deviations from to telemetry data

Any bit of model data classified as "incorrect" becomes a statistical outlier

Modeller can edit a stricter or looser system

Model Maintenance Scoping

Telemetry | Model | DMA | Depth | LMC | PRV | Create Balance | Summary

Incorrect Meters

BOARDHOUSE WTW CWT PUMPED OUTLET FLOW TO RAVIE HILL TWS — move
HAMMARHILL TWS DL0017 AI0006 SR HAMMARHILL INLET FLOW — move
HATSTON IND EST FLOW FROM LINTY BRAE FLOW — move
LINTY BRAE DSR 1961 HY402070:DL2670:AI0003-SR INLET FLOW — move
LINTY BRAE SUPPLY TO HEATHFIELD FARM FLOW — move
MARKSTONE TWS FLOW IN — move
SANDY HILL TWS FLOW IN — move
SHAPINSAY DSR 1973 HY506177 SR INLET FLOW — move
TOWERHILL NEW TWS FLOW IN — move
TWATT TO DOUNBY FLOW — move

Correct Meters

AYRE ROAD DMA — move
BOARDHOUSE WTW CWT RAVIE HILL OUTLET FLOW TO NORTH ZONE — move
BOARDHOUSE WTW CWT RAVIE HILL OUTLET FLOW TO SOUTH ZONE — move
BOARDHOUSE WTW CWT RAVIE HILL OUTLET FLOW TO WEST ZONE — move
BRIG OWAITHE BOOSTER TWP BRIG FLOW — move

AYRE ROAD DMA

Model Data Chart

Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Model Data

Model Data Chart

Average Day (28 Day Average) | Model Prediction

Save Comment

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MM Scoping App
Model analysis

Days of data compared

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Any bit of model data classified as "incorrect" becomes a statistical outlier

Modeller can edit a stricter or looser system

Model Maintenance Scoping

Telemetry | Model | DMA | Depth | LMC | PRV | Create Balance | Summary

Incorrect Meters

- BOARDHOUSE WTW CWT PUMPED OUTLET FLOW TO RAVIE HILL TWS — move
- HAMMARHILL TWS DL0017 AI0005 SR HAMMARHILL INLET FLOW — move
- HATSTON IND EST FLOW FROM LINTY BRAE FLOW — move
- LINTY BRAE DSR 1961 HY402070:DL2870:AI0003-SR INLET FLOW — move
- LINTY BRAE SUPPLY TO HEATHFIELD FARM FLOW — move
- MARKSTONE TWS FLOW IN — move
- SANDY HILL TWS FLOW IN — move
- SHAPINSAY DSR 1973 HY506177 SR INLET FLOW — move
- TOWERHILL NEW TWS FLOW IN — move
- TWATT TO DOUNBY FLOW — move

Correct Meters

- AYRE ROAD DMA — move
- BOARDHOUSE WTW CWT RAVIE HILL OUTLET FLOW TO NORTH ZONE — move
- BOARDHOUSE WTW CWT RAVIE HILL OUTLET FLOW TO SOUTH ZONE — move
- BOARDHOUSE WTW CWT RAVIE HILL OUTLET FLOW TO WEST ZONE — move
- BRIG OWAITHE BOOSTER TWP BRIG FLOW — move

LINTY BRAE DSR 1961 HY402070:DL2670:AI0003-SR INLET FLOW

Model Data Chart

Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Model Data

Save Comment

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MM Scoping App
DMA analysis

Pattern recognition on DMA balance

Highlight of any unusual property usage

Modeller can review all inflow/outflow meters

MM Scoping App Outputs and Results

Model Maintenance Scoping

Telemetry | Model | DMA | Depth | LMC | PRV | Create Balance | Summary

DMA Net Flow Assessment

Name	Problem	Property Problem	Comment
AYRE ROAD DMA	No	No	test comment for Ayre Road...
UPPER ONSTONE & FI...	No	Yes	
CLOOK & NORTHSIDE ...	No	Yes	
RAVIEHILL TO BRIG OWAIT...	No	Yes	
RAVIEHILL TO DOUNBY &a...	Yes	Yes	
TWATT & DOUNBY DMA	No	Yes	
TWATT & DOUNBY NO...	Yes	Yes	
QUOYLOO & MARWIC...	No	Yes	
QUEENA 10" TO QUH...	Yes	Yes	
TWATT & DOUNBY SO...	Yes	Yes	
BURGIR HILL TO LINTY BR...	No	Yes	

Meters

Name	problem	Comment	Model Problem	Model Comment
AYRE ROAD DMA	No		No	
BOARDHOUSE WTW...	No	telemetry comment	No	test comment for Bo...
BOARDHOUSE WTW...	No		No	
BOARDHOUSE WTW...	No		No	
BRIG OWAITHE BOO...	No		No	
BURGIR HILL NEW B...	No		No	
BURGIR HILL NEW T...	Yes		No Model Data	No model data
BURGIR HILL NEW T...	Yes		No	
BURGIRHILL NEW T...	No		No	
CAR NESS TWP 201...	Yes		No Model Data	No model data
CAULDHAME TWS F...	Yes		No	

Summary tab
- All data
- Classifications
- Notes

Report download options
- Comprehensive
- Concise

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MM Scoping App
Response from modellers
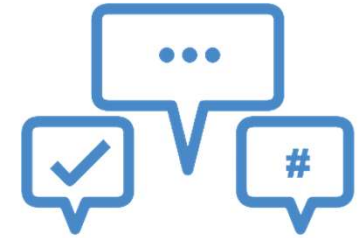
data assessment

data review

enhances

time

swiftly

Speeding

pinpoint

"Streamlining data assessment enables a more focused approach, directing attention where it's most n

"Speeding up the data review process"

"it allows us to focus on where there are data issues occurring without spending time reviewing good

"The app enhances our ability to pinpoint data discrepancies swiftly"

ability

attention

App

streamlining

data issues

focused approach

discrepancies

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Data Verification Tools
Future Applications

- Comparison with more advanced machine learning techniques and more data

- Further develop the apps that are currently in the suite

- ML analysis to highlight models with low confidence

- Apply similar techniques to automate other common data reviews such as pressure loggers from field tests
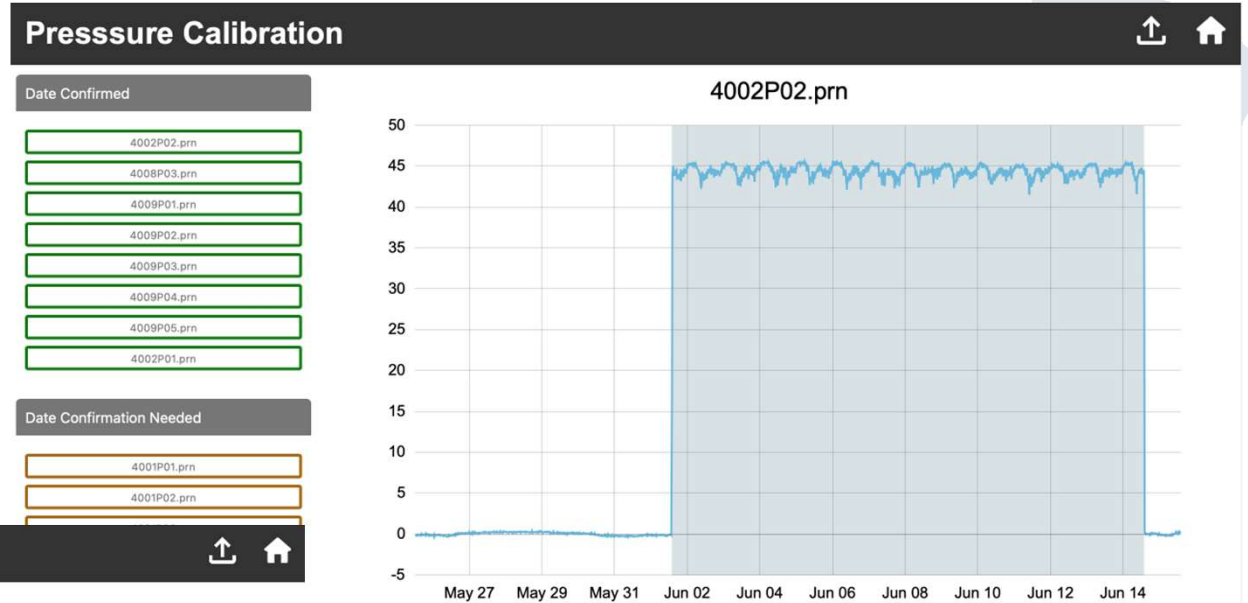
Pressure Calibration App

App Features

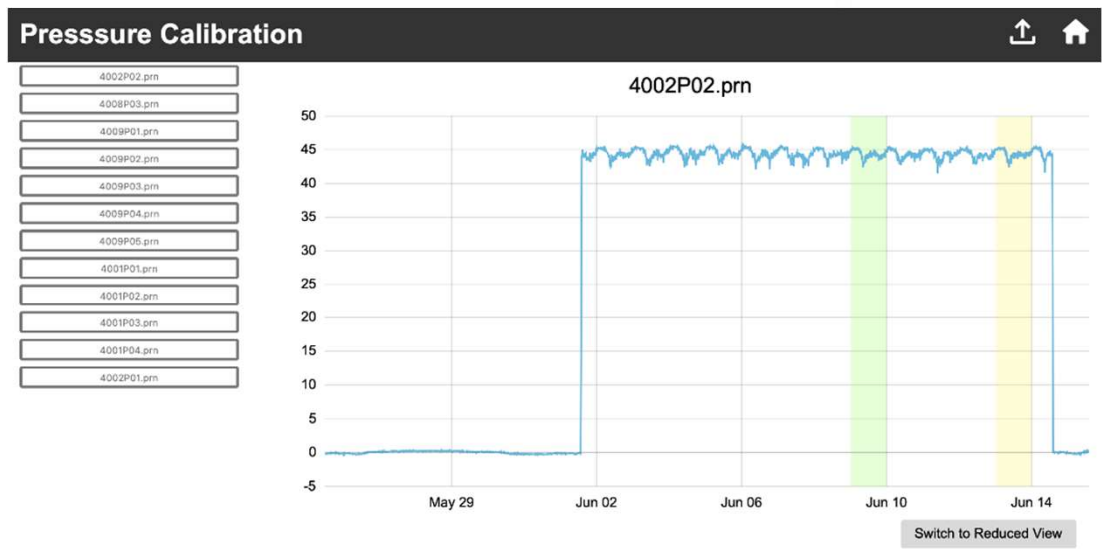- Automatically selects start/end dates

- Gets user input where it can't
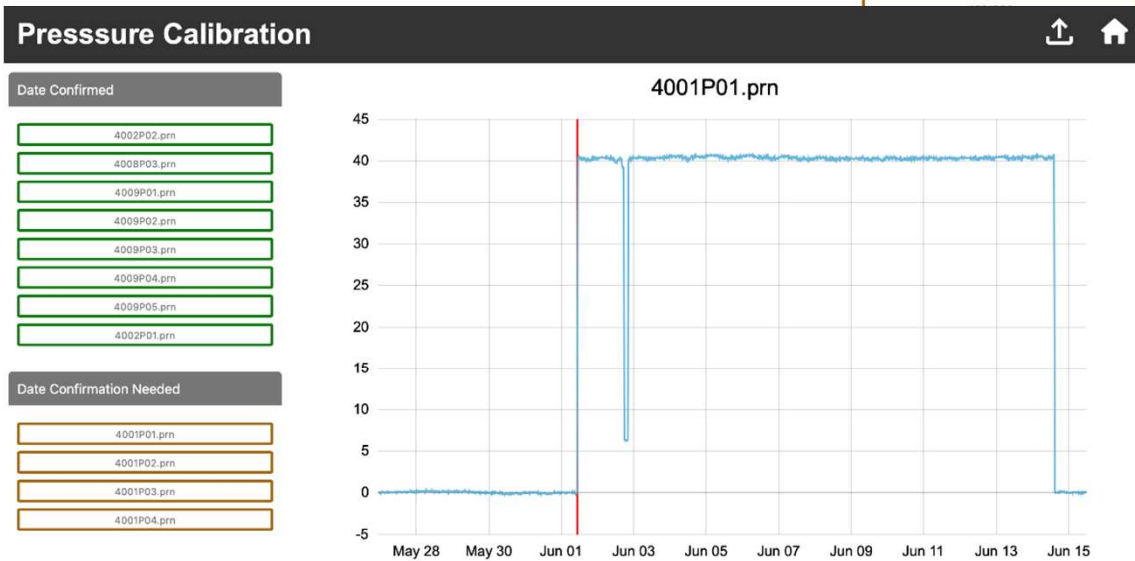
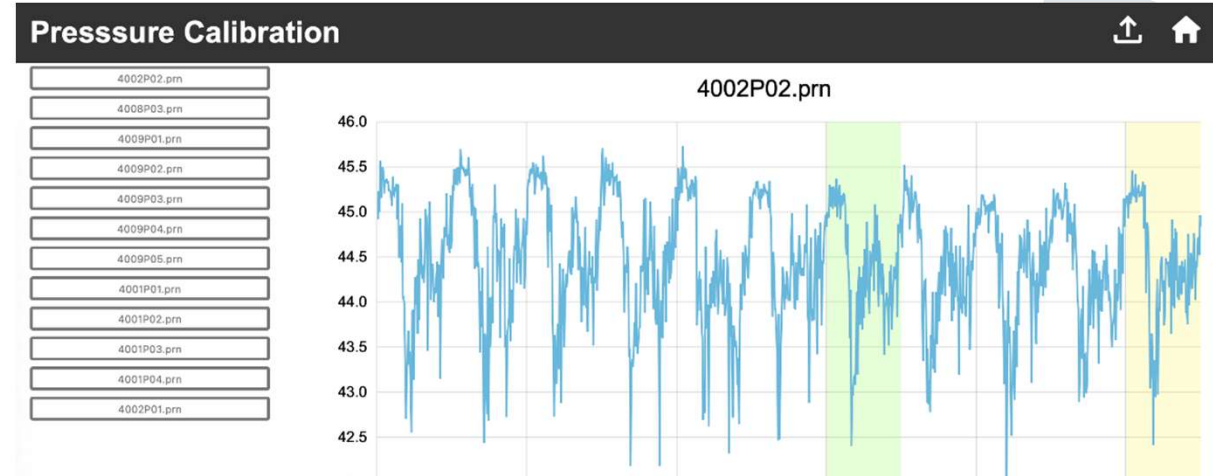# Pressure Calibration App

App Features

- Provides calibration day suggestions
- Returns offset values

Thank you for listening