WatErnomics

OÉ Gaillimh
NUI Galway

IWRA WORLD WATER CONGRESS XV
EDINBURGH, 25-29 MAY 2015

Water conservation with novel application of fault detection diagnostics (FDD) applied to a rain water harvesting system in Ireland

Presenter: Niall Chambers, Masters Student.

25/05/2015

PRESENTATION OUTLINE

1. Introduction to *Waternomics* Project

2. Fault Detection & Diagnosis (FDD) & Case Study

3. Methodology & Results

4. Conclusions

1. Introduction

Wat€rnomics

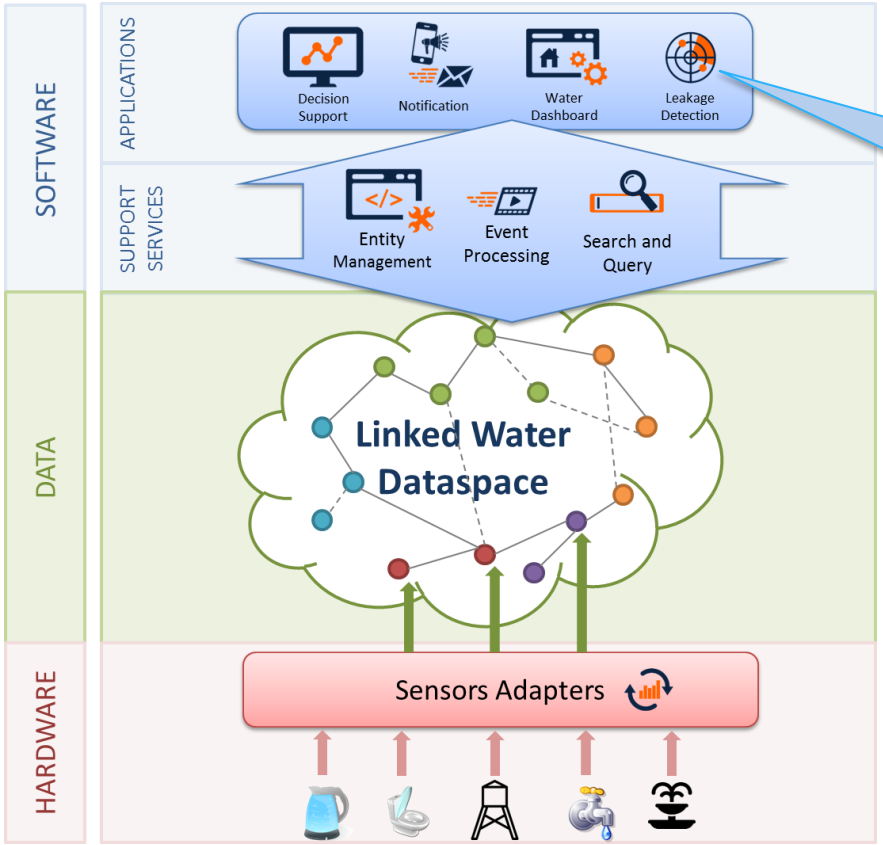
Project co-funded by the European Commission within the 7th Framework Program (Grant Agreement No. 619660)

PROBLEM DESCRIPTION

Buildings use 21% of all water in the EU

Estimated 20-30% of this wasted or leaked

ICT SOLUTION

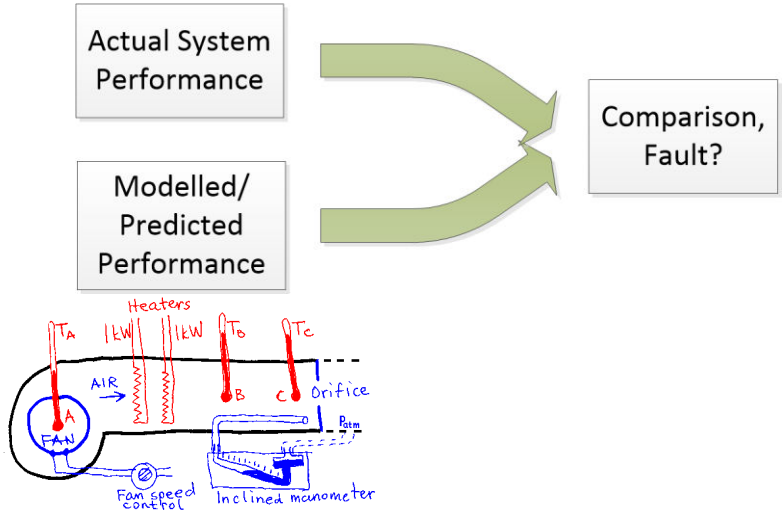


Leakage and Fault Detection

2. Fault Detection Diagnostics (FDD) & Case Study

FAULT DETECTION AND DIAGNOSTICS (FDD)

- Measurement Science/Analytic tool
- Applied in space industry, Automated systems, HVAC etc.
- Reduces Downtime
- Improves Maintenance Effectiveness

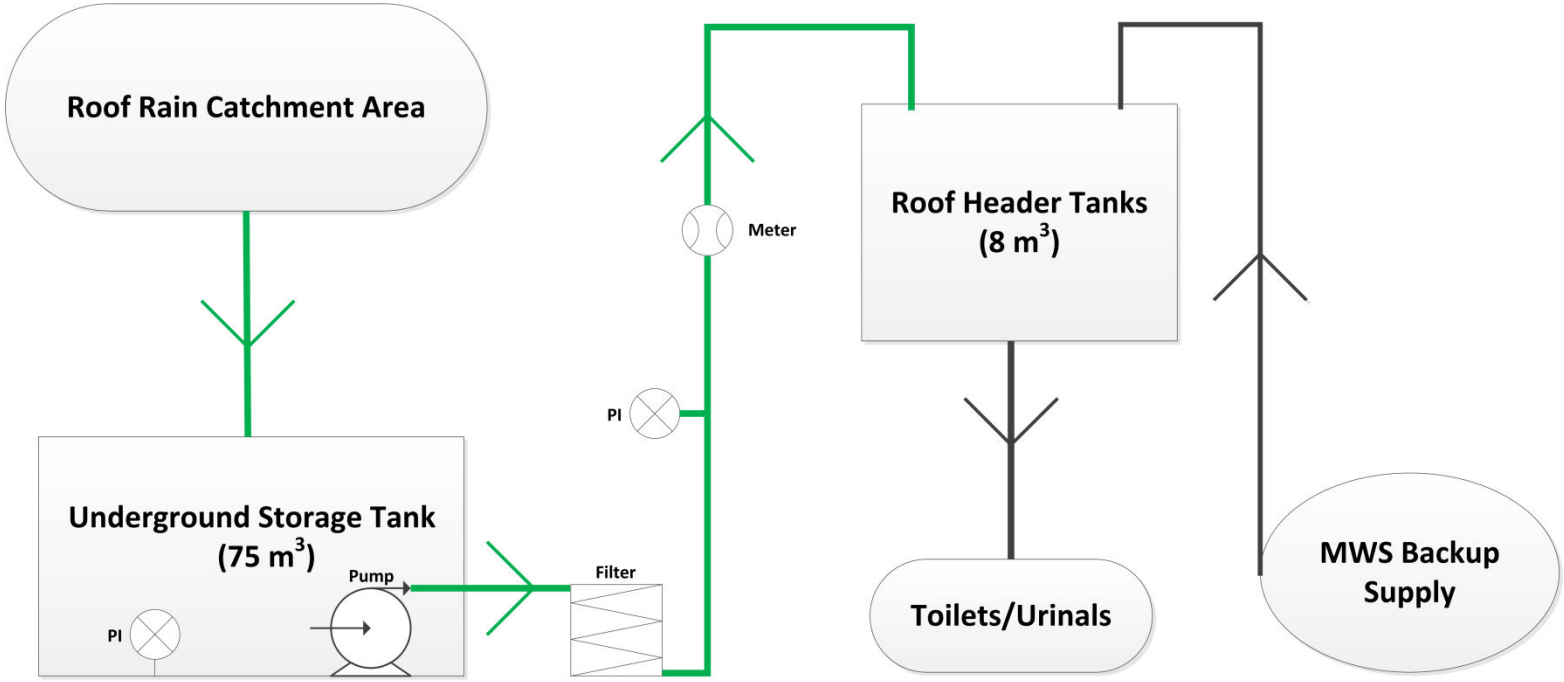


IRELAND'S PILOT SITE / CASE STUDY

National University of Ireland, Galway
Engineering Building

- Commissioned and Occupied in 2011
- ~1,000 Students & 100 Staff
- 5200 m^2 Plan Area, 4 Storeys
- Labs, Classrooms, Café, Toilets & Showers etc.

ENGINEERING BUILDING RAINWATER HARVESTING SYSTEM



4. Methodology & Results

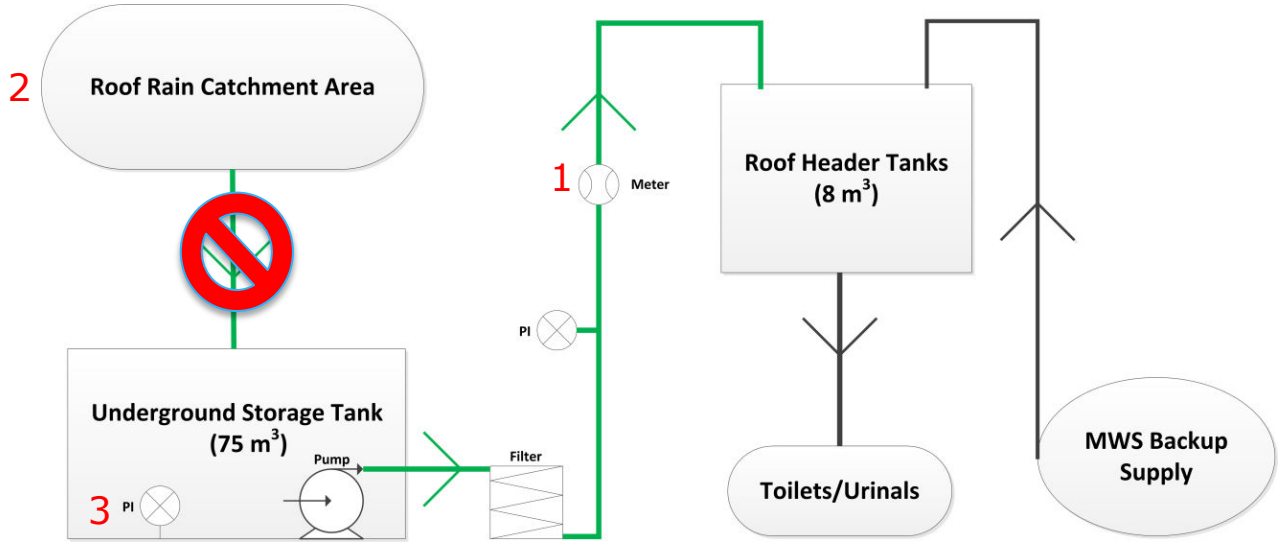
APPROACH / ASSUMPTIONS

Intermittent Expert Judgement

Continuous Automated Inspection Process

Signals and readings from the system can be utilised to identify a fault within the system

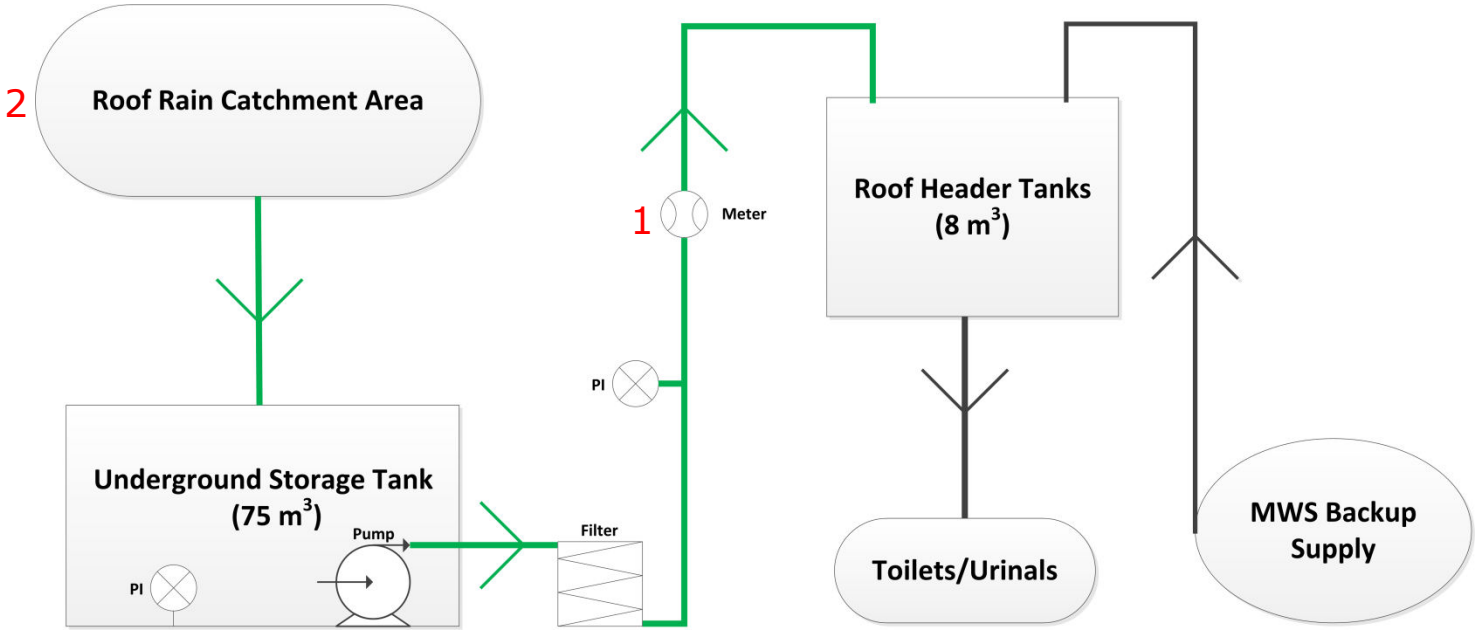
EXAMPLE FAULT



No.	RWH Signal
1	Rain Water meter = 0 m^3/week
2	Rainfall = 40 m^3/week
3	Pressure Indicator in Storage Tank Specifies = 0 m^3

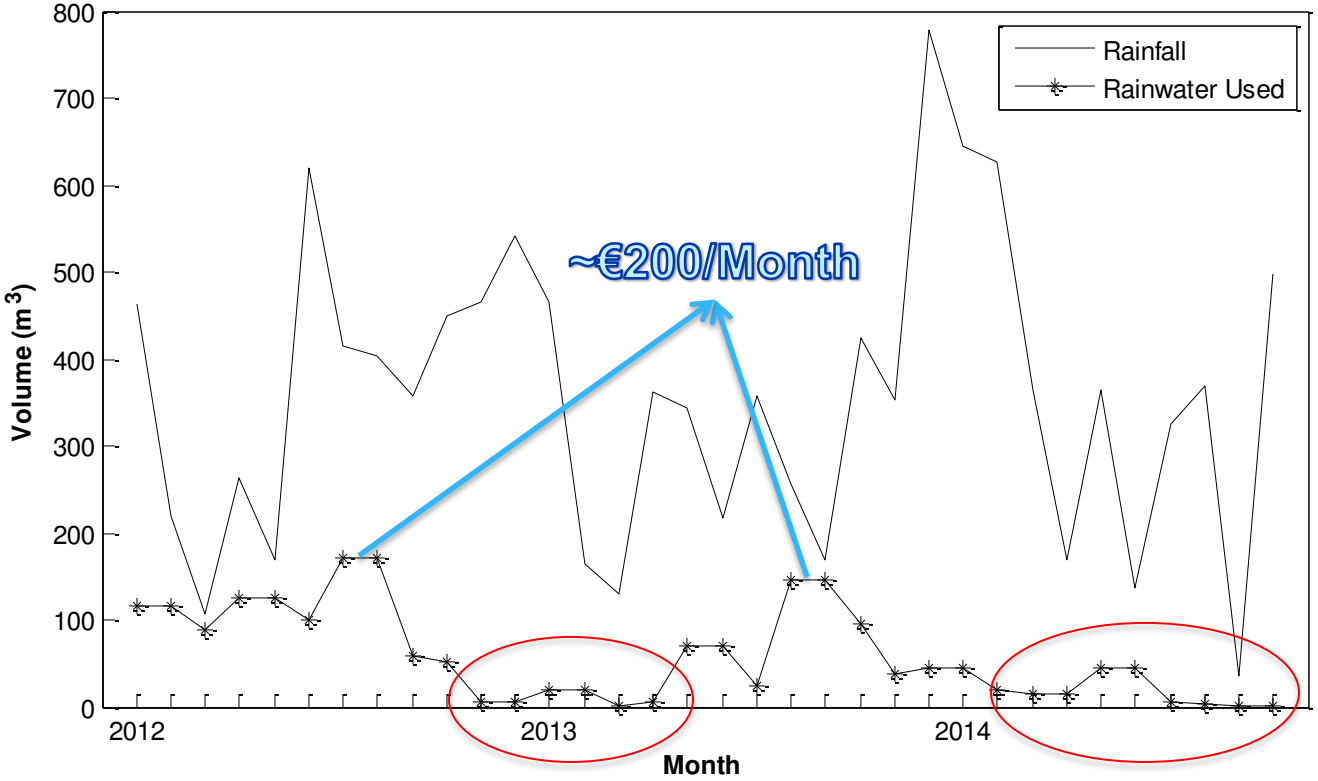
= Blockage in Pipe

FAULT FOUND



No.	RWH Signal
1	Rain Water meter = 0 m^3/week

ENGINEERING BUILDING RWHS FAULT FOUND



5. Conclusions and Questions

CONCLUSIONS

- *Waternomics* will provide a software platform to improve building water management by:
  - Affecting behavioural Changes
  - Increasing user awareness
  - Correcting leaks and malfunctions through FDD

- FDD is a proven methodology applied to many systems industries

- FDD was applied to a RWHS in a novel way

- Various levels of FDD can be applied to the system

- The most basic level of FDD identified a significant and persistent fault which will save €200/month in the Ireland Pilot site

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FURTHER DETAILS

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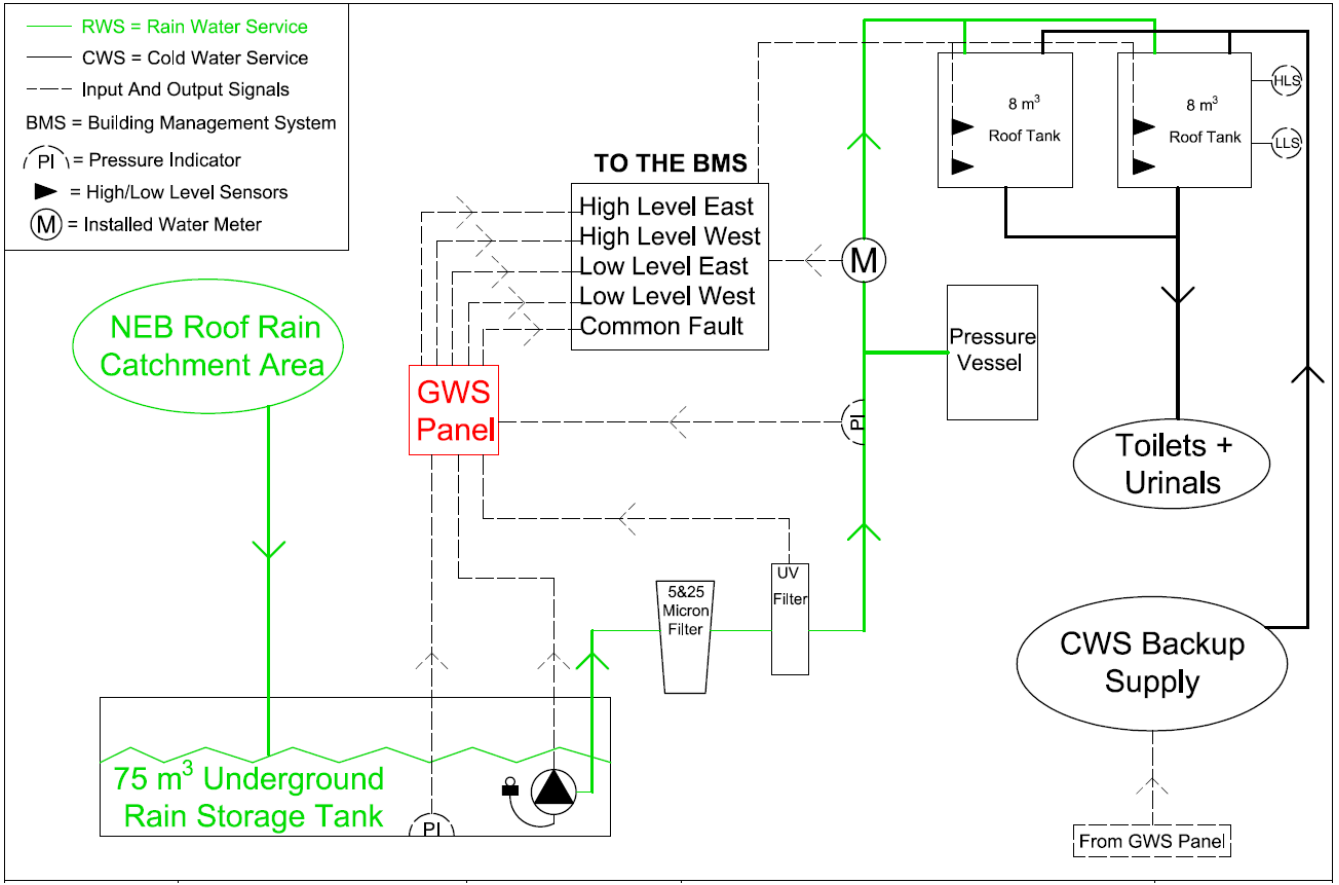
COMPLETE FDD TABLE

Outline of FDD Rules								
Rule No.	Rules, Based on Condtions	Conditions are Either True, False or Irrelevant						
		1	2	3	4	5	6	7
1	First Alarm	✓	✓	–	–	–	–	–
2	Insuficient Stored Water	✓	✓	✓	–	–	–	–
3	Insufficient Rainfall	✓	✓	✓	✓	–	–	–
4	Roof to Storage Tank Pipe Blockage	✓	✓	✓	✗	–	–	–
5	Power to Pump issue	✓	✓	✗	–	✗	–	–
6	Pump Blockage/Mechanical Failure	✓	✓	✗	–	✓	✗	–
7	Filter is Broken/Requires Servicing	✓	✓	✗	–	–	✗	–
8	Leak in Pipeline/Pump Malfunction	✓	✓	✗	–	✓	–	✓

COMPLETE RWHS SCHEMATIC



OUTSTANDING QUESTIONS

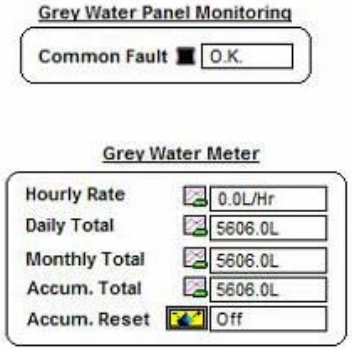
- How can I calculate the money that is being lost when I don't know how much water that the toilet and Urinal system (GWS) use in the building?
- There is a meter on the RWHS top up to the header tanks, but I'm not sure if this system ever worked to capacity i.e. serviced all of the GWS needs
- The only way that I could really find out is to place a meter on the CWS top up to one of the tanks

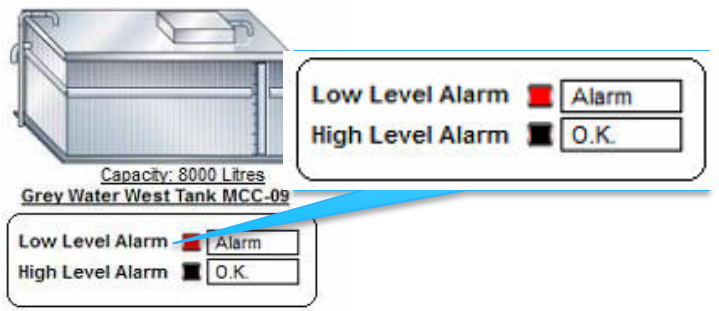
OUTSTANDING QUESTIONS

- Where did the idea of applying FDD to water networks in the project come from?
- Was it in the brief, are other projects under this framework doing the same?

ASSESSMENT AND PLANNING

	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4
STANDARD BASED METHODOLOGY	ASSESS	PLAN	DO	CHECK	ACT
	Water Review, Audit, Diagnosis and Commitment	Organizational Procedures + Baseline	Implementation and operation	Management and verification	Certification & Review
	ISO 50002	ISO 50001 IPMVP	ISO 50001 IPMVP	ISO 50001 IPMVP	ISO 14046 Water Footprint

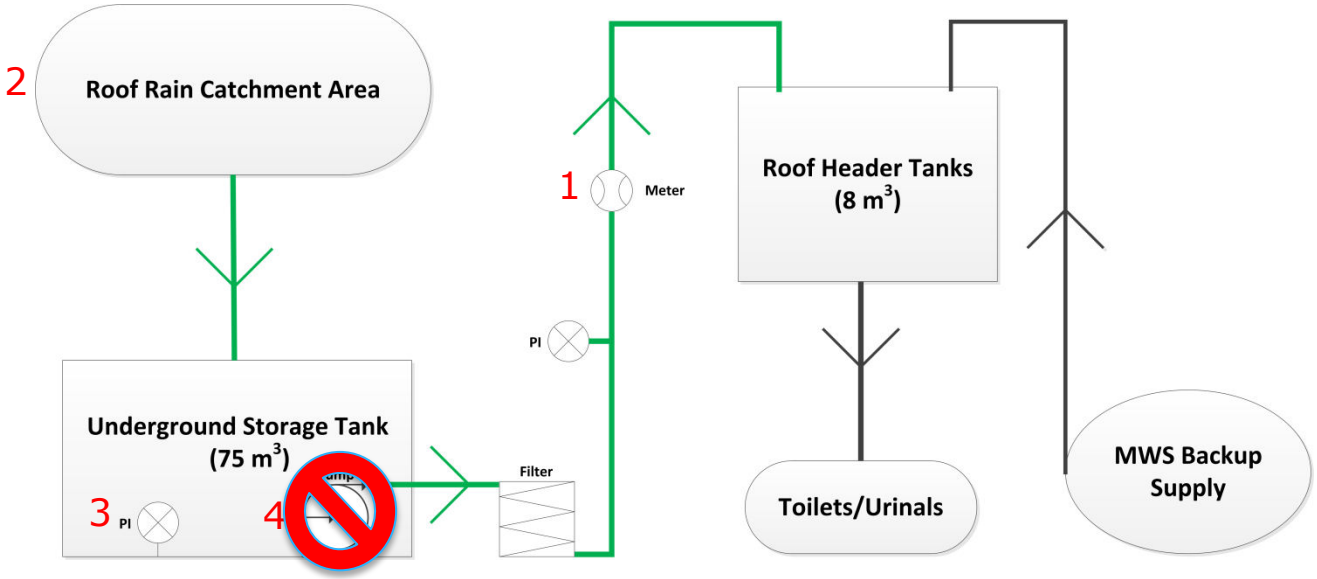




FAULT DETECTION AND DIAGNOSTICS (FDD)

- Energy in Buildings
- Provided 10-30% Energy Savings

EXAMPLE FAULT #2



No.	RWH Signal
1	Rain Water meter = 0 m^3/week
2	Rainfall = 40 m^3/week
3	Pressure Indicator in Storage Tank Specifies = 40 m^3
4	Power to Pump Operational? **Yes**

= Pump Mechanical Fault