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هيئة كهرباء و مياه الشارقة
Sharjah Electricity & Water Authority

Integrating GIS data for Water Distribution Modeling

Case Study:
General Directorate of Water

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Agenda

- Introduction
- Enterprise GIS in SEWA
- Building hydraulic models from Geospatial databases
- WaterGEMS and ArcGIS
- Use of hydraulic model
- Scenario analysis and master planning
- Water loss reduction
- Improving pressure management pumping scheduling
- Conclusions

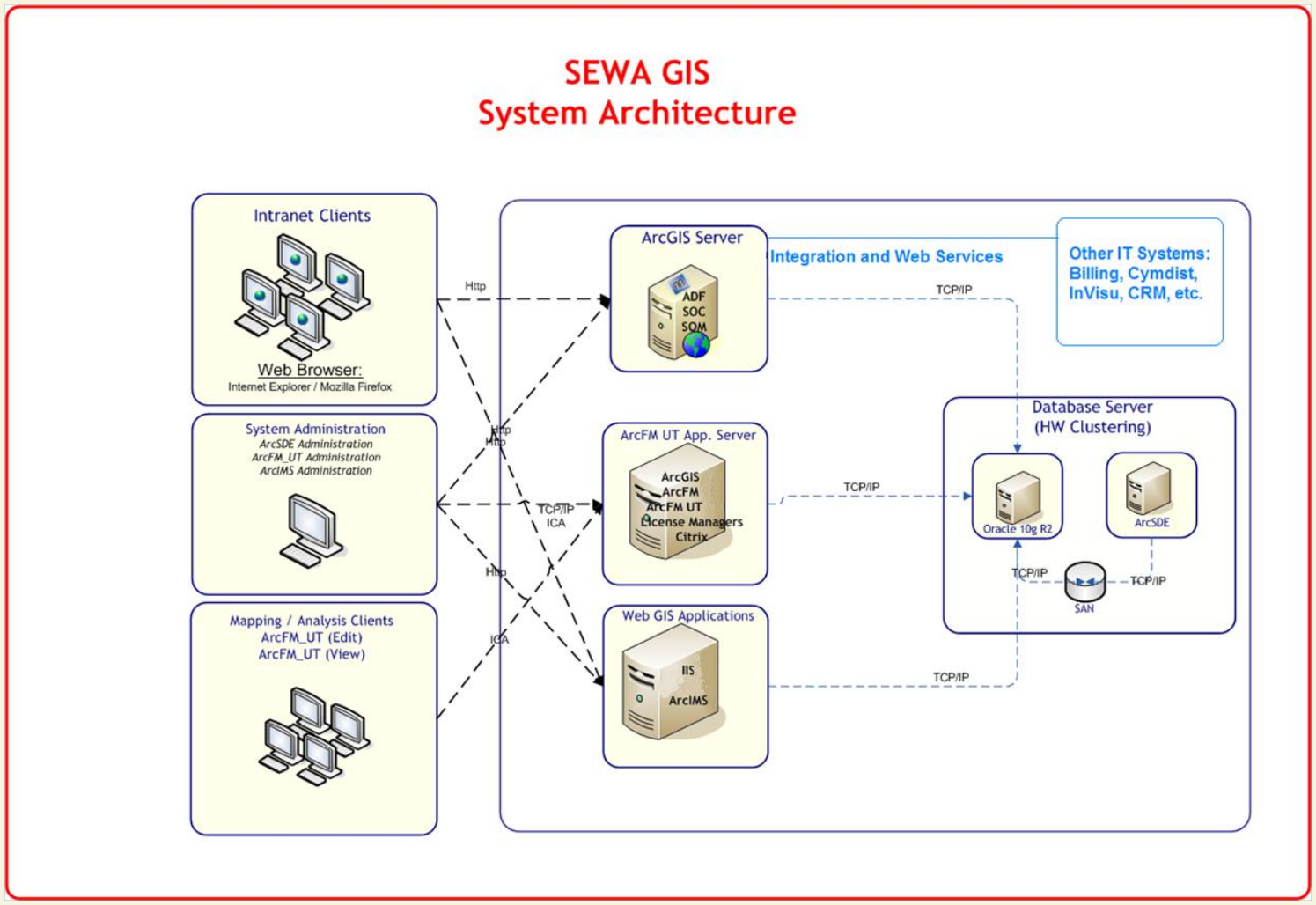
Introduction….

- Authority founded in 1992
- Mission
  - Energy provider for Sharjah emirate of UAE including Khorfakkan and Kalba.
- Challenges
  - Providing Electricity to 350,000 consumers, Water to 270,000 consumers and Gas to 220,000 consumers
  - More than 15,000 KMs of under ground services maintained
  - More than 30,000 on ground components/assets maintained

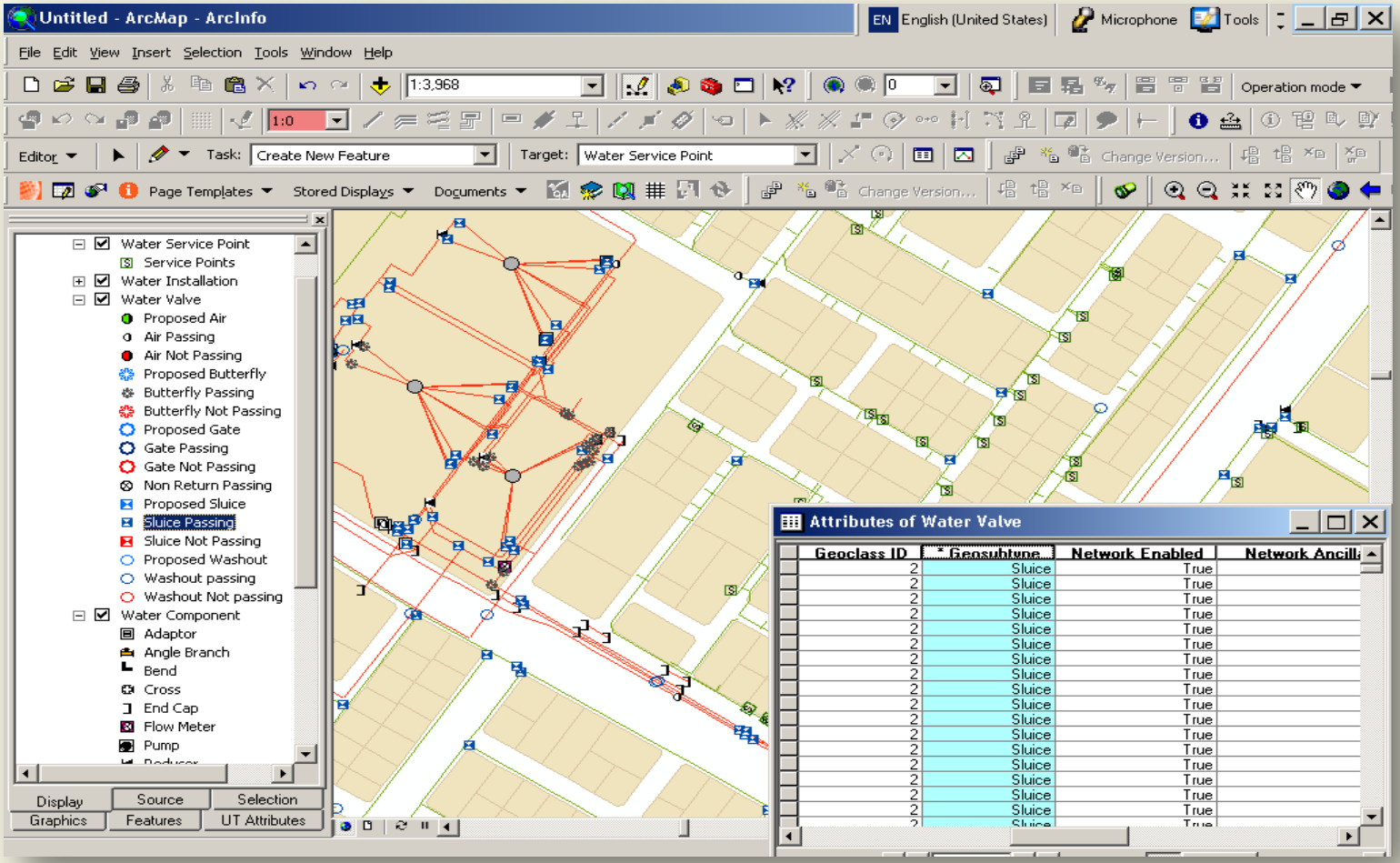
Enterprise GIS in SEWA….

- Implementation of Enterprise GIS(2005-2007) for:-
  - Electricity
  - Water
  - Natural GAS
  - Communication (FOC)
  - Street Light
- Based on ESRI Technologies & Oracle Database
- Create, manage & distribute GIS services using ArcGIS Server
- Editing & Viewing Utilities Network using ArcFM_UT
- Web-based mapping and applications using GeoCortex
- Customized applications using .NET & SQL Server

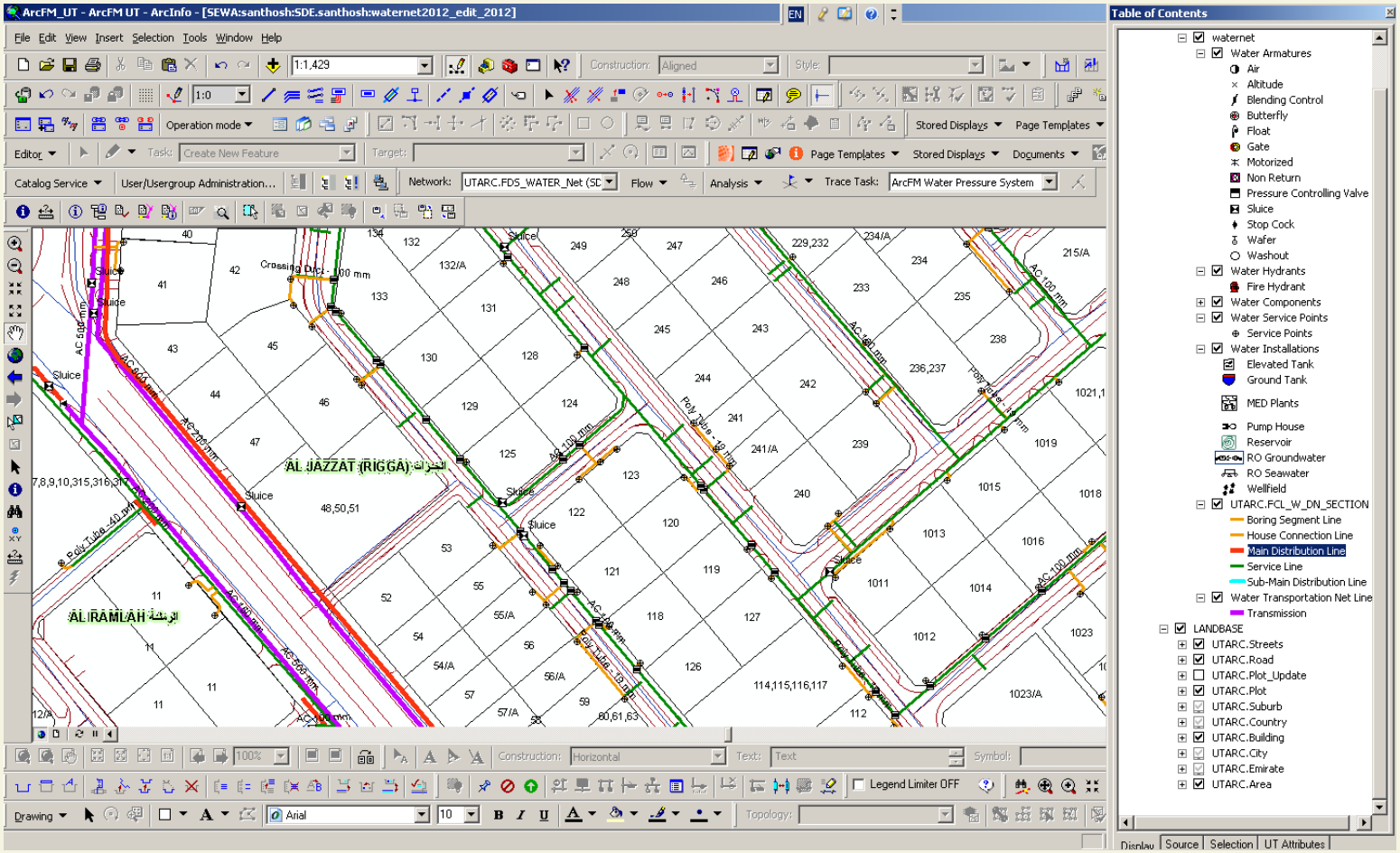
Centralized System Architecture



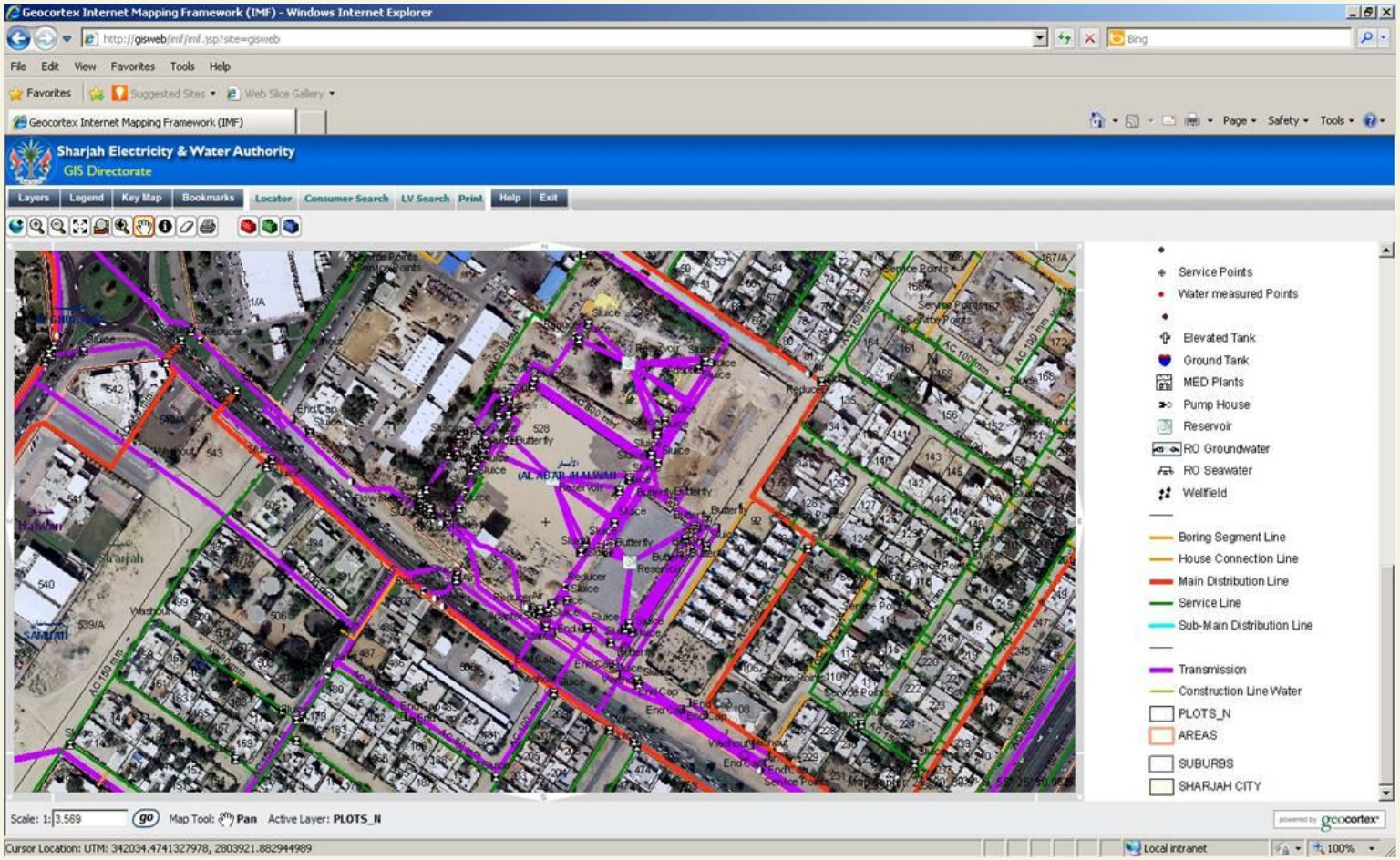
Water Network using ArcGIS (ESRI)



Water Network using ArcFM_UT (SICAD)

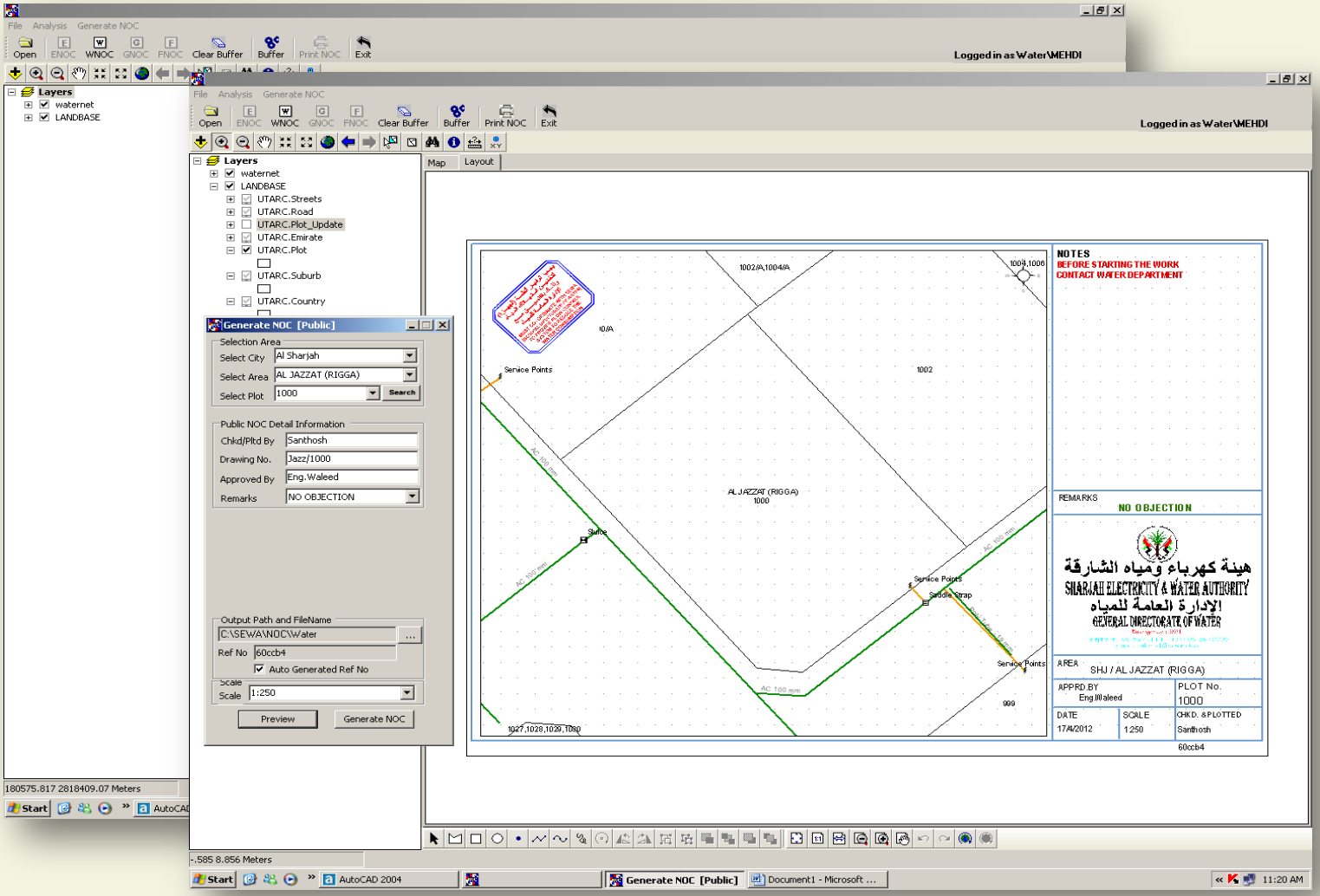


Water Network using Web View (GeoCortex)

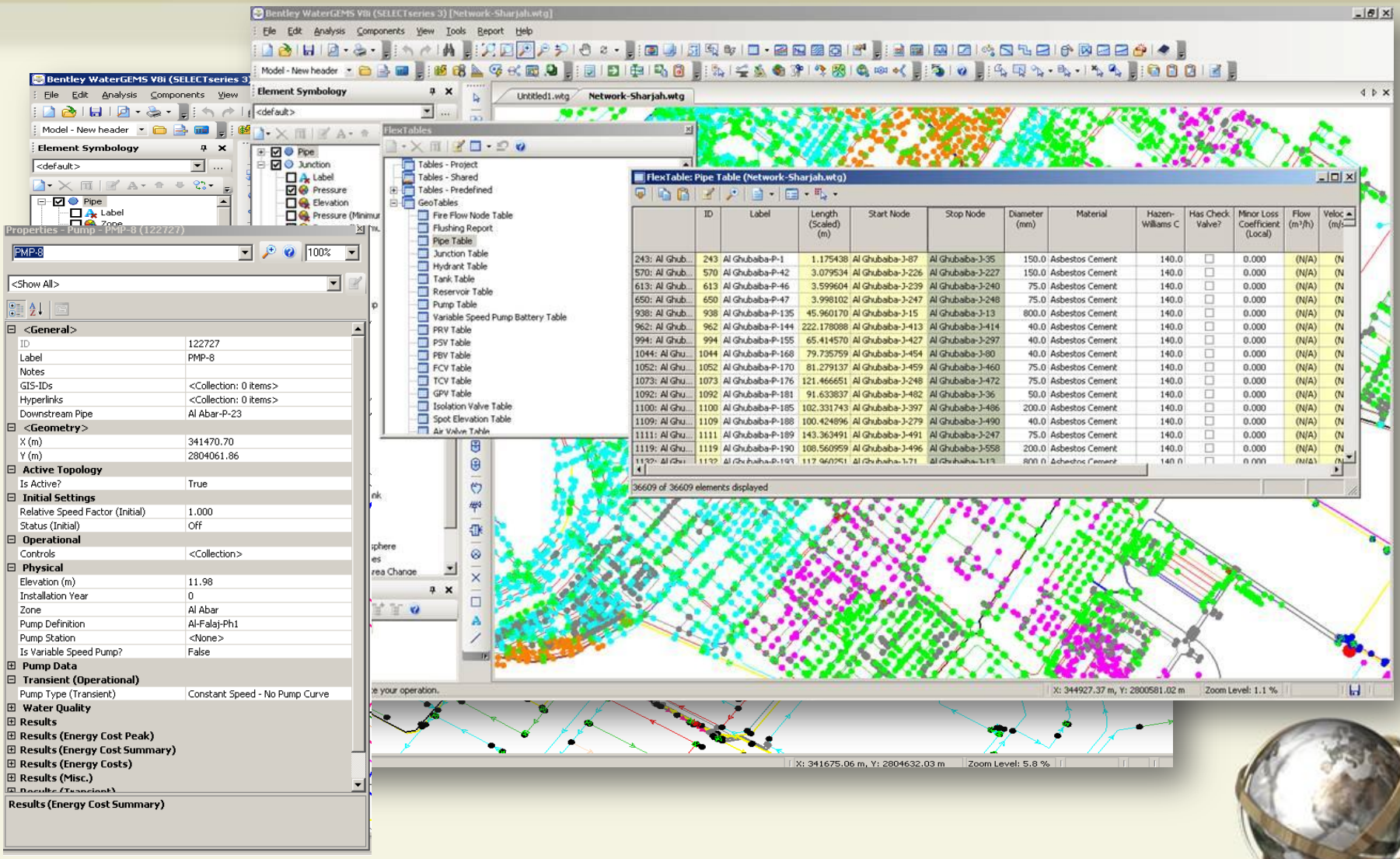


Applicaiton for issuing Certificate (ArcEngine)

No Objection Certificate



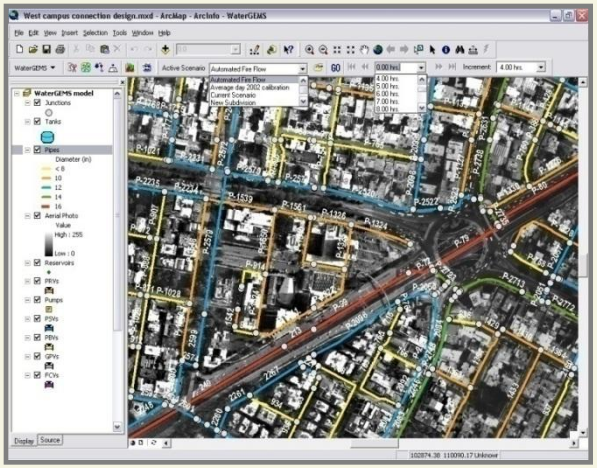
Hydraulic model using WaterGEMS (Bentley)



Water Network Modeling (WaterGEMS)

Water distribution design, modeling and optimization with GIS integration

Hydraulic modeling



- Darwin Designer: network rehabilitation
- Darwin Calibrator: leakage detection
- Darwin Scheduler: energy efficiency

+

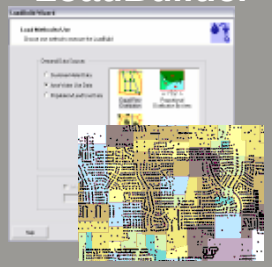
GIS Integration

Bentley GIS Solution

or

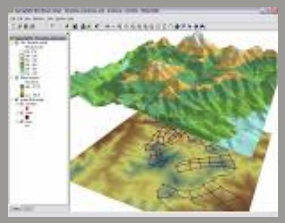
ESRI GIS Solution

Model Builder & LoadBuilder



Bi-directional GIS-model synchronization; Water demand assignment

TRex

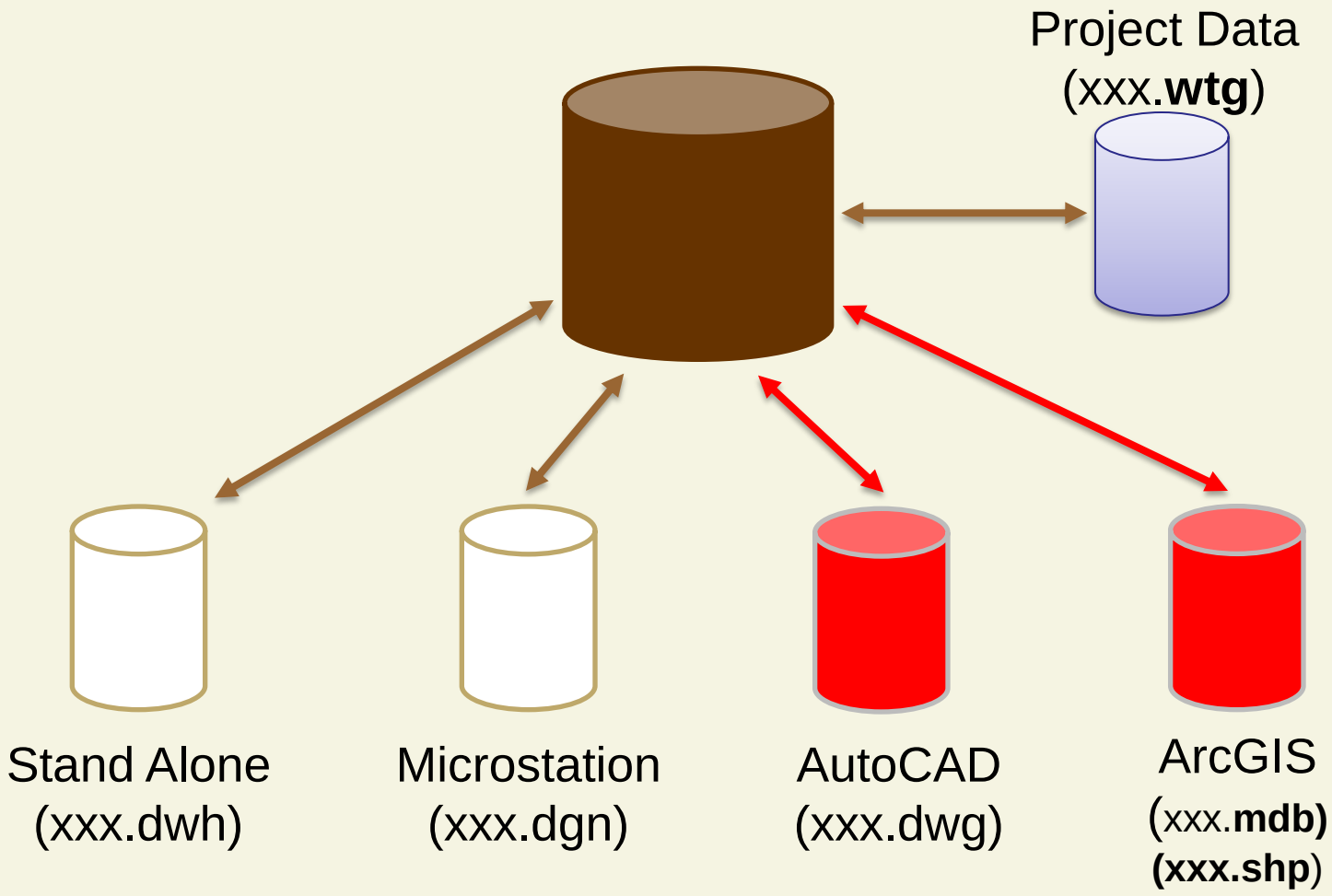


Automated elevation extraction

Model Sources

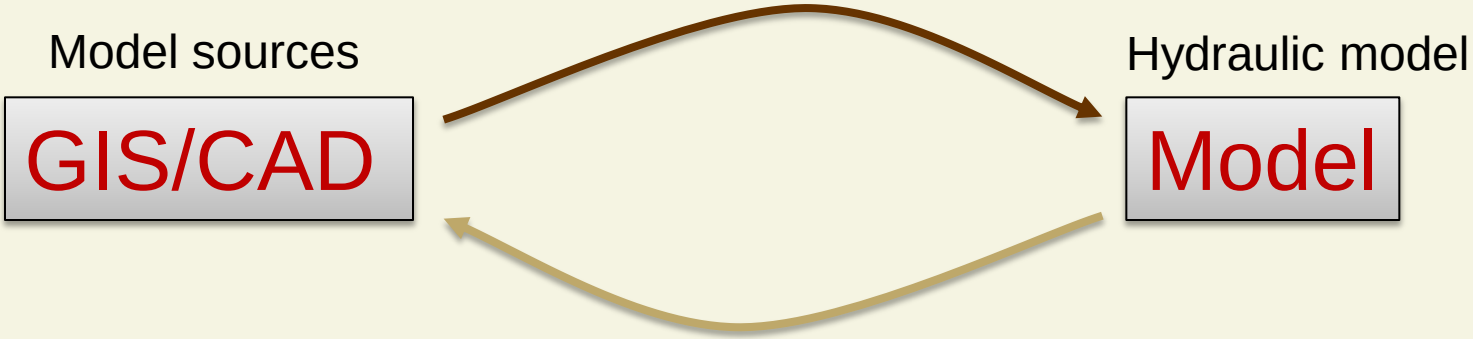
- Access (Jet)
- Coverages
- **Geodatabases**
- Geometric Networks
- dBase
- FoxPro
- ODBC
- OLEDB
- Oracle Spatial
- HTML Import
- HTML Export
- Lotus
- Excel
- Paradox
- **Shapefiles**
- CAD files
- EPAnet
- Old WaterCAD

WaterGEMS Modeling Data



Synchronization between GIS data and Hydraulic Model

Build model from GIS/CAD



Correct GIS/CAD when modeler needs to update underlying data

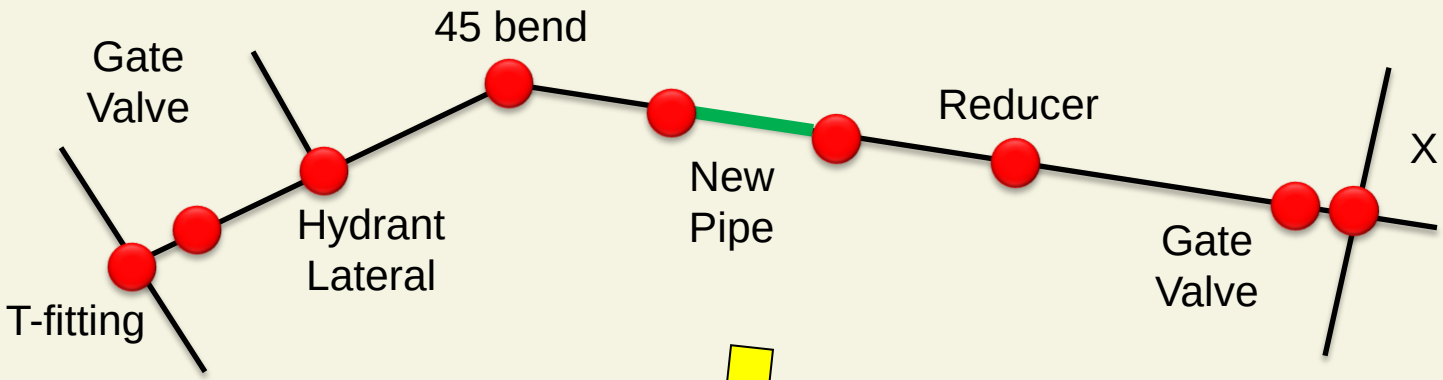
How it Works

Source File e.g. GIS, Excel → **Target File (WaterGEMS Data Store)**

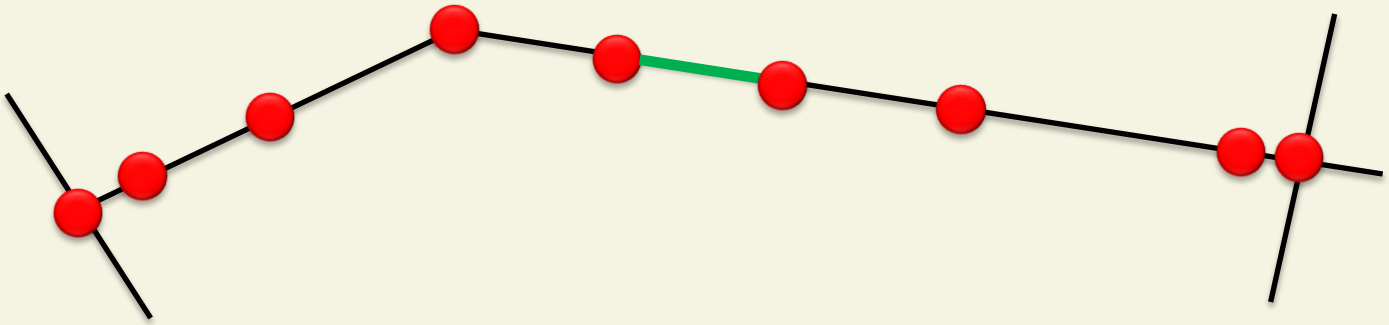
Model Builder

The key is to map and import attributes that are relevant for hydraulic model

GIS Features to Model Elements



GIS View



Model after ModelBuilder

GIS Feature →GEMS Element

Bend, fitting, negligible loss	Pressure junction
Bend, fitting, significant loss	GPV, TCV or minor loss on adjacent pipe
Isolating valve, used for criticality analysis	Isolating valve
Isolating valve, always open, negligible loss	Pressure junction
Isolating valve, always open, significant loss	GPV, TCV or minor loss on adjacent pipe GPV
Isolating valve, normally closed	Closed valve
Air release valve	Pressure junction
Air release valve	Air release valve

GIS Feature →GEMS Element (2)

Customer/lateral	Pressure junction
Hydrant + lateral	Hydrant with lateral as property, hydrant + lateral, or just a hydrant
Check valve in-system	Property of adjacent pipe
Check valve at pump	Part of pump
System water meter	GPV, TCV or minor loss on adjacent pipe
Pump control valve	Pressure junction
Reducer	Pressure junction w/ different diameter each side
Change in material	Pressure junction

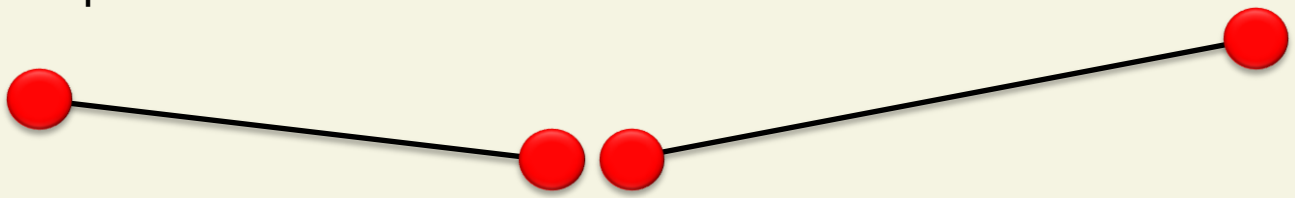
Considerations

- Not all attributes from source GIS files need be copied (e.g. inspection date, other attributes)
- Not all attributes in target file need to come through ModelBuilder (e.g. color coding)
- x,y coordinates automatically come in from Shapefiles/geodatabases/CAD drawings
- System Demands may be better imported using LoadBuilder and customer billing data
- Elevations are best imported from DEMs using TerrainExtractor (TRex)

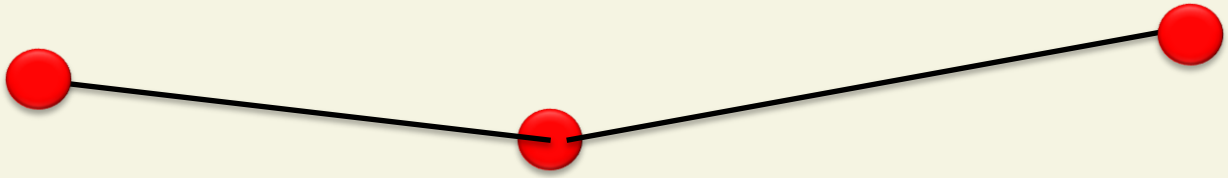
Connectivity Issues

Pipes without end nodes

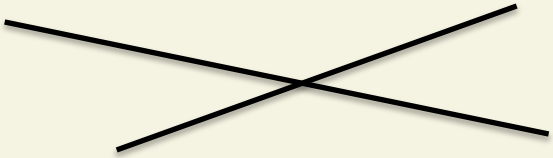
Pipes that do not connect but should



Pipes that appear to connect but are not

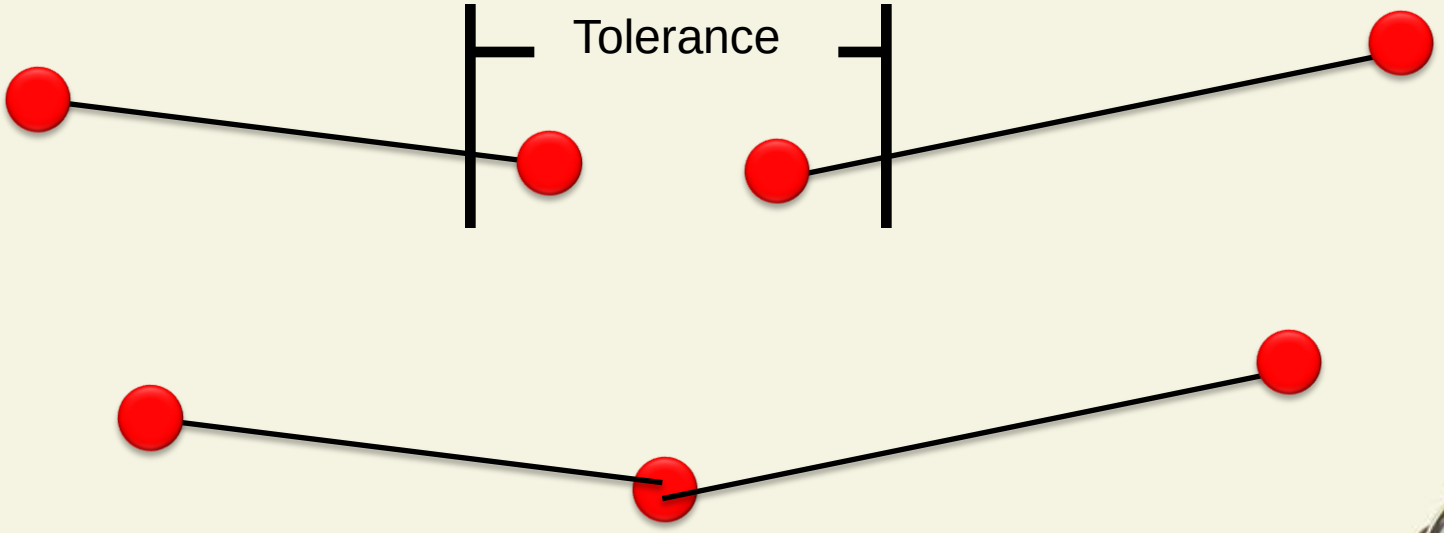


Pipes that cross without junctions



Resolving Connectivity Problems

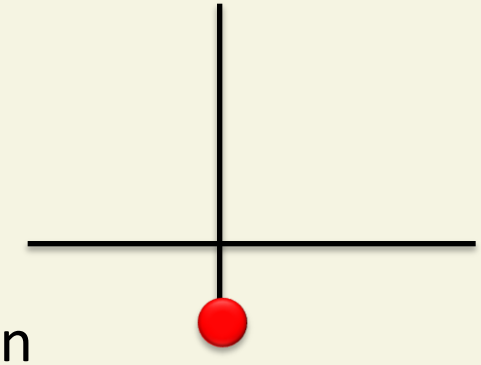
- Add end nodes to pipes without end nodes
- Snap ends of pipes to single node if within (user specified) tolerance

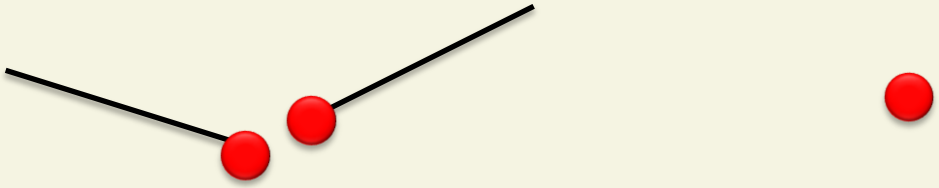


Network Navigator

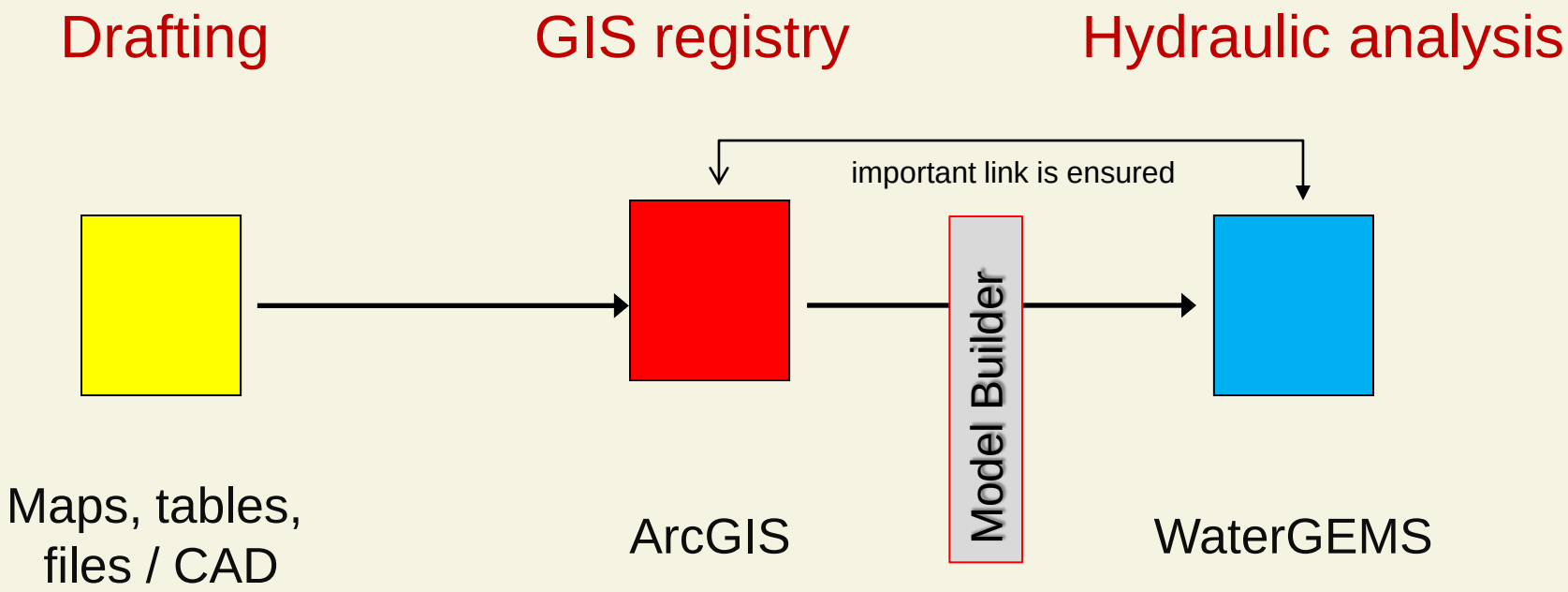
Finds possible problems caused by

- Nodes in close proximity to other nodes
- Nodes in close proximity to pipes
- Orphaned nodes
- Elements with messages from previous run
- Tracing and connectivity analysis





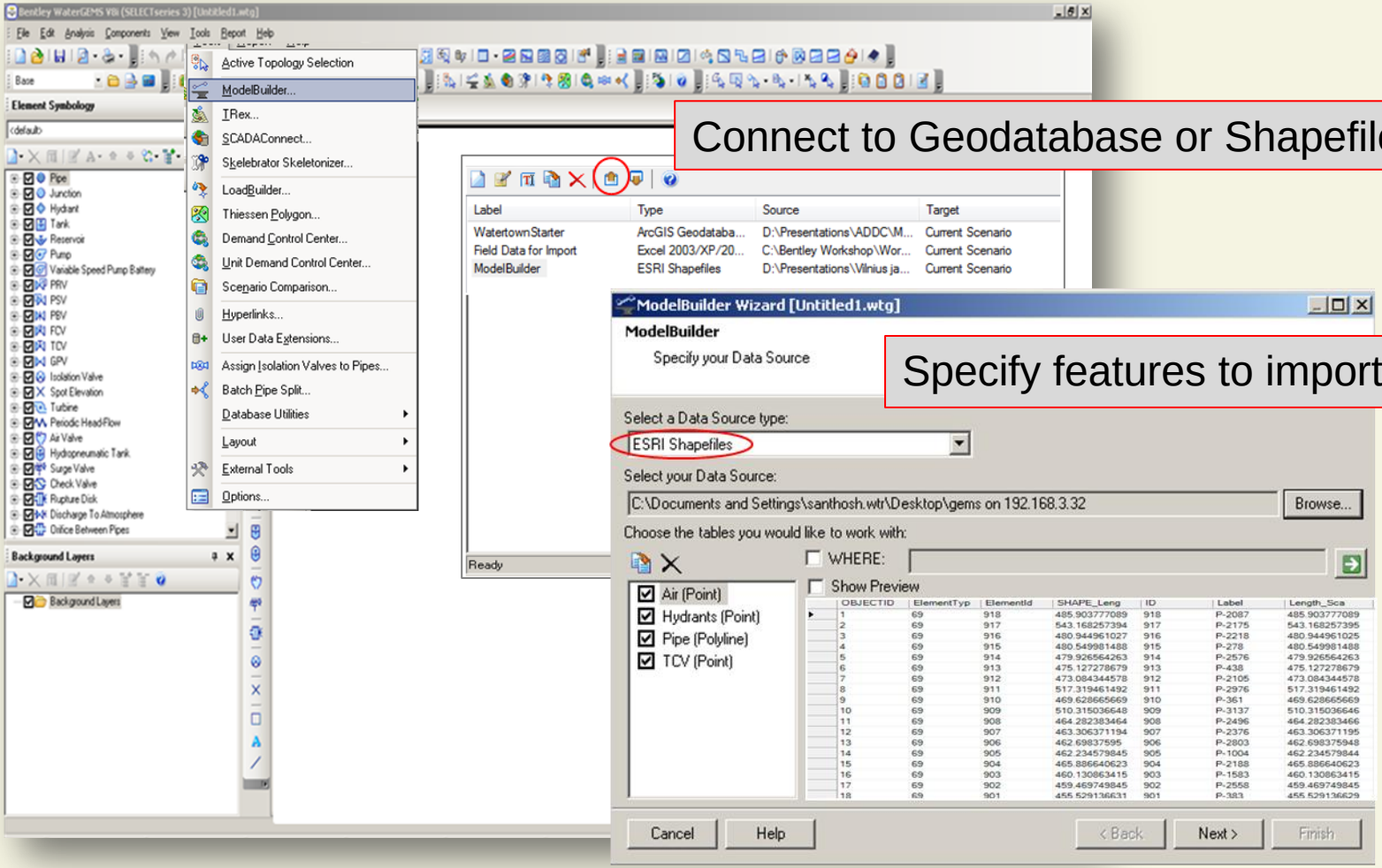
Work Flow


Drafting
GIS registry
Hydraulic analysis
important link is ensured
Model Builder
Maps, tables, files / CAD
ArcGIS
WaterGEMS

Describe the GIS asset registry creation of SEWA

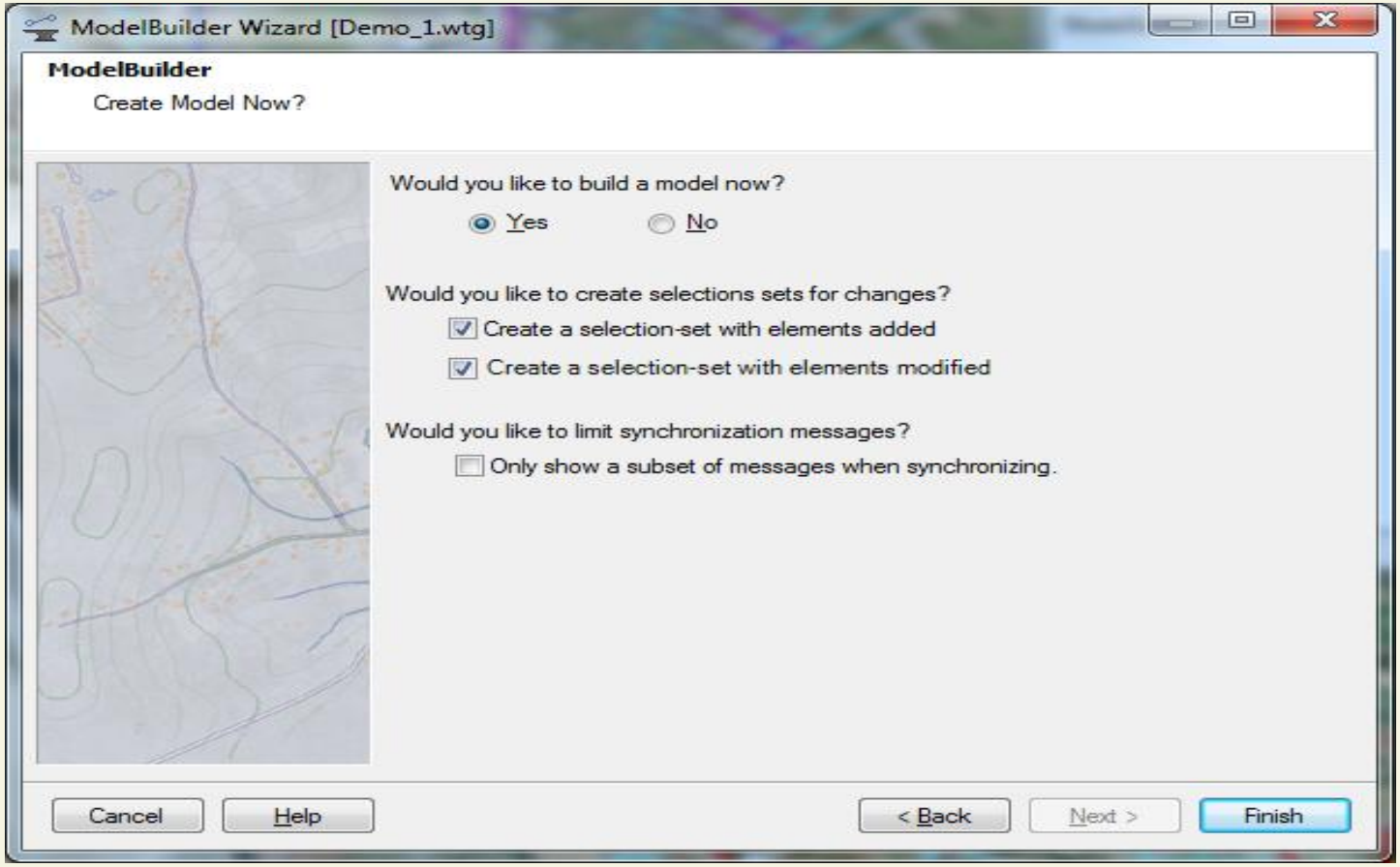
- CAD files used…
- Maps and as build drawings…
- XLS, TXT, and other data files used
- Shape files
- ArcGIS Geospatial databases (.MDB)
- OracleSpatial 10g

Model Builder module of WaterGEMS

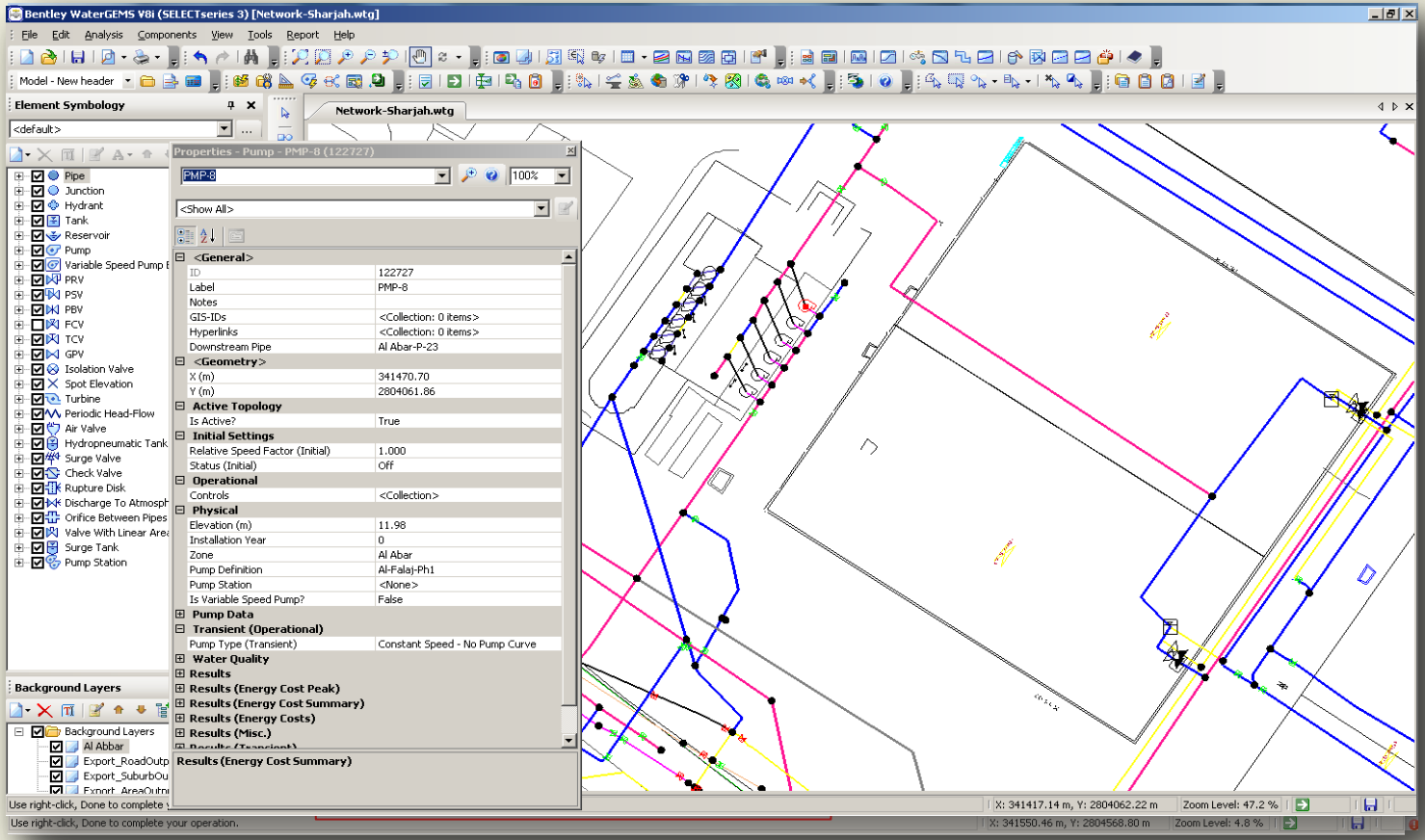


Model Builder module of WaterGEMS

Build or Synchronize model from GIS data



WaterGEMS hydraulic model for SEWA



Pumping Station and Reservoir Location
Al Abbar (Halwan) Area

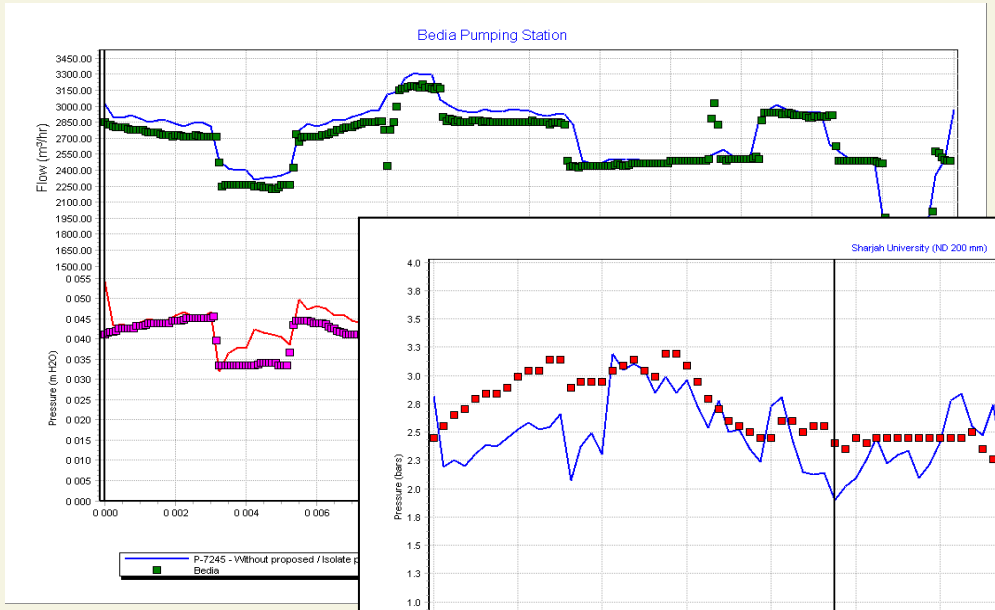
Calibration

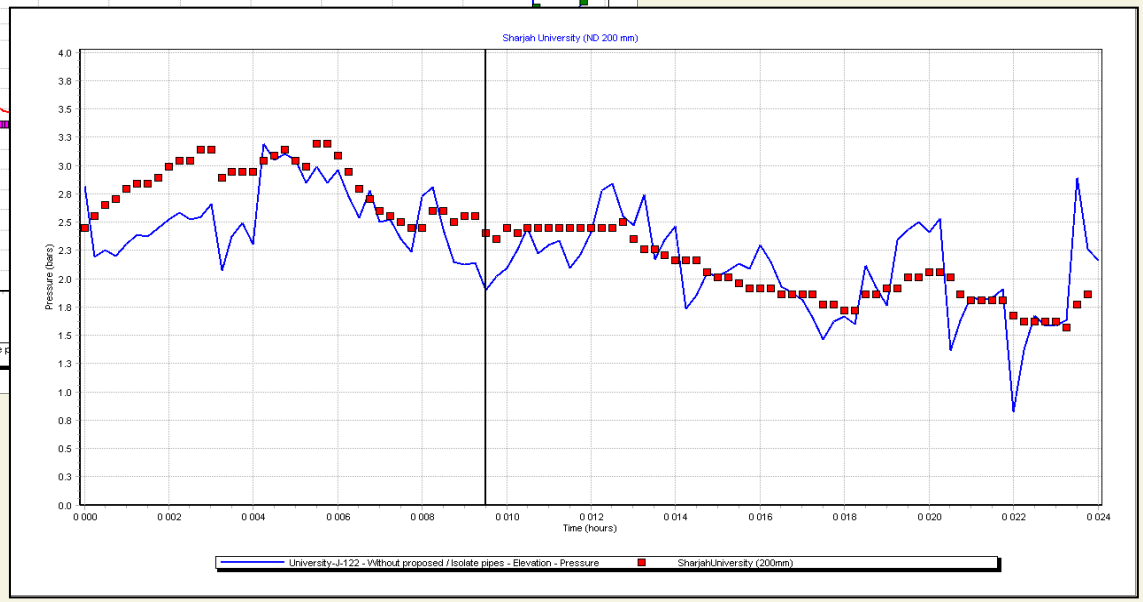
To Guarantee the reality of the model

- Comparing the field survey measurements and the modelling results
- Adjust hydraulics parameters in order to get the same results (consumption profile, consumption coefficient, …)
- 50 temporary locations have been prepared for the field survey

Hydraulic model – Results – Calibration curves

Bedia Flow and pressure

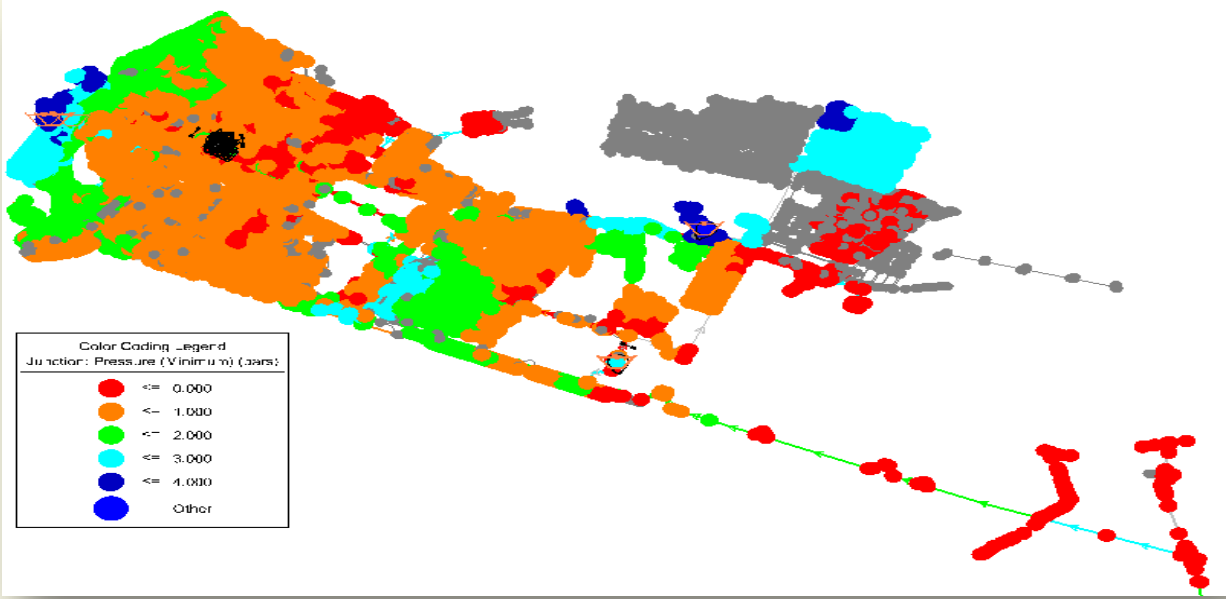




Pressure at University

Diagnosis of the potable water network (minimum pressure)

- Low pressure (criteria to be defined with SEWA)
- High velocities
- Major head losses



Conclusions

1. Scenario comparisons for real-time network operational decisions
2. Finding leakages hot-spots using hydraulic model and measured flow and pressure data
3. Better pressure management and optimal pumping scheduling
4. Planning the renewal of the pipes using the Pipe Renewal Planning Module
5. Updating GIS with modeling results

Thank You ☺

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