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Introduction to Epanet

Objective:

Introduction to Epanet (water supply simulation software) using a geo-referenced map.

Part 1
Refreshing of basic hydraulics concept used in Epanet

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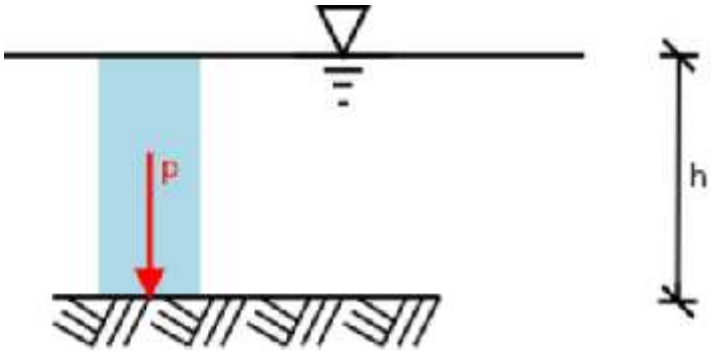
Introduction to Epanet

Basic hydraulic knowledge for Epanet

Hydrostatic pressure



p = ρ * g * h
p = pressure
ρ = Fluid density (water)
g = Acceleration (gravity)
h = high of water over the point

p = ρ * g * h
p = 1000 kg/m³ * 9.81 m/s² * 10m
p = 98 100 kg/(m*s²)
p = 98 100 N/m²
p = 98.1 kN/m²

Units:

p = 98100 N/m² = 98100 Pa = 0.981 bar = 32.819 foot of water = 10.0034 m of water

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Basic hydraulic knowledge for Epanet

Relative and absolute pressure

$p_{abs} = pA + \rho * g * h$

- Absolute pressure: p_{abs}
- Atmospheric pressure: pA
- hydrostatic pressure: $\rho * g * h$

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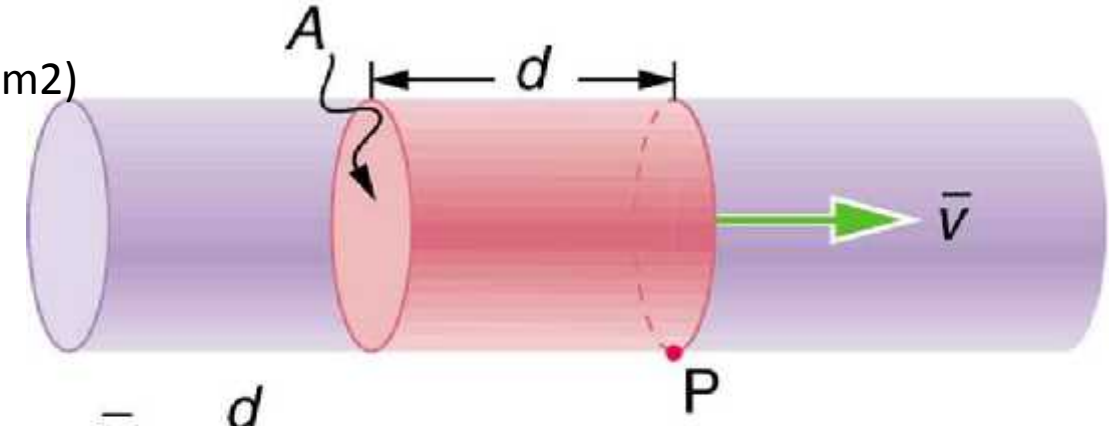
Basic hydraulic knowledge for Epanet

Flow and velocity in round pipes
Water under pressure (full pipe)

The pipe must be filled

$v = Q / A = 4 * Q / (\pi * d^2)$ $\quad Q=v*A$

- v = velocity (m / s)
- Q = Flow (m^3 / s)
- A = Surface of the section of the pipe (m2)
- d = Diameter (m) (d in Epanet (mm)



$$\bar{v} = \frac{d}{t}$$

$$Q = \frac{V}{t} = \frac{Ad}{t} = A\bar{v}$$

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Basic hydraulic knowledge for Epanet

Equation of continuity

$Q = v / A = \text{const}$

- v = velocity m / s
- Q = flow en m^3 / s
- A = Pipe section transversal m^2

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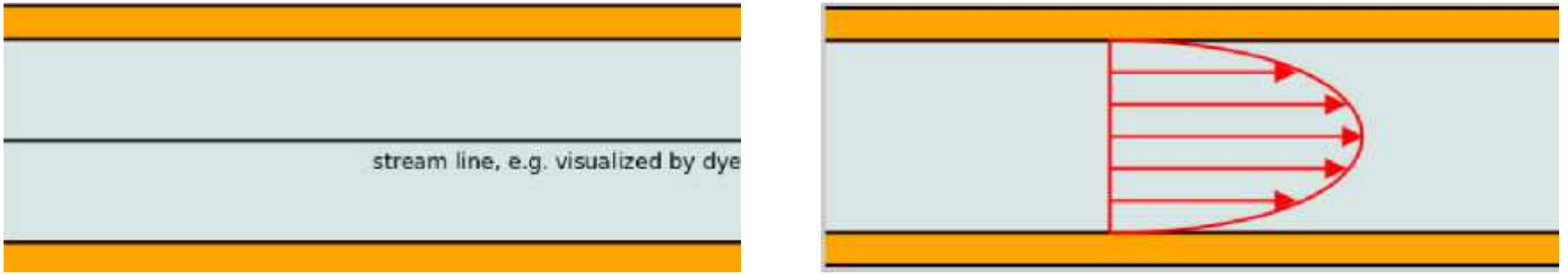
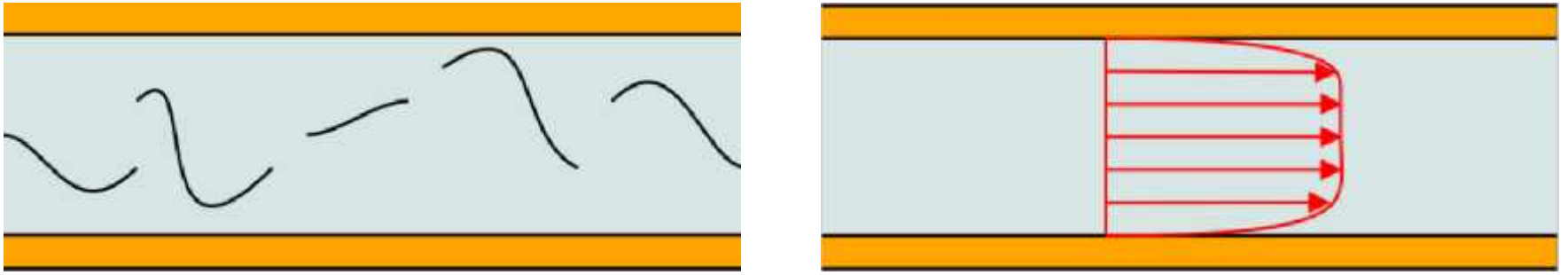
Flow types: laminar - turbulent

laminar



turbulent



EPANET considers both types of flows!

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Reynolds number (Re) is used to numerically describe the type of flow

- laminar
- transition
- turbulent

- laminar: Re <2000
- transition : 2000 <Re <4000
- turbulent Re> 4000

For flow in a pipe or tube, the Reynolds number is generally defined as:[11]

$$\mathrm{Re} = \frac{\rho \mathbf{v} D_H}{\mu} = \frac{\mathbf{v} D_H}{\nu} = \frac{\mathbf{Q} D_H}{\nu A}$$

where:

- D_H is the hydraulic diameter of the pipe; its characteristic travelled length, L, (m).
- $\mathbf{Q}$ is the volumetric flow rate (m^3/s).
- A is the pipe *cross-sectional* area (m^2).
- $\mathbf{v}$ is the mean velocity of the fluid (SI units: m/s).
- μ is the dynamic viscosity of the fluid (Pa·s = N·s/m^2 = kg/(m·s)).
- ν is the kinematic viscosity ($\nu = \mu/\rho$) (m^2/s).
- ρ is the density of the fluid (kg/m^3).

The simulation with turbulent flow are different than laminar flow

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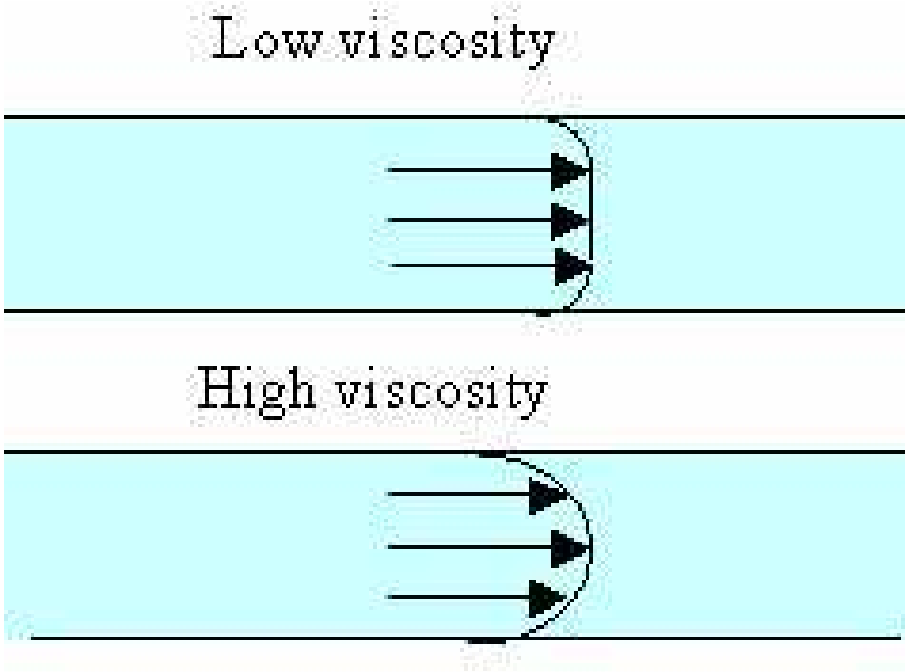
Viscosity

- A liquid with high viscosity resists deformation (i.e. Honey).
- Viscosity of water depends on the temperature
  -- with 20 ° C: ν = 1,01 * 10-6 m² / s
  -- with 10 ° C: ν = 1,31 * 10-6 m² / s

FOR EPANET:
If water temperature is not around 20°C you could consider it in Epanet in the parameter of the "relative viscosity"



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Relative viscosity in Epanet

Temperatura agua	Viscosidad relativa al agua de 20°C	Temperatura agua	Viscosidad relativa al agua de 20°C	Temperatura agua	Viscosidad relativa al agua de 20°C	Temperatura agua	Viscosidad relativa al agua de 20°C
1	1.7	26	0.87	51	0.586	76	0.436
2	1.666	27	0.852	52	0.58	77	0.43
3	1.612	28	0.833	53	0.574	78	0.424
4	1.558	29	0.815	54	0.568	79	0.419
5	1.504	30	0.796	55	0.562	80	0.413
6	1.463	31	0.782	56	0.556	81	0.407
7	1.421	32	0.767	57	0.55	82	0.401
8	1.38	33	0.753	58	0.544	83	0.395
9	1.338	34	0.738	59	0.538	84	0.389
10	1.297	35	0.724	60	0.532	85	0.383
11	1.265	36	0.709	61	0.526	86	0.377
12	1.232	37	0.695	62	0.52	87	0.371
13	1.2	38	0.68	63	0.514	88	0.365
14	1.167	39	0.666	64	0.508	89	0.359
15	1.135	40	0.651	65	0.502	90	0.353
16	1.108	41	0.646	66	0.496	91	0.347
17	1.081	42	0.64	67	0.49	92	0.341
18	1.054	43	0.634	68	0.484	93	0.335
19	1.027	44	0.628	69	0.478	94	0.329
20	1	45	0.622	70	0.472	95	0.323
21	0.978	46	0.616	71	0.466	96	0.317
22	0.956	47	0.61	72	0.46	97	0.311
23	0.933	48	0.604	73	0.454	98	0.305
24	0.911	49	0.598	74	0.448	99	0.299
25	0.889	50	0.592	75	0.442	100	0.293

i.e desert situation during day

Water Temp. °C	Rel. Viscosity to water of 20°C
26	0.87
27	0.852
28	0.833

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Basic hydraulic knowledge for Epanet

Friction loss along pipes

Energy is dissipated due to friction of water (particle)

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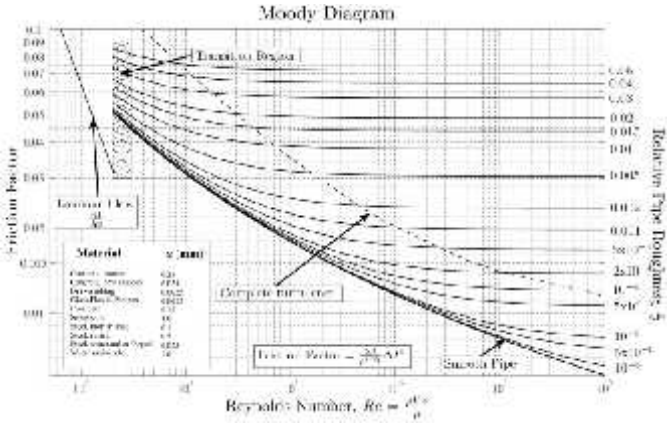
Basic hydraulic knowledge for Epanet

Friction loss, Darcy-Weisbach

$$HL = f \times \frac{L}{D} \times \frac{V^2}{2g}$$

- hf = friction loss mm
- f = friction parameter (non dimension) (Darcy) -> Moody Diagram
- l = length of pipe m
- d = diameter of pipe en m
- v = velocity of water m / s
- g = 9,81 m / s ²



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Basic hydraulic knowledge for Epanet

Friction loss, Hazen-Williams

$$H_L = \frac{4.727 L Q^{1.852}}{C^{1.852} d^{4.871}}$$

where:

HL = friction loss m
Q = flow m3/s
L = length of pipe m
d = Diameter of pipe m
C = coefficient (Hazen-Williams C-factor) no dimension

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Basic hydraulic knowledge for Epanet

Friction loss, Chezy-Manning

$$H_L = \frac{4.66 n^2 L Q^2}{d^{5.33}}$$

Where

HL = friction loss m
Q = flow
L = length of pipe m
d = diameter of pipe m
n = friction coefficient of Manning no dimension

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Basic hydraulic knowledge for Epanet

$$H_L = \frac{4.727 L Q^{1.852}}{C^{1.852} d^{4.871}}$$

The **Hazen-Williams formula** is the most commonly used headloss formula in the US. It cannot be used for liquids other than water and was originally developed for turbulent flow only.

$$HL = f \times \frac{L}{D} \times \frac{V^2}{2g}$$

The **Darcy-Weisbach formula** is the most theoretically correct. It applies over all flow regimes and to all liquids.

$$H_L = \frac{4.66 n^2 L Q^2}{d^{5.33}}$$

The **Chezy-Manning formula** is more commonly used for open channel flow.

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Introduction to Epanet

Basic hydraulic knowledge for Epanet

Darcy-Weisbach

$$HL = f \times \frac{L}{D} \times \frac{V^2}{2g}$$

Hazen-Williams

$$H_L = \frac{4.727 L Q^{1.852}}{C^{1.852} d^{4.871}}$$

Chezy-Manning

$$H_L = \frac{4.66 n^2 L Q^2}{d^{5.33}}$$

Q = v*A

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Basic hydraulic knowledge for Epanet

Friction loss

Roughness Coefficients for New Pipe

Material	Hazen-Williams C (unitless)	Darcy-Weisbach (mm)	Manning's n (unitless)
Cast Iron	130 - 140	0.25908	0.012 - 0.015
Concrete or Concrete Lined	120 - 140	0.3048 – 3.048	0.012 - 0.017
Galvanized Iron	120	0.01524	0.015 - 0.017
Plastic	140 - 150	0.001524	0.011 - 0.015
Steel	140 - 150	0.04572	0.015 - 0.017
Vitrified Clay	110	0	0.013 - 0.015

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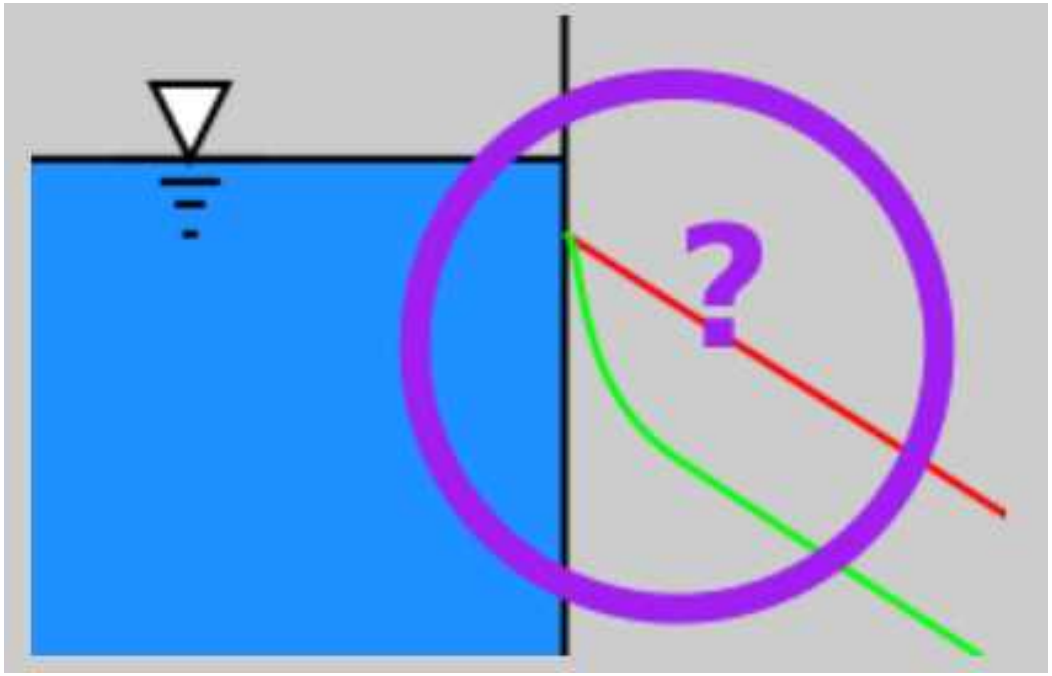
Basic hydraulic knowledge for Epanet

Minor losses or local losses

- Minor losses

i.e. Bends, fitting, valves, etc.

Below the coefficient to consider in the setup of Epanet:



FITTING	*LOSS COEFFICIENT*
Globe valve, fully open	10.0
Angle valve, fully open	5.0
Swing check valve, fully open	2.5
Gate valve, fully open	0.2
Short-radius elbow	0.9
Medium-radius elbow	0.8
Long-radius elbow	0.6
45 degree elbow	0.4
Closed return bend	2.2
Standard tee - flow through run	0.6
Standard tee - flow through branch	1.8
Square entrance	0.5
Exit	1.0

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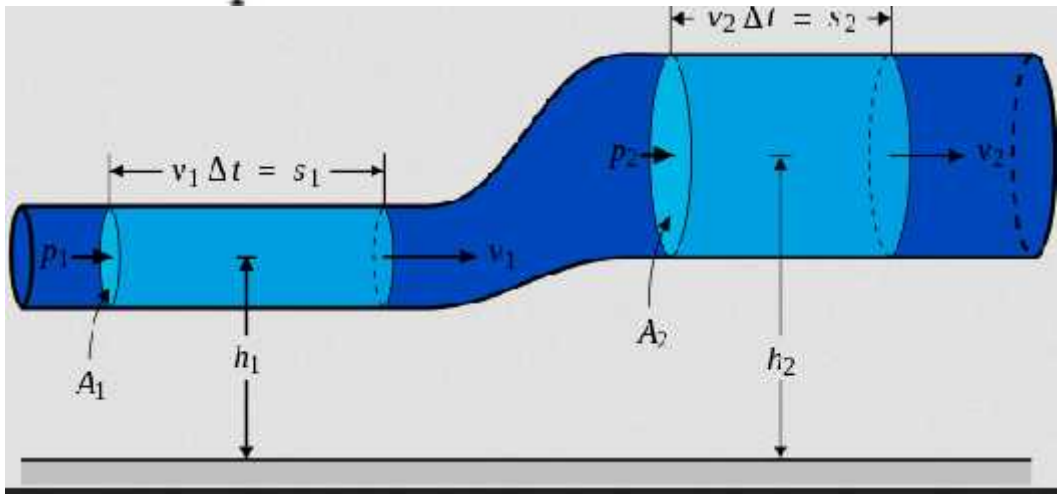
Basic hydraulic knowledge for Epanet

BERNOULLI'S EQUATION

$$\frac{1}{2}\rho V^2 + \rho g h + P = \text{constant}$$

where ρ = density of water,
V = velocity of water.
g = acceleration due to gravity.
h = elevation (height) of water.
P = pressure of water.



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Basic hydraulic knowledge for Epanet

Flow classification: stable / unstable

- stable flow doesn't change over the time
- unstable flow changes over the time

I.e. Parameter that could change:

- Speed
- Flow
- Pressure

Introduction to Epanet

Basic hydraulic knowledge for Epanet

Flow classification: stable / unstable

- EPANET simulates ONLY constant flow

- Water hammer is an example of unstable flows in pipe
- The simulation over time allows to analyse different flows in the pipe (pattern)

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Introduction to Epanet

Fire fighting, fire water

In urban setting think about water for fire fighters

A regulation might exist

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Introduction to Epanet

Fire fighting, fire water

Planungsrichtwerte für die Brandbekämpfung

Art der Bebauung	Risiko bezogen auf die Art der Bebauung	Q [l/min] 1)	Löschreserve [m³] 2)
Einzelobjekte, z.B.			
Einzelnes Wohnhaus	klein	600–900	20–100
Einzelnes landwirtschaftliches Gut	mittel	1000	20–100
Weiler, kleiner Ort in offener Bauweise	gross	1200	20–100
Dorfgebiet, z.B.			
Dorf mit offener Bauweise	klein	1500	150
Dorf mit teilweise geschlossener Bauweise	mittel	1800	200
Dorf mit Gewerbezone	gross	2200	300
Stadtgebiet, z.B.			
Städtische Quartiere	klein	2400	300
Städtische Überbauung mit Gewerbezone	mittel	2800	400
Stadtgebiet mit Warenhäusern, Hotels etc.	gross	3200	500
Industrie und Grossbetriebe, z.B.			
Sachwert bis 5 Mio., Umweltgefährdung normal 3)	klein	3600	600
Sachwert bis 50 Mio., Umweltgefährdung erhöht 3)	mittel	4800	700
Sachwert über 50 Mio., Umweltgefährdung gross 3)	gross	5400	800

1) Bedarf für Sprinkler und Feuerwehr; der Anteil Feuerwehr beträgt gemäss Brandschutzrichtlinie Sprinkleranlagen der VKF 300–900 l/min. Beim Einsatz von Sprinkleranlagen sind die Erläuterungen in den Abschnitten 4.2.2.3 und 5.3.6 zu berücksichtigen
2) Bei gesicherter Leistungsfähigkeit der Wasserversorgung in Bezug auf die Nachspeisung kann die Löschreserve reduziert werden
3) vgl. Brandschutzrichtlinie Sprinkleranlagen der VKF

Introduction to Epanet

Basic hydraulic knowledge for Epanet

Limitation of Epanet

With Epanet is not possible to simulate open channels

Typical open channels:

- river
- Sewer

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Basic hydraulic knowledge for Epanet

Limitation of Epanet

Epanet doesn't have plugins

Thanks

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Introduction to Epanet

Part 2, *developing a simple network with Epanet and run a simple analysis*

Objectives:

We develop a very simple water supply composed by:

1. Source (spring)
2. Pump from spring to “elevated” reservoir (25m3)
3. Gravity distribution to the village (or refugees camp)
4. Distribution points in the village with a given demand

Existing data

1. Spring yield and ground elevation
2. Pump performance data
3. Nodes location and elevation
4. Type and length of pipe
5. Elevation, type and size of reservoir
6. Average water demand at water distribution points over 24 hr (daily water consumption)

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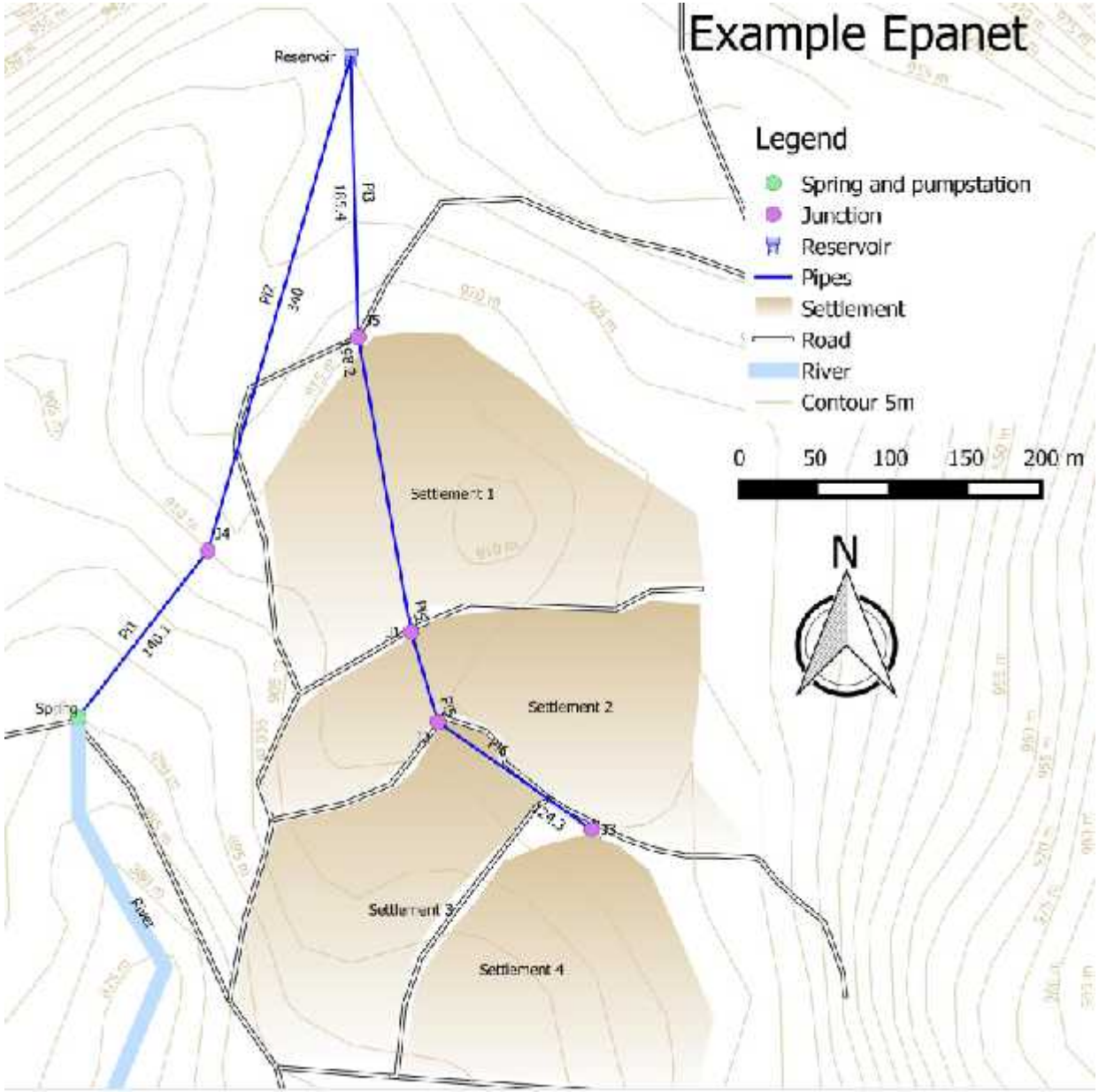

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Introduction to Epanet

Necessary data related to the Epanet network

Junction	Elevation (m)	Information
J1	913	Settlement 2; 20 families; 4'000 l/d; 0.0463 l/s
J2	912	Settlement 3; 40 families; 8'000 l/d; 0.0926 l/s
J3	915	Settlement 4; 60 families; 12'000 l/d; 0.139 l/s
J4	910	No demand; joint control valve
J5	916	Settlement 1; 50 families; 10'000 l/d; 0.115 l/s
TOTAL		**170 families, 850 individuals, 34'000 l/d, 0.395 l/s**
Tank	930	Round reservoir, 25.1 m3, 4m diameter, 2.5m wall height, ground elevation 930m (inlet), Elevation overflow 932m.
Spring (R1)	890	Good water quality, seasonal variation on yield, max 15m3/h min 11m3/h
Pump (Pu1)	890	NB 32-200.1/207 A-F-A-BAQE (6m3/h, h=70m) located few meter from spring (see Grundfos webcaps for selection, www.grundfos.com)
Pipes uPVC		
Pi1		140.1 m (from pump)
Pi2		340.0m
Pi3		185.4m
Pi4		198.2m
Pi5		62.5m
Pi6		124.3m

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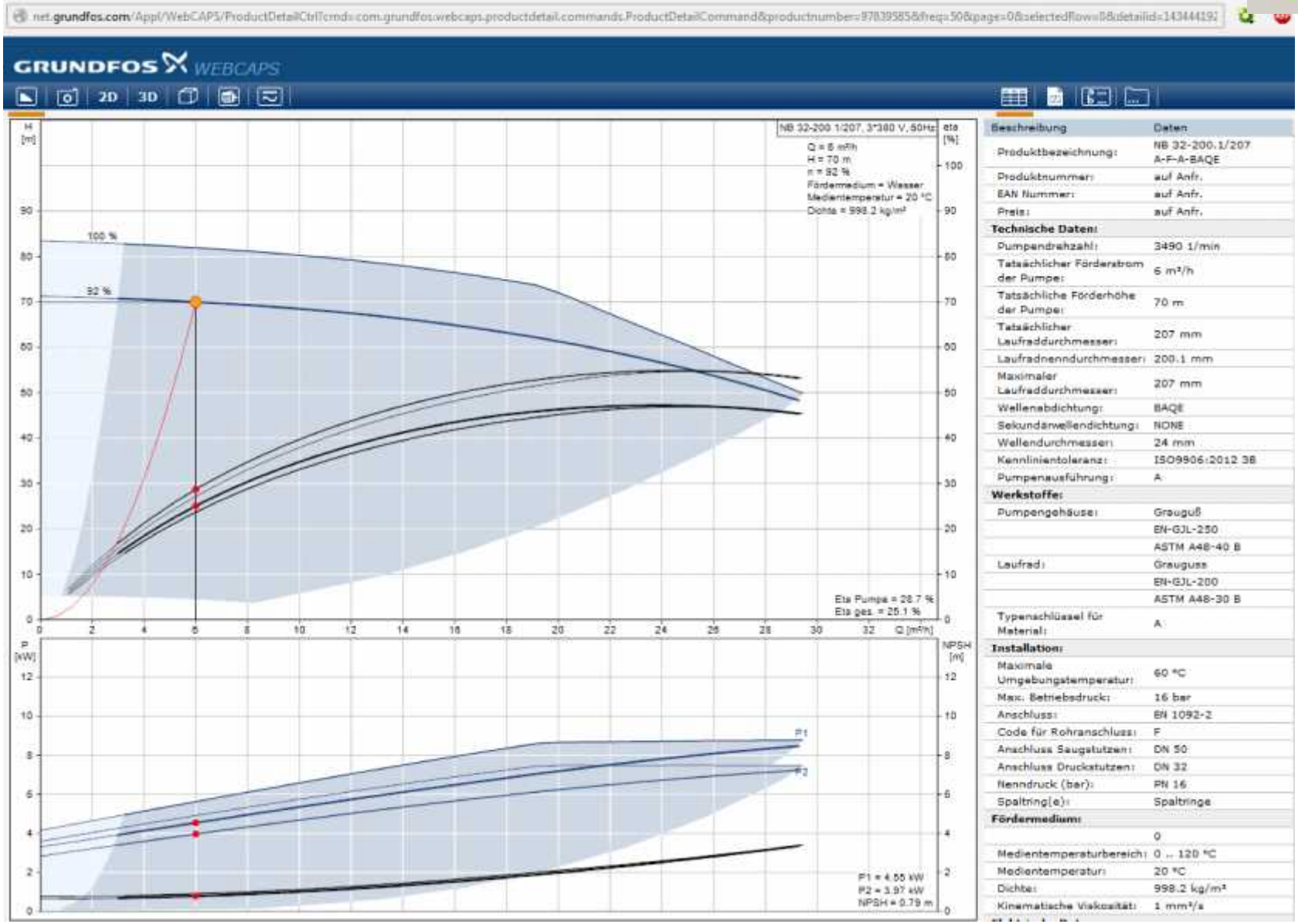
EPANET

Pump specification



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uPVC pipes						
Code	ND	Pressure	IntD	C	Pressure	Thickness
	(mm)	Bar	(mm)		m H2O	mm (max)
P20-16	20	16	17.0	140	162.56	1.5
P25-12	25	12.5	22.0	140	127	1.5
P25-16	25	16	21.2	140	162.56	1.9
P32-10	32	10	28.8	140	101.6	1.6
P32-12	32	12.5	28.2	140	127	1.9
P32-16	32	16	27.2	140	162.56	2.4
P40-6	40	6.3	37.0	140	64.01	1.5
P40-10	40	10	36.2	140	101.6	1.9
P40-12	40	12.5	35.2	140	127	2.4
P40-16	40	16	34.0	140	162.56	3
P50-6	50	6.3	46.8	140	64.01	1.6
P50-10	50	10	45.2	140	101.6	2.4
P50-12	50	12.5	44.0	140	127	3
P50-16	50	16	42.6	140	162.56	3.7
P63-5	63	6	59.2	140	60.96	1.9
P63-6	63	6.3	59.0	140	64.01	2
P63-10	63	10	57.0	140	101.6	3
P63-12	63	12.5	55.4	140	127	3.8
P63-16	63	16	53.6	140	162.56	4.7
P75-5	75	6	70.6	140	60.96	2.2
P75-6	75	6.3	70.4	140	64.01	2.3
P75-10	75	10	67.8	140	101.6	3.6
P75-12	75	12.5	66.0	140	127	4.5
P75-16	75	16	63.8	140	162.56	5.6
P90-5	90	6	84.6	140	60.96	2.7
P90-6	90	6.3	84.4	140	64.01	2.8
P90-10	90	10	81.4	140	101.6	4.3
P90-12	90	12.5	79.2	140	127	5.4
P90-16	90	16	76.6	140	162.56	6.7
P110-6	110	6.3	104.6	140	64.01	2.7
P110-10	110	10	101.6	140	101.60	4.2
P110-12	110	12.5	99.4	140	127	5.3
P110-16	110	16	96.8	140	162.56	6.6
P125-6	125	6.3	118.8	140	64.01	3.1
P125-10	125	10	115.4	140	101.60	4.8
P125-12	125	12.5	113.0	140	127	6

It is important to know the type/brand and their properties of the pipes you are using.

Providers usually have that information.

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Introduction to Epanet

Water supply schema example

Download and installation of Epanet

1. Download Epanet at http://epanet.de/
2. Install Epanet (works in Windows, Apple, Linux) in several languages

Epanet is free program, developed (v1 2003), no plugins possible.

There are many other similar programs like WaterCad (commercial), Branch (open source in DOS), WatDis (free with plugins in CD) and others.

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Introduction to Epanet

Basic main configuration of Epanet

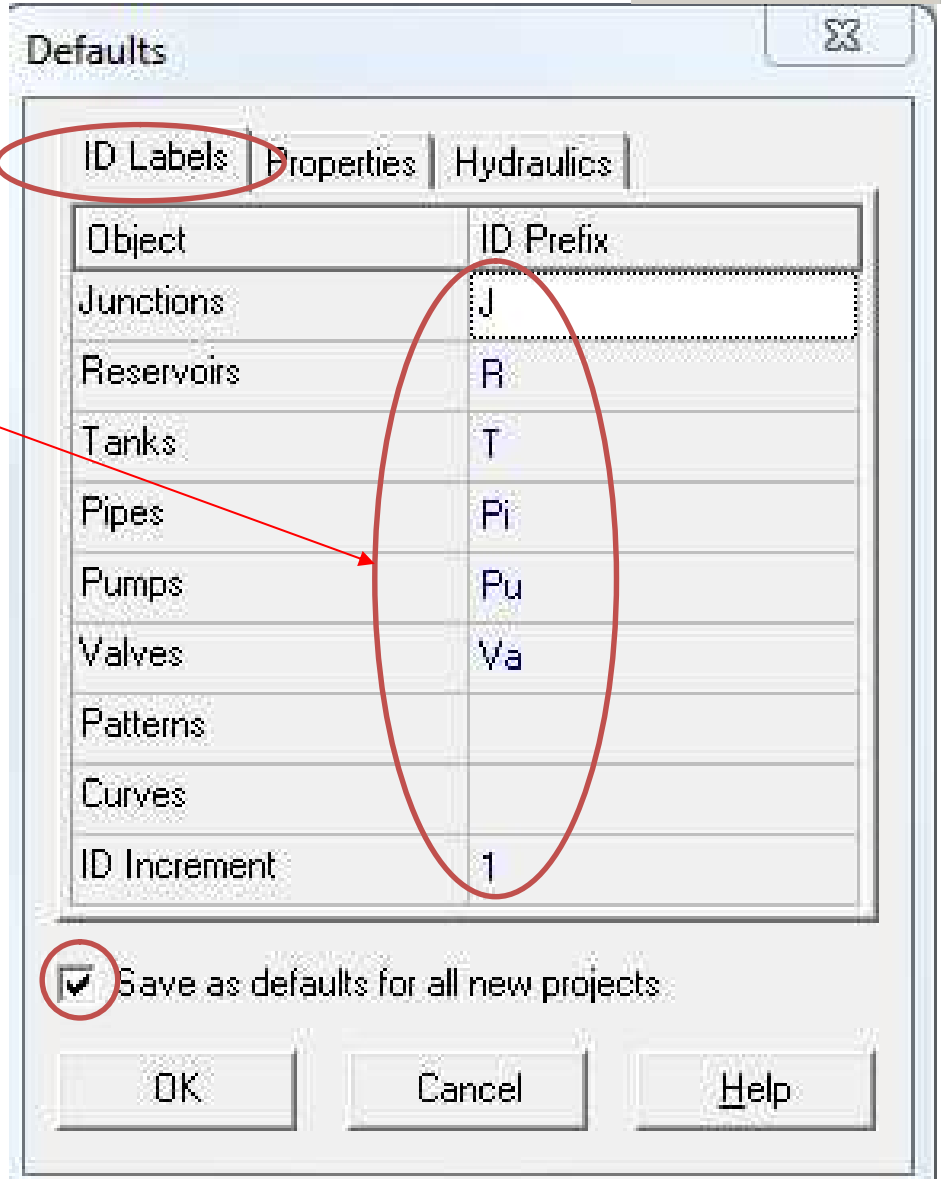
Defaults / ID labels

1.Open Epanet

2.Select **Project**| **Default**

3.ID labels

Set the parameters accordantly



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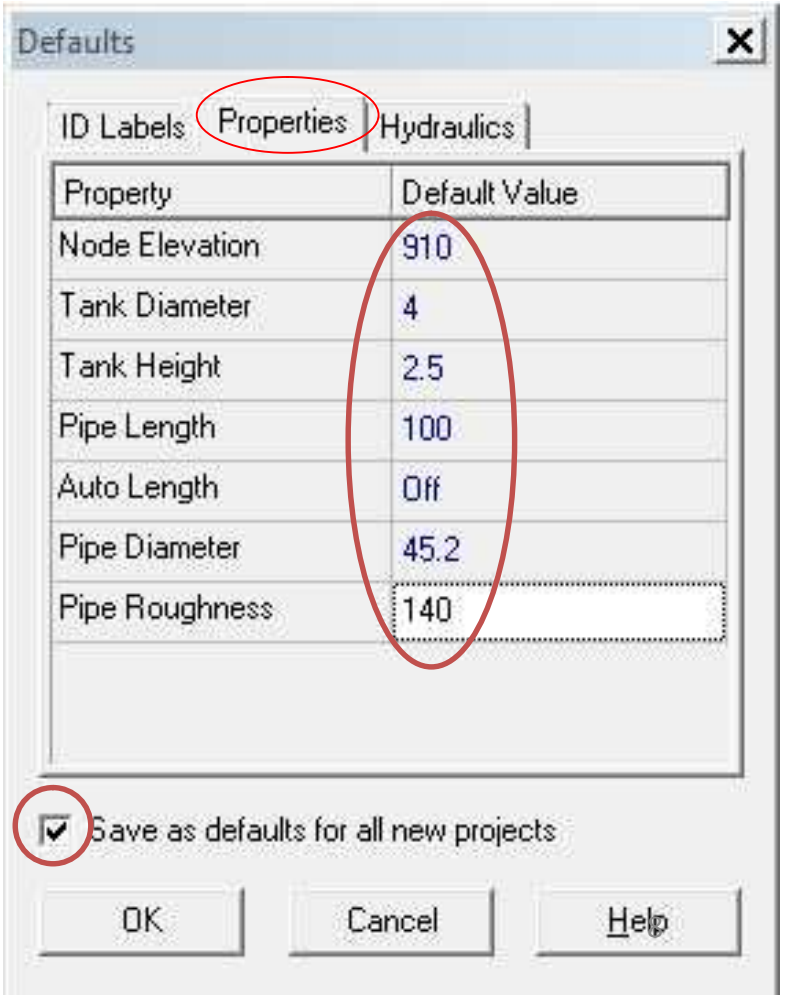
Program configuration

Defaults / Properties

4. Select the default parameter as per convenience



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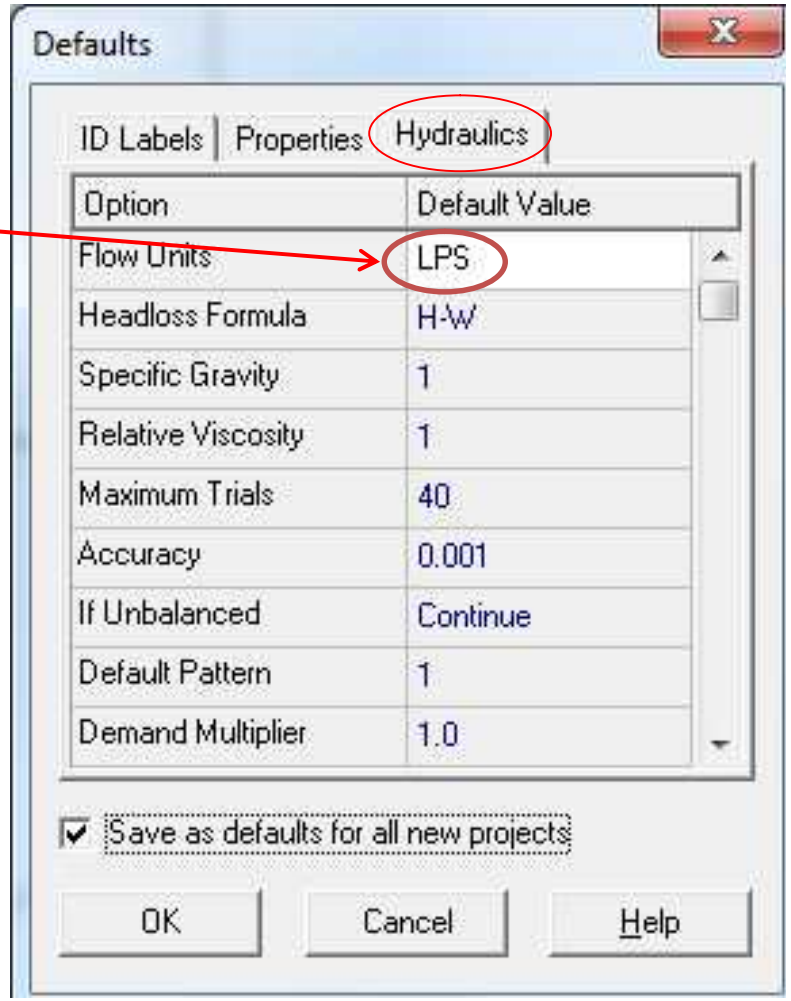
Program configuration

Defaults / Hydraulics

5. In the windows “Hydraulics” select “**Flow Units**” with the unity you prefer i.e **LPS** (liter per second)



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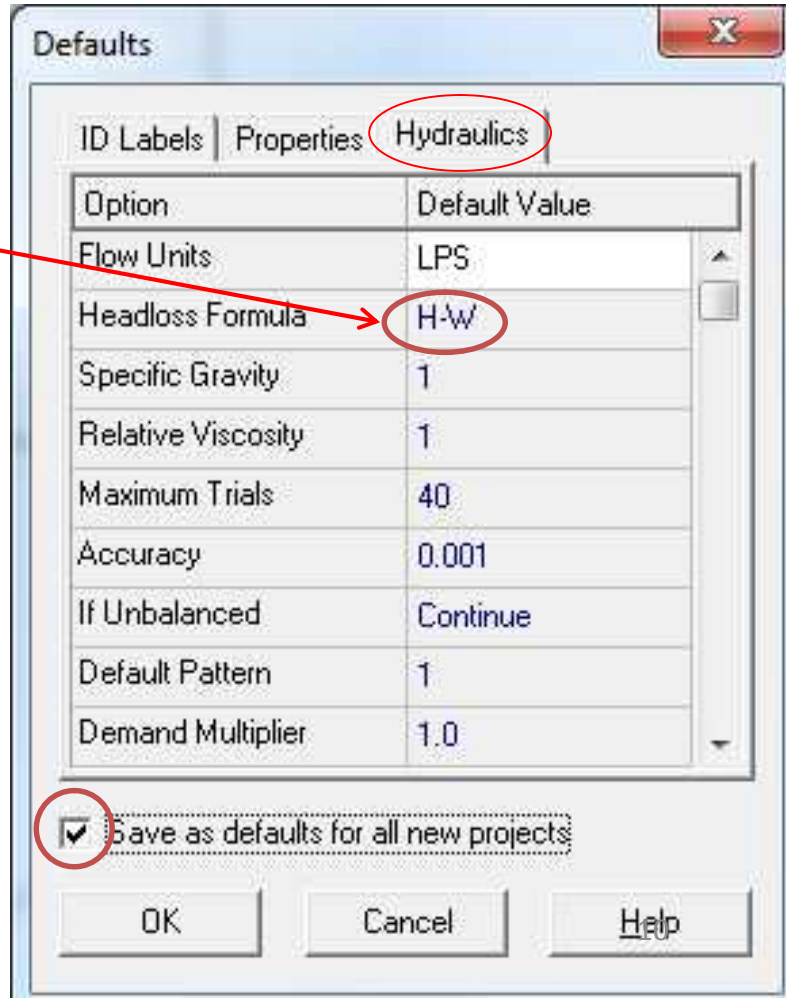
Program configuration

Defaults / Hydraulics

6. Select the head loss formula you prefer

a) Hazen-Williams **(H-W)**
b) Darcy-Weisbach **(D-W)**
c) Chezy-Manning **(C-M)**



The Hazen-Williams formula is the most commonly used head loss formula in the US. It cannot be used for liquids other than water and was originally developed for turbulent flow only.

The Darcy-Weisbach formula is the most theoretically correct. It applies over all flow regimes and to all liquids.

The Chezy-Manning formula is more commonly used for open channel flow.

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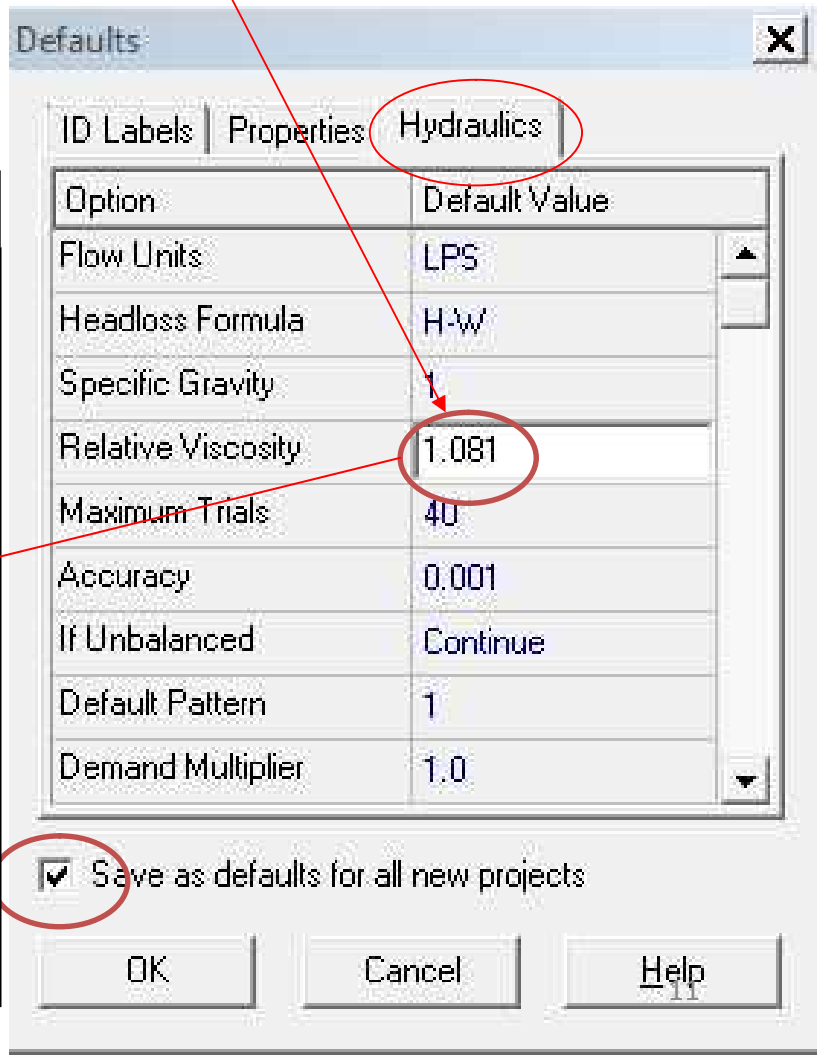
Program configuration

7. Put the relative viscosity in relation to the average temperature

Save all as default for all projects

Temperatura agua	Viscosidad relativa al agua de 20°C	Temperatura agua	Viscosidad relativa al agua de 20°C	Temperatura agua	Viscosidad relativa al agua de 20°C	Temperatura agua	Viscosidad relativa al agua de 20°C
1	1.72	26	0.87	51	0.586	76	0.436
2	1.666	27	0.852	52	0.58	77	0.43
3	1.612	28	0.833	53	0.574	78	0.424
4	1.558	29	0.815	54	0.568	79	0.419
5	1.504	30	0.796	55	0.562	80	0.413
6	1.463	31	0.782	56	0.556	81	0.407
7	1.421	32	0.767	57	0.55	82	0.401
8	1.38	33	0.753	58	0.544	83	0.395
9	1.338	34	0.738	59	0.538	84	0.389
10	1.297	35	0.724	60	0.532	85	0.383
11	1.265	36	0.709	61	0.526	86	0.377
12	1.232	37	0.695	62	0.52	87	0.371
13	1.2	38	0.68	63	0.514	88	0.365
14	1.167	39	0.666	64	0.508	89	0.359
15	1.135	40	0.651	65	0.502	90	0.353
16	1.108	41	0.646	66	0.496	91	0.347
17	1.081	42	0.64	67	0.49	92	0.341
18	1.054	43	0.634	68	0.484	93	0.335
19	1.027	44	0.628	69	0.478	94	0.329
20	1	45	0.622	70	0.472	95	0.323
21	0.978	46	0.616	71	0.466	96	0.317
22	0.956	47	0.61	72	0.46	97	0.311
23	0.933	48	0.604	73	0.454	98	0.305
24	0.911	49	0.598	74	0.448	99	0.299
25	0.889	50	0.592	75	0.442	100	0.293



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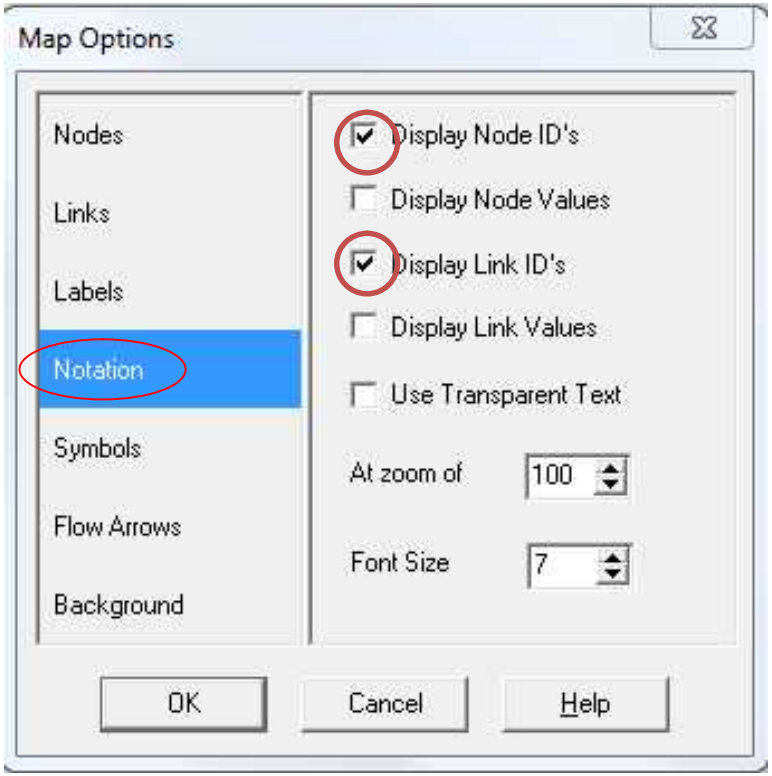
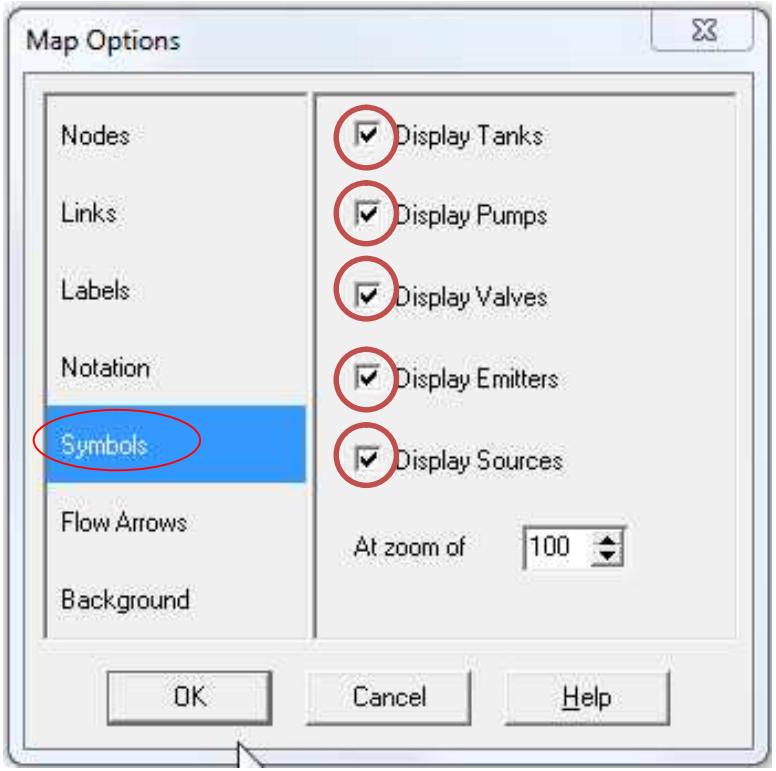
Introduction to Epanet

Configuration of map (layout)

1.Select **View | Options**.
2.Select **Notation** (it displays the name of the items like link, joints, pump, reservoir, etc.)
3.Select **Symbols** (it displays all the icons of the network)
4.Rest of option are self explaining





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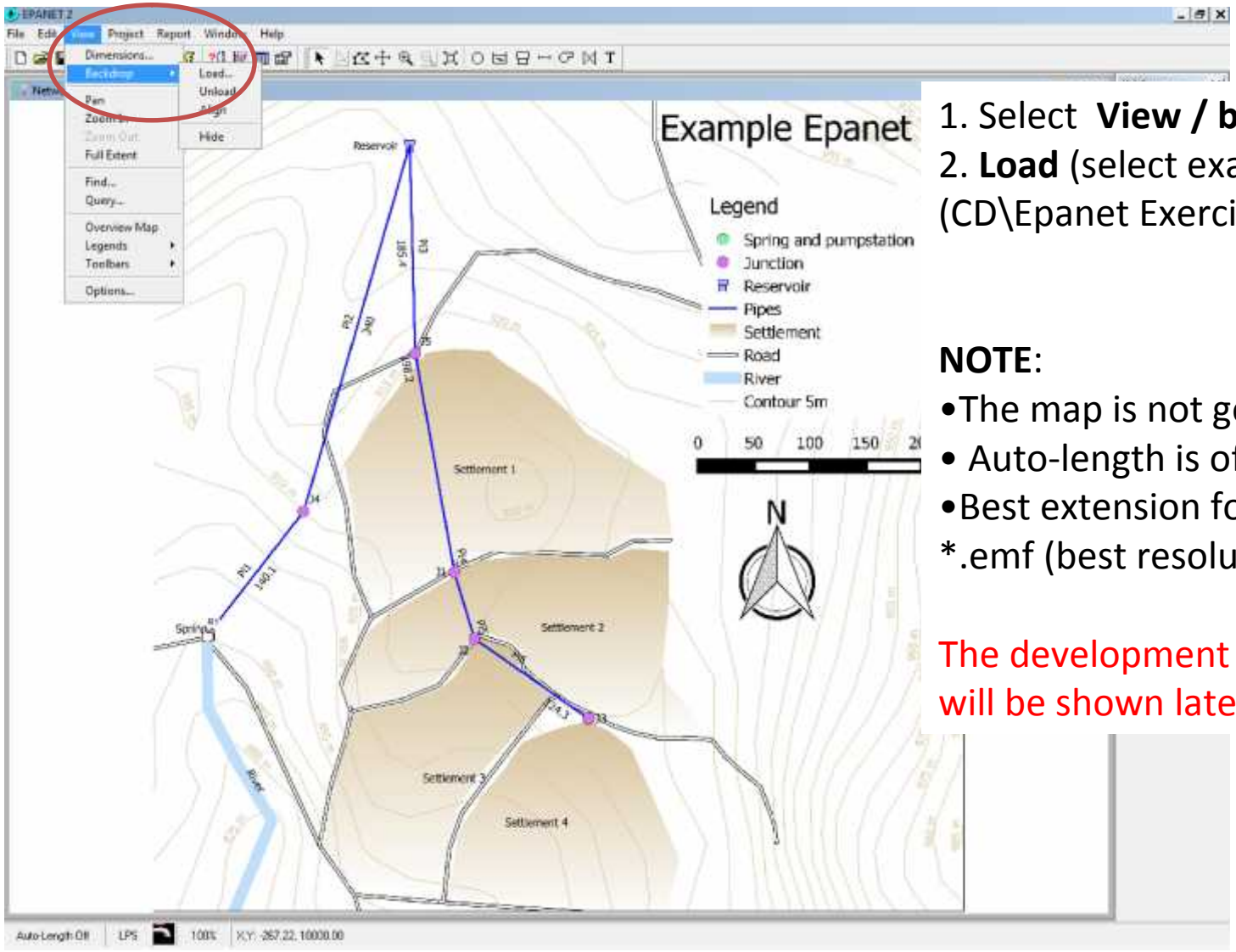
Introduction to Epanet

Insert the backdrop map



1. Select **View / backdrop**
2. **Load** (select example-emf.emf (CD\Epanet Exercise\example-emf.emf)

NOTE:

- The map is not geo-reference yet.
- Auto-length is off.
- Best extension for backdrop map is *.emf (best resolution)

The development and sizing of the map will be shown later if time allows

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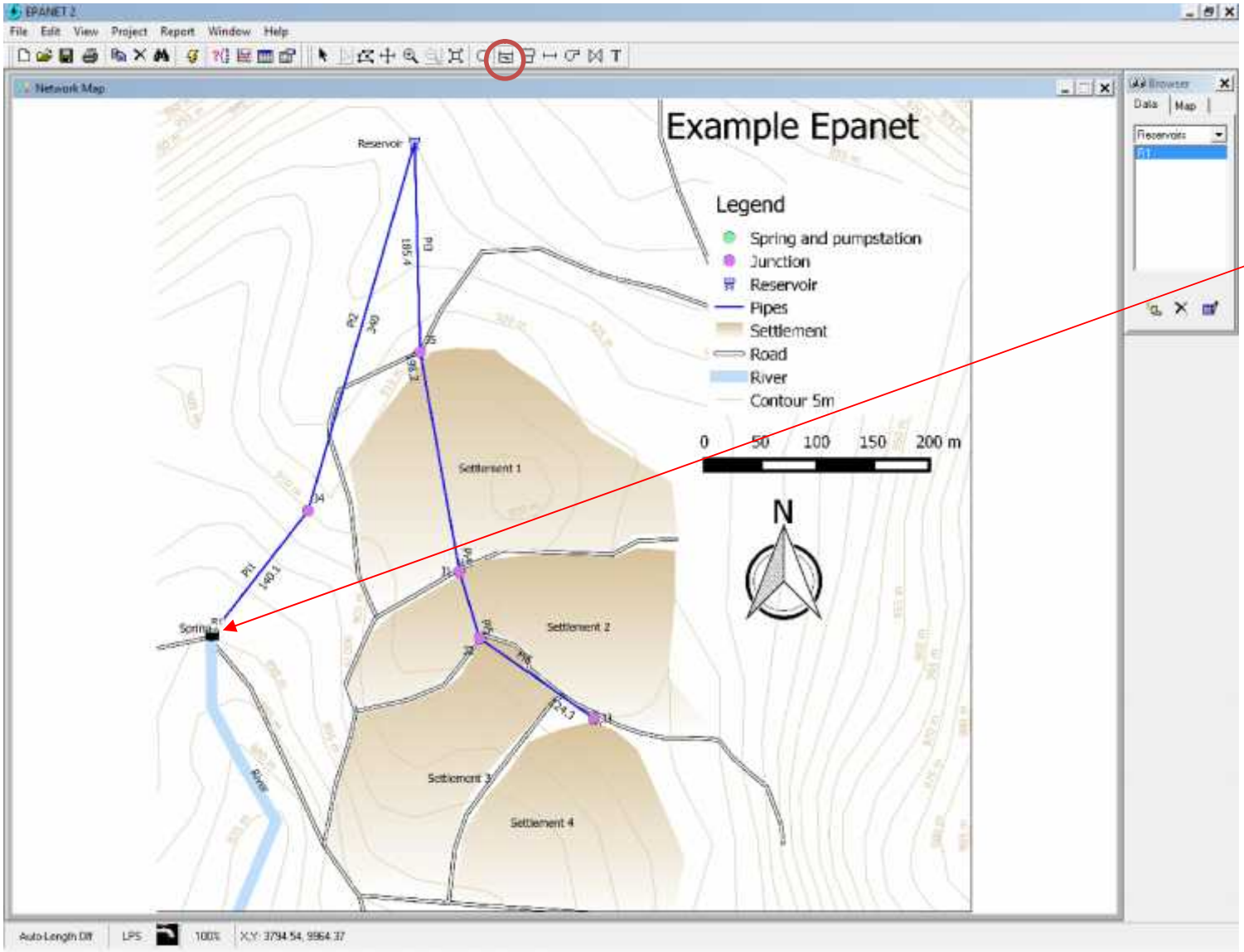
Introduction to Epanet



Drawing the network

1. Add “reservoir at the spring.

(if the toolbar is not visible **View -> Toolbars ->Map**).

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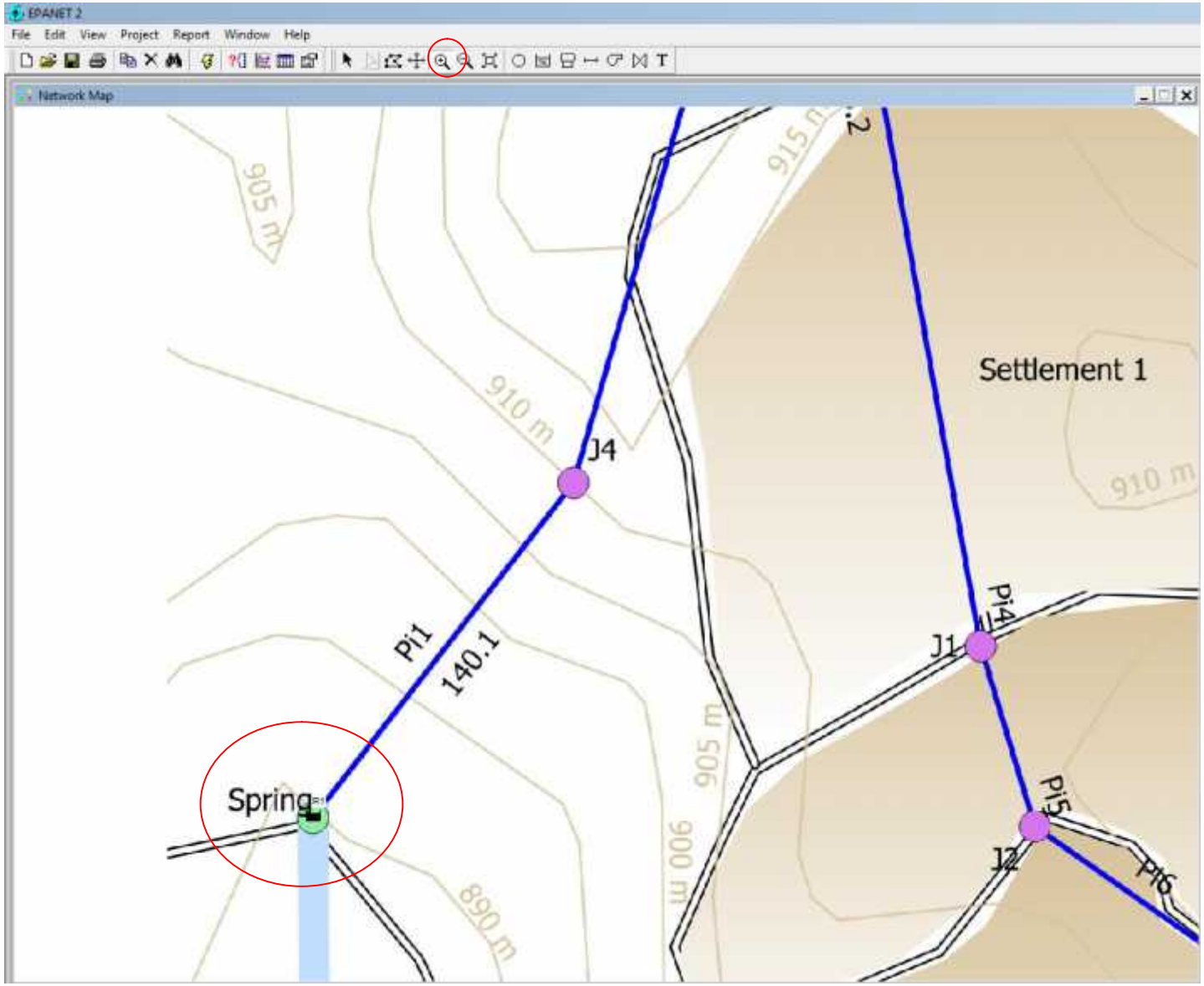
Introduction to Epanet



Drawing the network

Eventually zoom in

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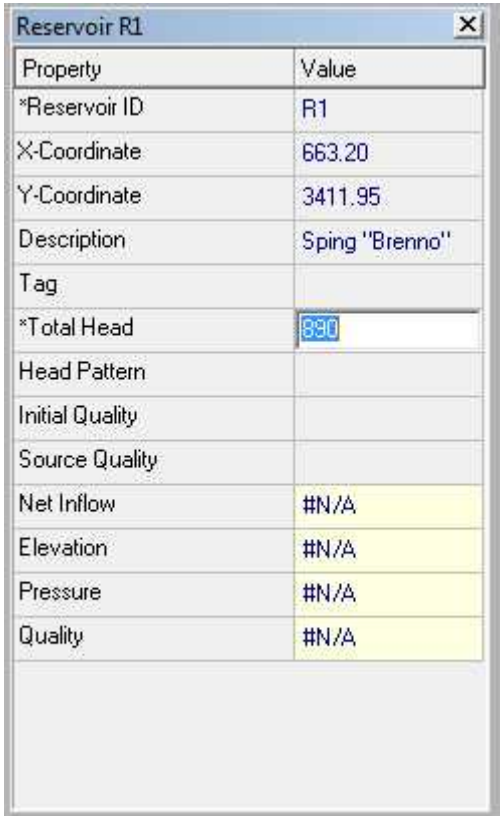
Introduction to Epanet

Drawing the network

1.Click twice on the R1 and the parameters setup of the spring (reservoir) appears

Coordinates do not play a role yet
Important you put the elevation (*Total Head) (in meter) of the outlet of the spring.

(considering the dropdown in case of a BH)



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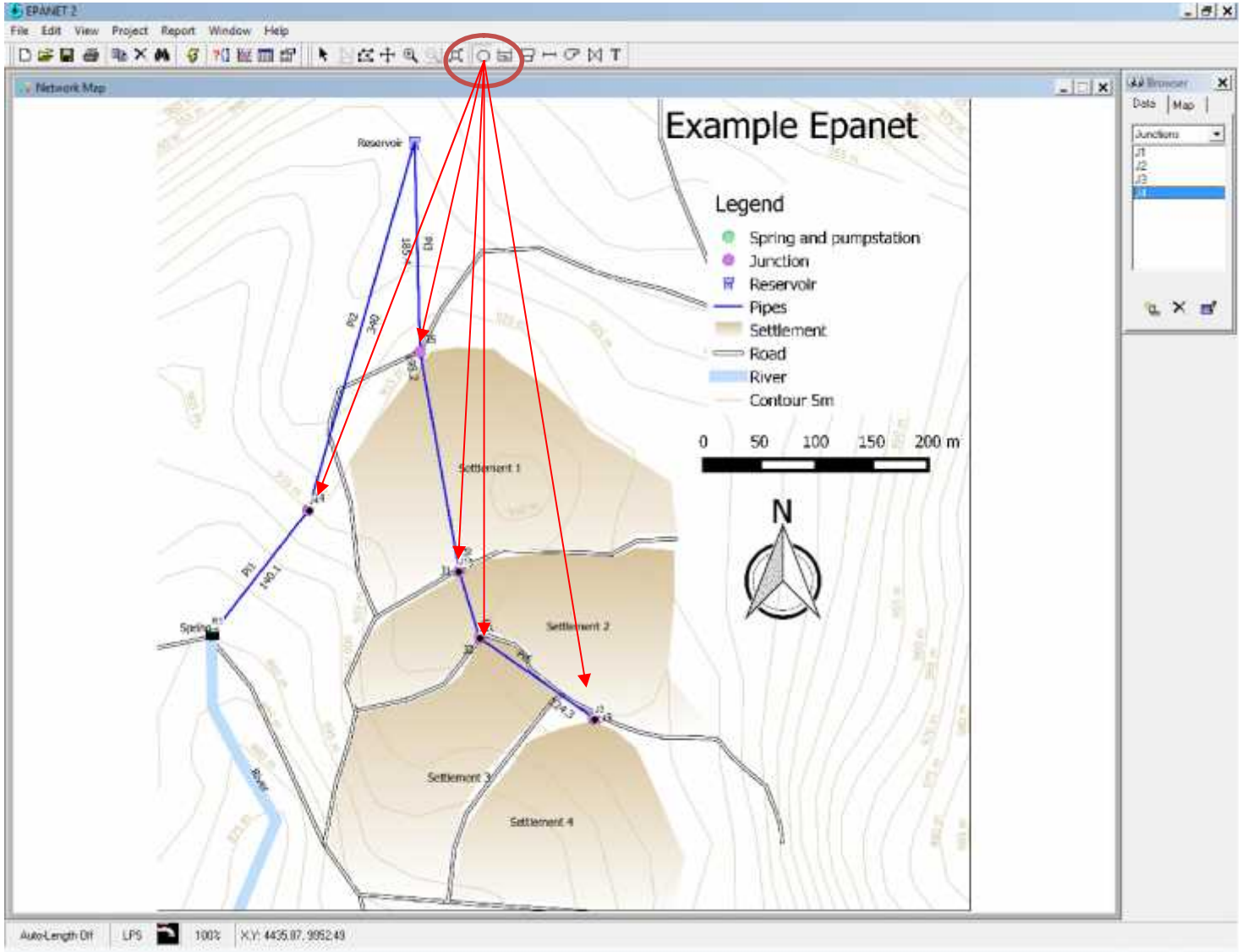
Introduction to Epanet



Drawing the network

1. Add "Junctions" ○
2. Set parameters

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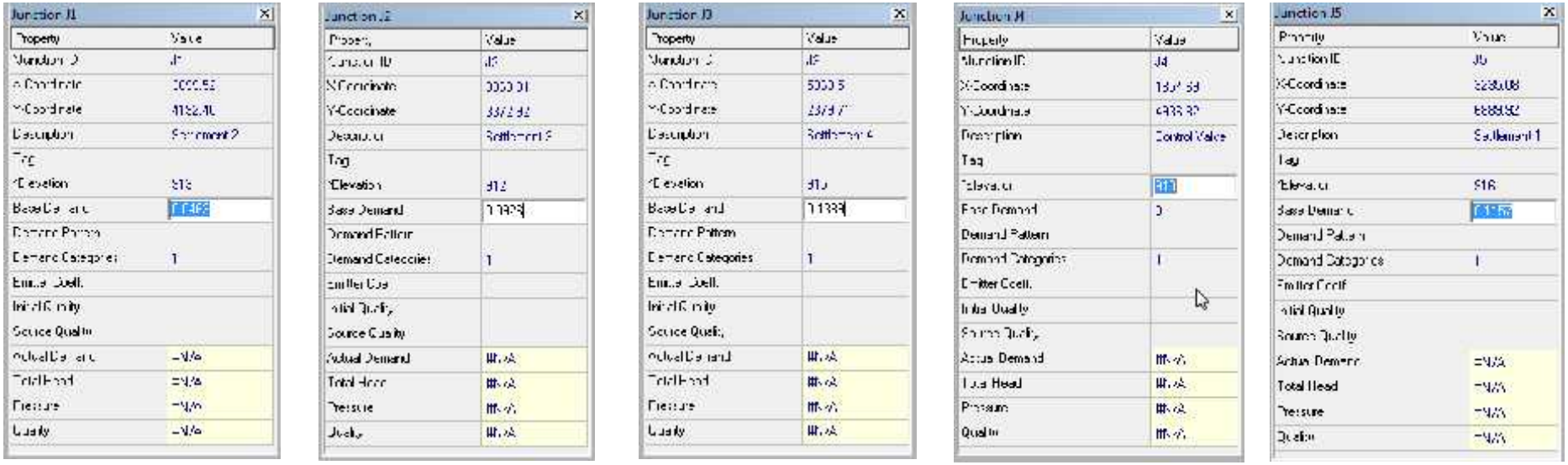
Introduction to Epanet

Drawing the network

2. Set parameters for the junctions



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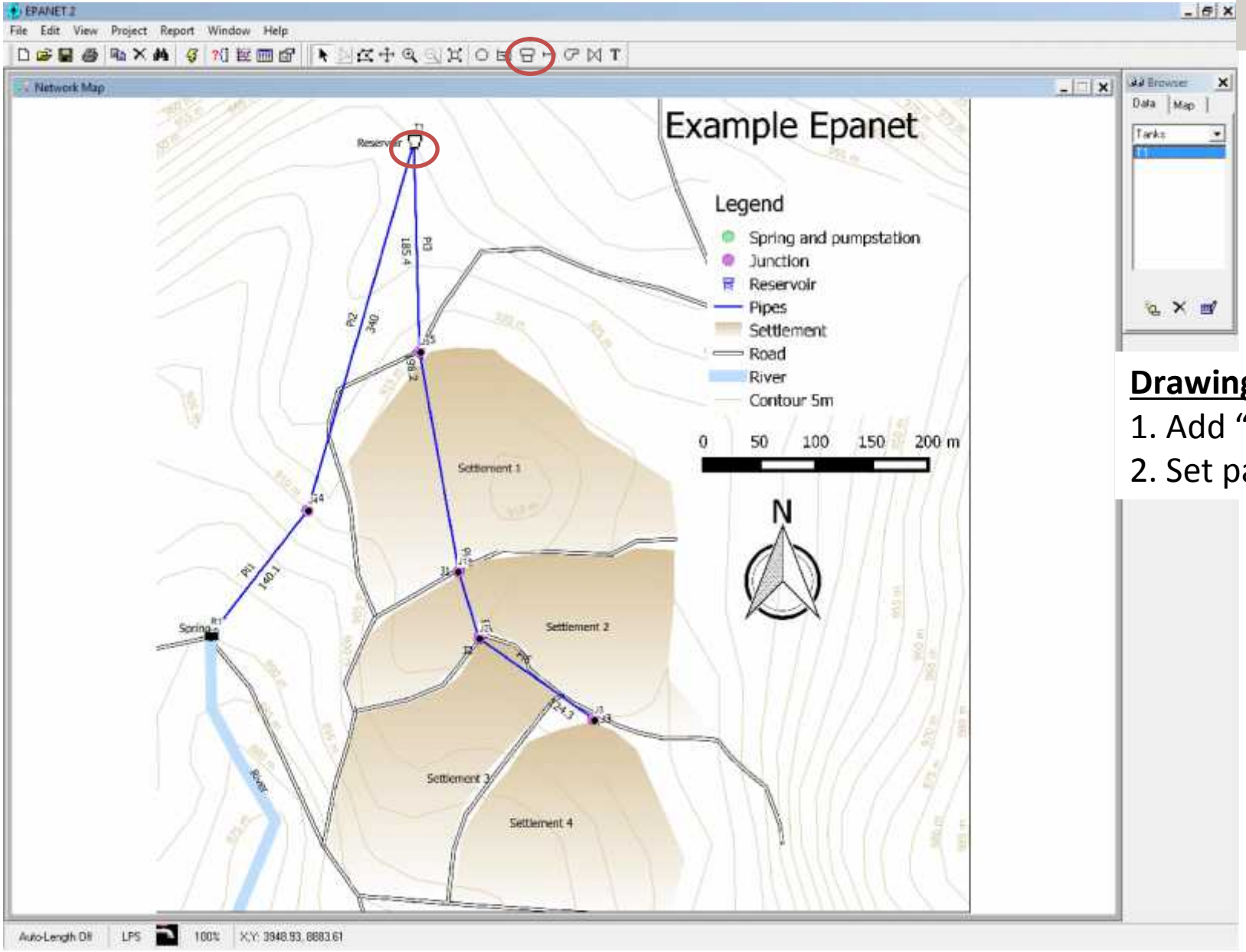
Introduction to Epanet



Drawing the network

1. Add “Tank”
2. Set parameters

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Introduction to Epanet

Drawing the network

2. Set parameters for the reservoir

Initial water level in the reservoir 1m

Volume of round tank:
2m X 2m X 3.14 X 2m (height) =25.13m3

Tank T1

Property	Value
*Tank ID	T1
X-Coordinate	3161.67
Y-Coordinate	9478.59
Description	
Tag	
*Elevation	930
*Initial Level	1
*Minimum Level	0
*Maximum Level	2
*Diameter	4
Minimum Volume	
Volume Curve	
Mixing Model	Mixed
Mixing Fraction	
Reaction Coeff.	
Initial Quality	
Source Quality	
Net Inflow	#N/A
Elevation	#N/A
Pressure	#N/A
Quality	#N/A

Ev. fire reserve!

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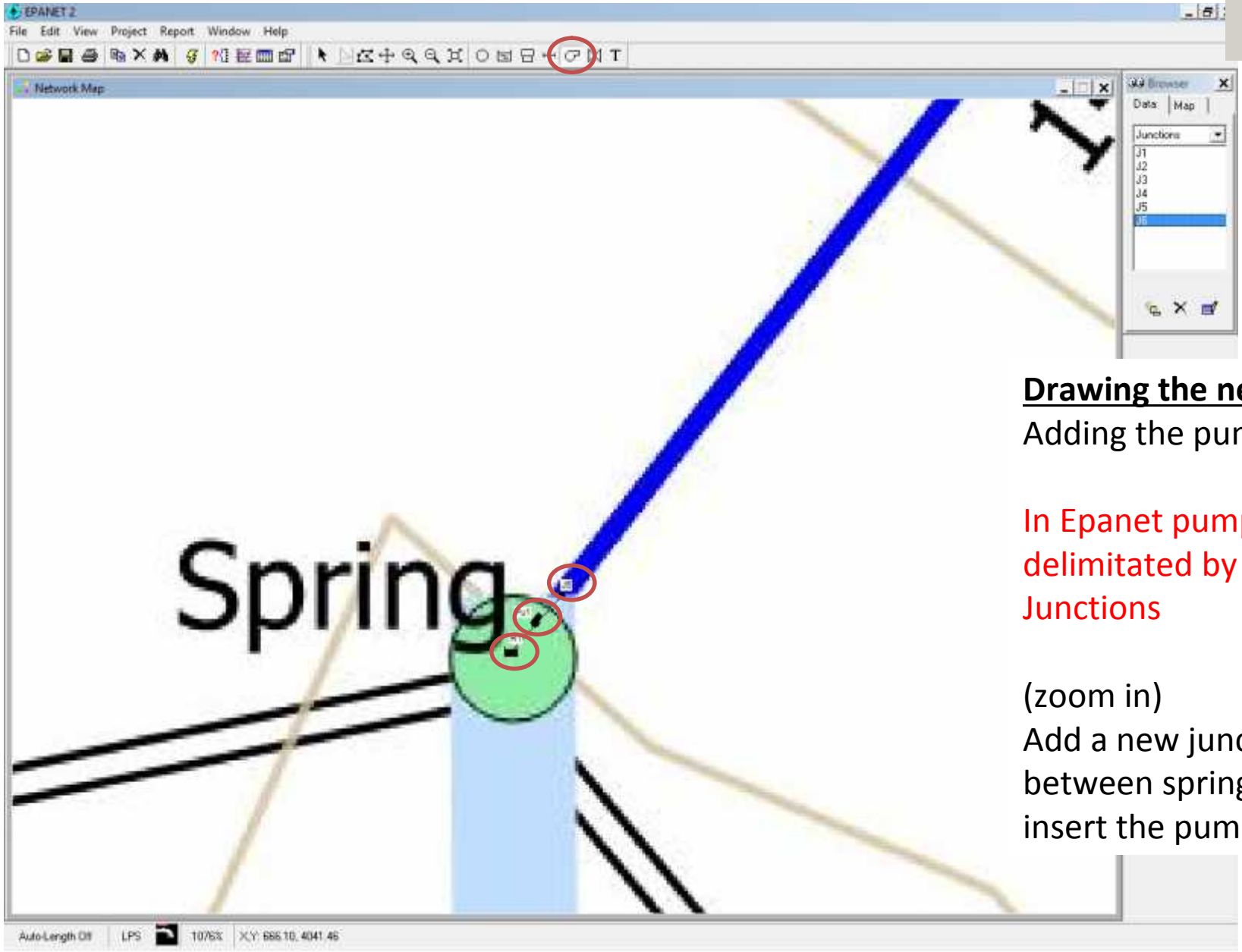
Introduction to Epanet



Drawing the network

Adding the pump

In Epanet pumps are delimitated by two Junctions

(zoom in)

Add a new junction (J6) and between spring (R1) and J6 insert the pump (Pu1)

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Introduction to Epanet

Adding the Pump

Insert parameter for the Junction (J6) and Pump

Junction J6

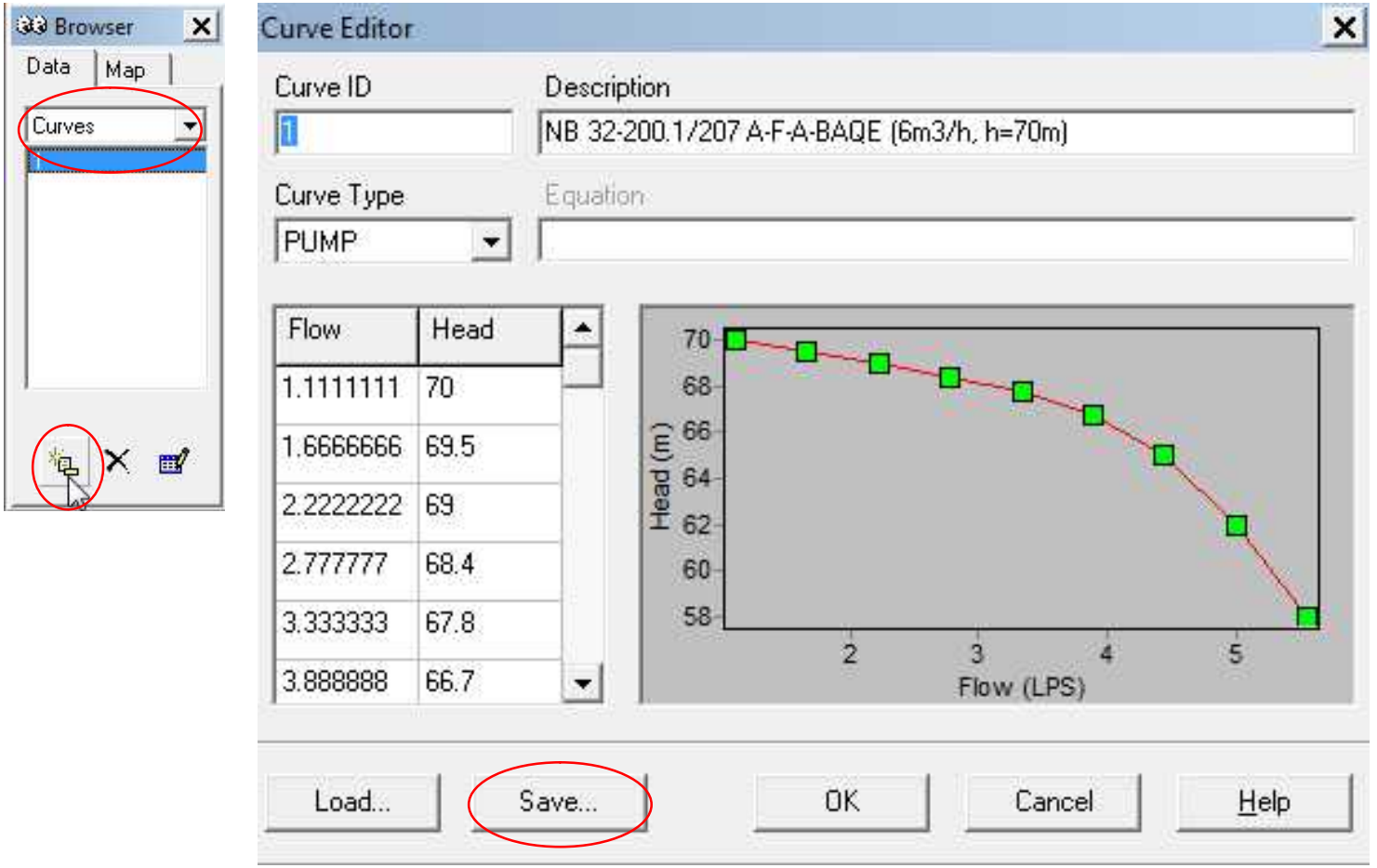
Property	Value
*Junction ID	J6
X-Coordinate	796.41
Y-Coordinate	3445.66
Description	
Tag	
*Elevation	890
Base Demand	0
Demand Pattern	
Demand Categories	1
Emitter Coeff.	
Initial Quality	
Source Quality	
Actual Demand	#N/A
Total Head	#N/A
Pressure	#N/A
Quality	#N/A

Pump Pu1

Property	Value
*Pump ID	Pu1
*Start Node	R1
*End Node	J6
Description	NB 32-200.1/207 A-F-A-BAQE (6m3/h, h=70m)
Tag	
Pump Curve	
Power	
Speed	
Pattern	
Initial Status	Open
Effic. Curve	
Energy Price	
Price Pattern	
Flow	#N/A
Headloss	#N/A
Quality	#N/A
Status	#N/A

Introduction to Epanet

Create the Pump curve 1



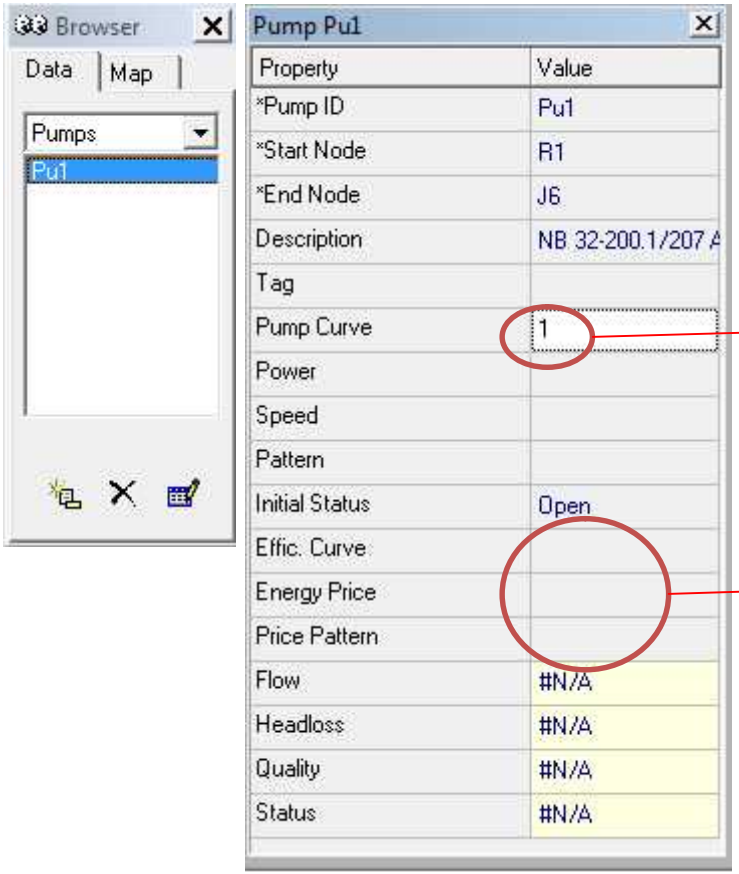
Pump curve taken from the graphic
Curve can be saved for future use

Introduction to Epanet

Drawing the network

Adding the Pump

Insert the parameters for pump (Pu1)



This number must correspond to the pump curve number

If you plan to calculate the power consumption and power cost fill the parameters

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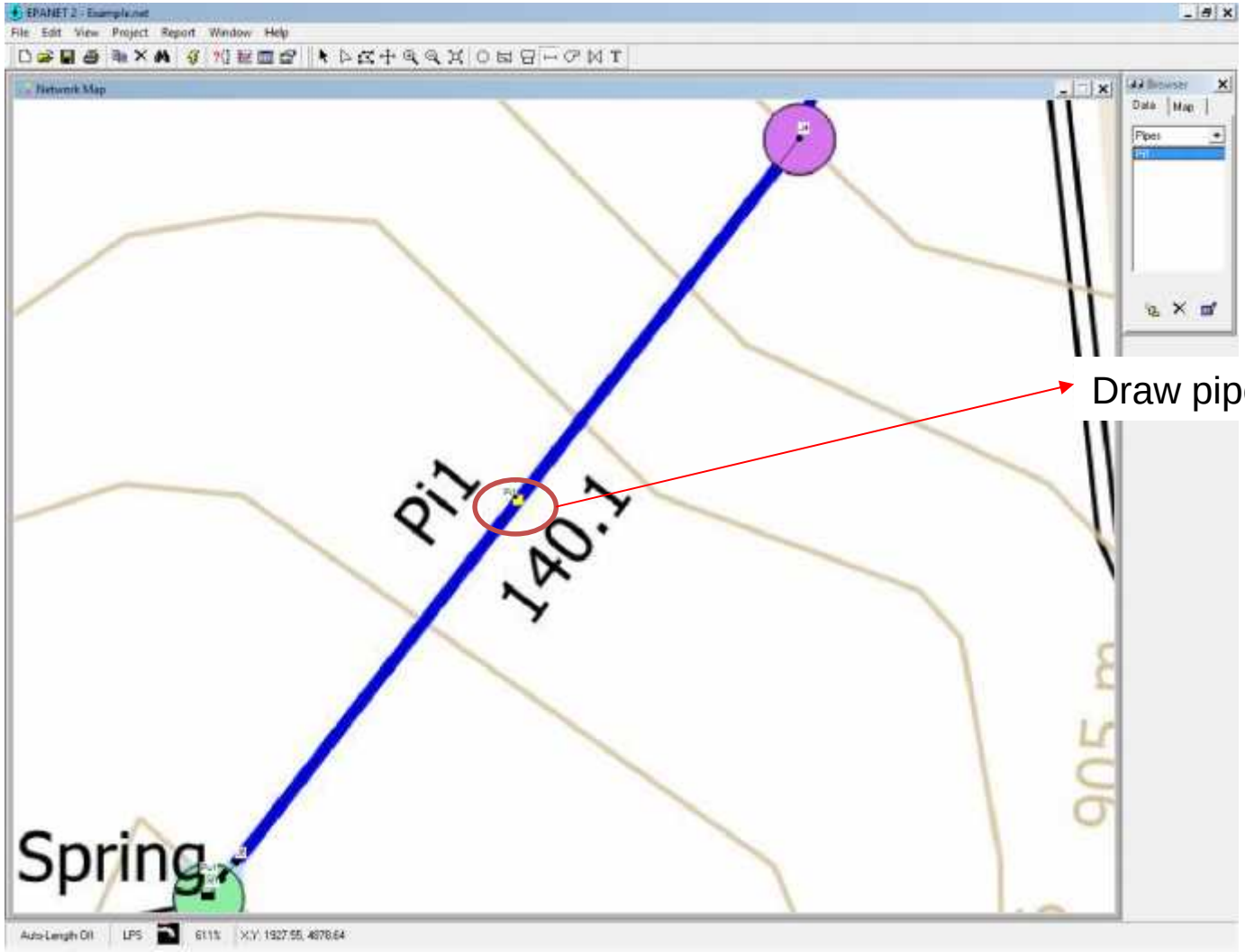
Introduction to Epanet

Drawing the network

Adding the pipes



Draw pipe ⊢ from J6 to J4 (zoom in)

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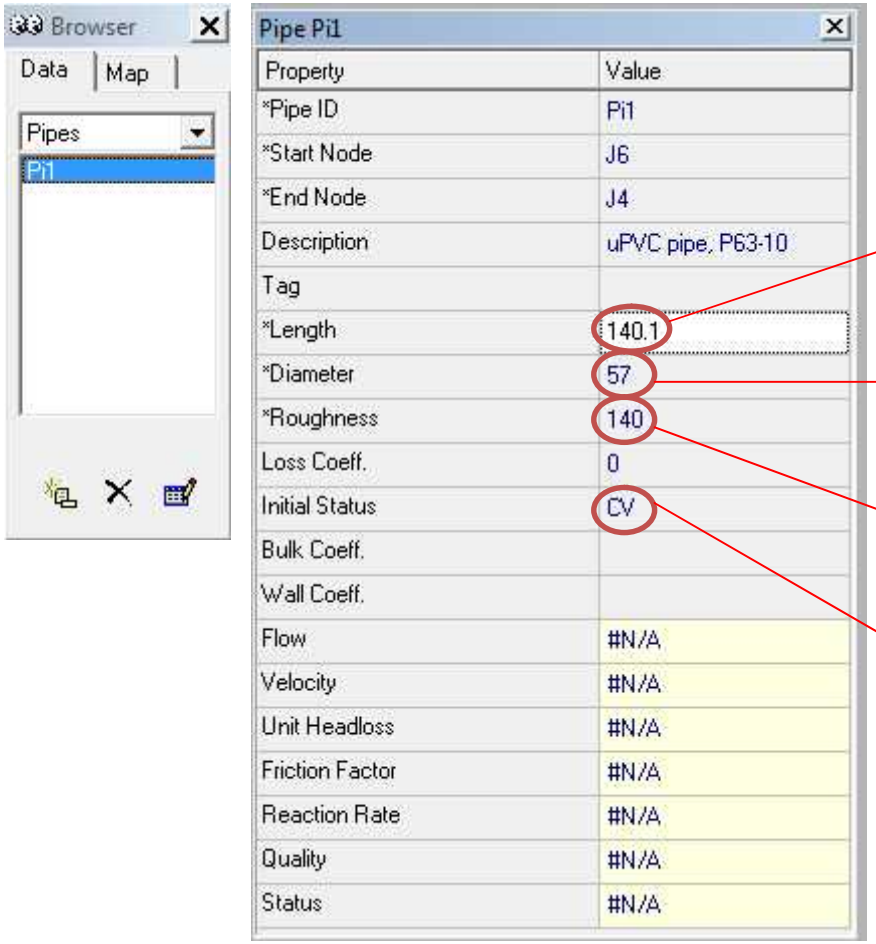
Introduction to Epanet

Drawing the network

Adding the pipes

Insert parameters for pipe (Pi1)



Length given

Estimate the diameter with Q=vA v=Q/A, A=Q/v (v ~ 1-2 m/s)

Roughness depends on type/age of pipe and used formula

check valve restricting flow to one direction

Note: Firefighters' regulation Might limit the size

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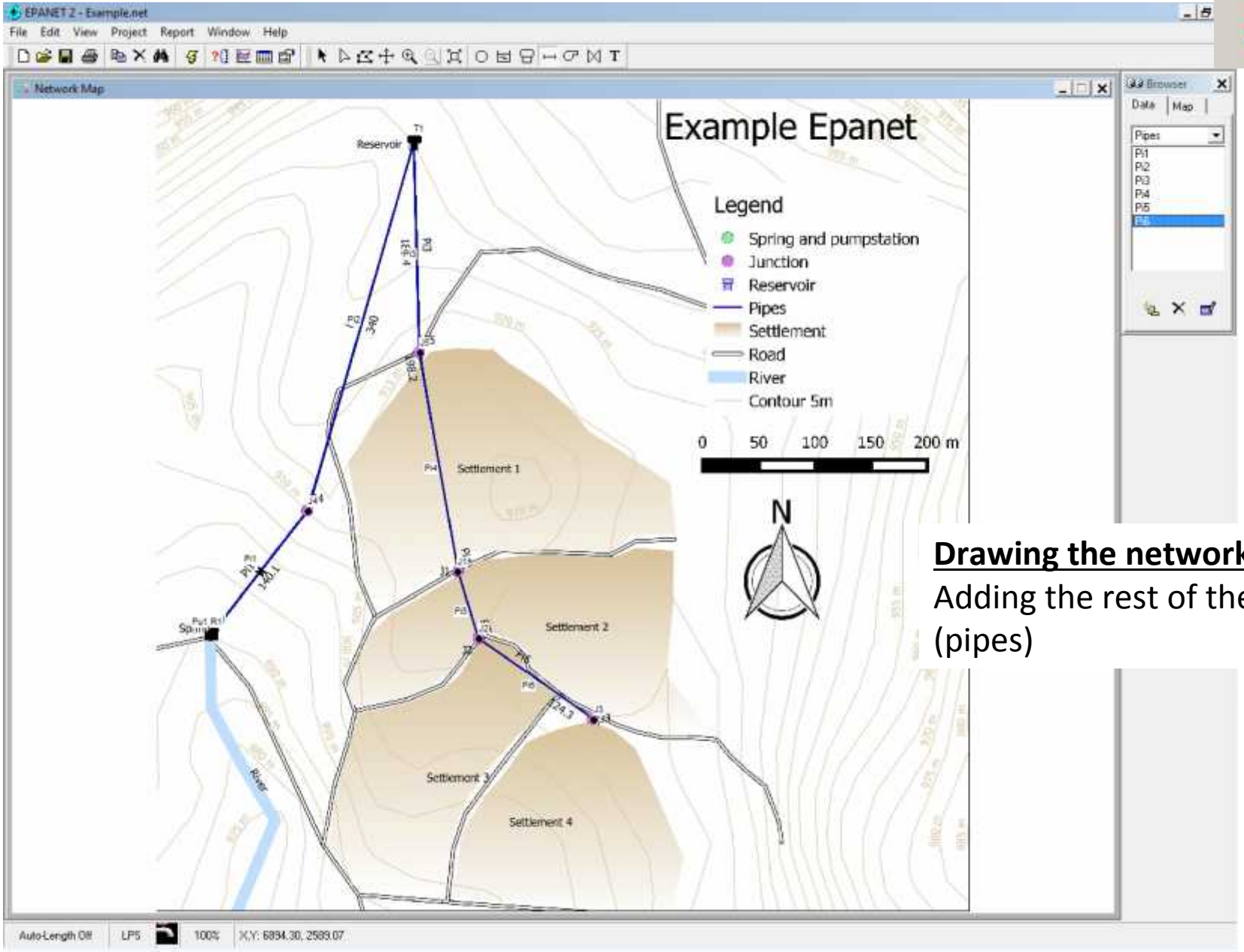
Introduction to Epanet



Drawing the network

Adding the rest of the links (pipes)

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Introduction to Epanet

Drawing the network Insert parameters for pipes

Pipe Pi1

Property	Value
*Pipe ID	Pi1
*Start Node	J6
*End Node	J4
Description	uPVC pipe, PR
Tag	
*Length	140.1
*Diameter	57
*Roughness	140
Loss Coeff.	0
Inital Status	CV

Pipe Pi2

Property	Value
*Pipe ID	Pi2
*Start Node	J4
*End Node	T1
Description	uPVC, P63-10
Tag	
*Length	340
*Diameter	57
*Roughness	140
Loss Coeff.	0
Initial Status	CV

Pipe Pi3

Property	Value
*Pipe ID	P3
*Start Node	T1
*End Node	J5
Description	uPVC P63-10
Tag	
*Length	185.4
*Diameter	57
*Roughness	140
Loss Coeff.	0
Initial Status	Open

Pipe P4

Property	Value
*Ppe ID	Pi4
*Start Node	J5
*End Node	J1
Description	P50-10
Tag	
*Length	198.2
*Diameter	45.2
*Roughness	140
Loss Coeff.	0
Initial Status	Open

Pipe Pi5

Property	Value
*Pipe ID	PiE
*Start Noce	J1
*End Node	J2
Description	uPVC P50-10
Tag	
*Length	62.5
*Diameter	45.2
*Roughness	140
Loss Coef.	0
Initial Status	Open

Pipe Pi6

Property	Value
*Pipe ID	Pi6
*Start Node	J2
*End Node	J3
Description	uPVC P40-10
Tag	
*Length	124.3
*Diameter	36.2
*Roughness	140
Loss Coeff.	0
Initial Status	Open

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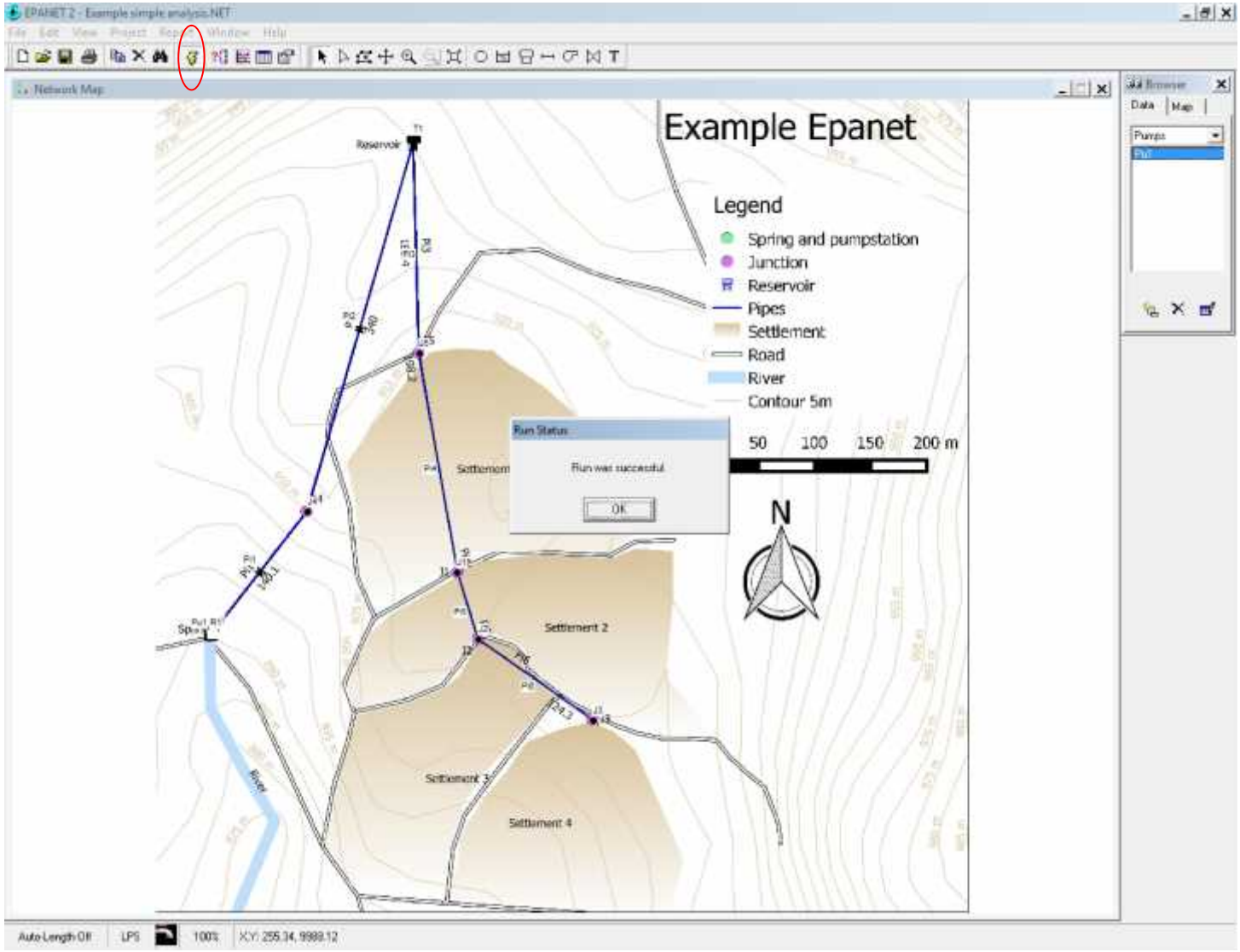
Introduction to Epanet

Running the system (single analysis)



If system desn‘t work, error message will be displayed and source of error explained

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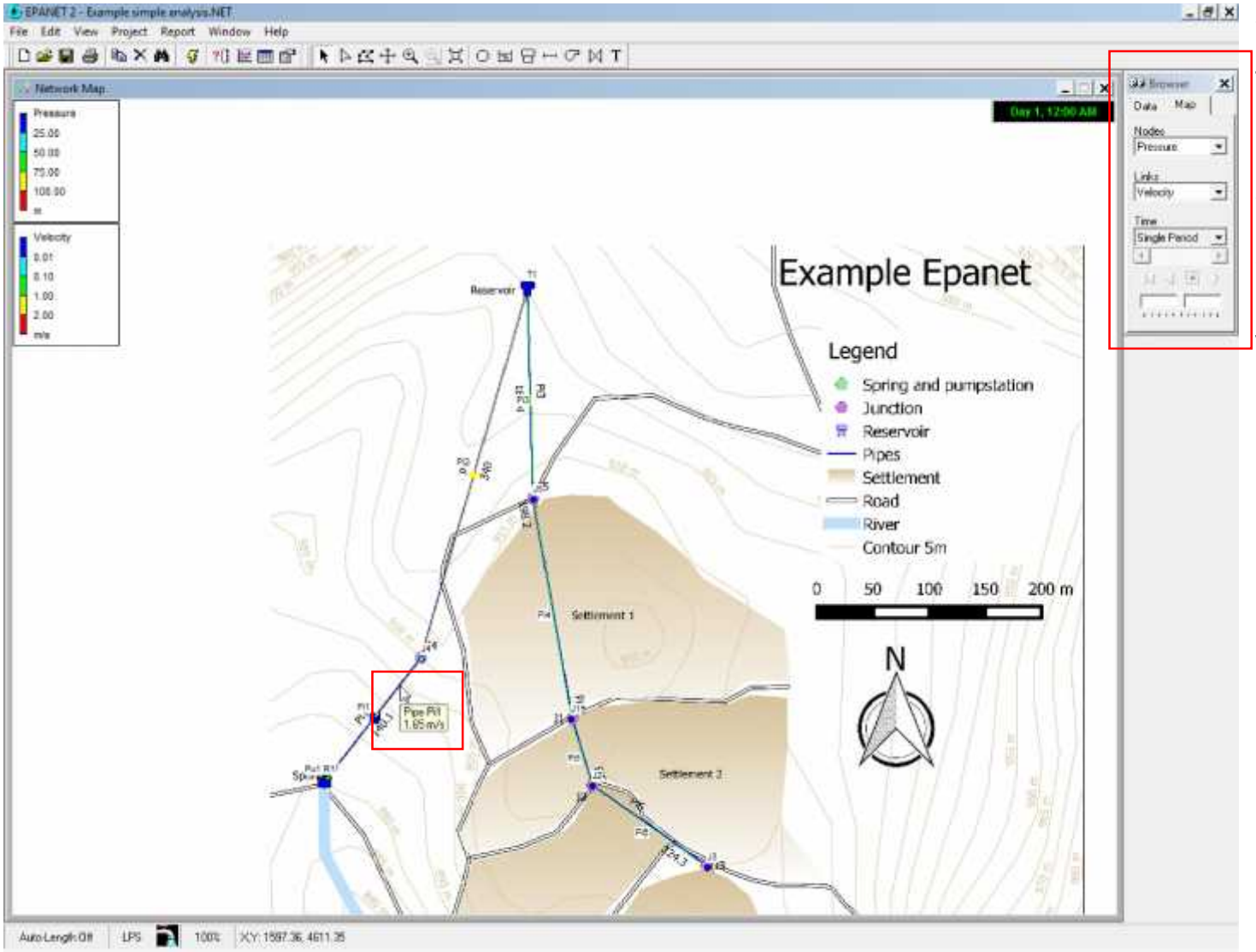
Introduction to Epanet

Running the system (single analysis)



You can display / hide the map in view menu.

You can display several characteristics of the system i.e. velocity in pipes and pressure at junctions.

Select the browser on map, and fly with the mouse over the concerned item.

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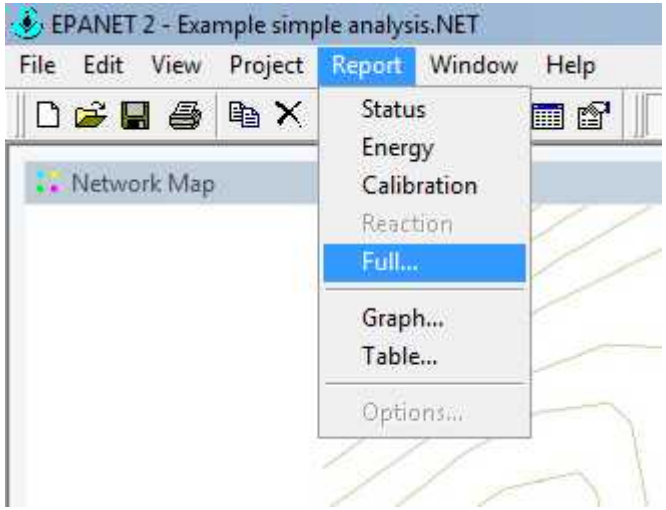
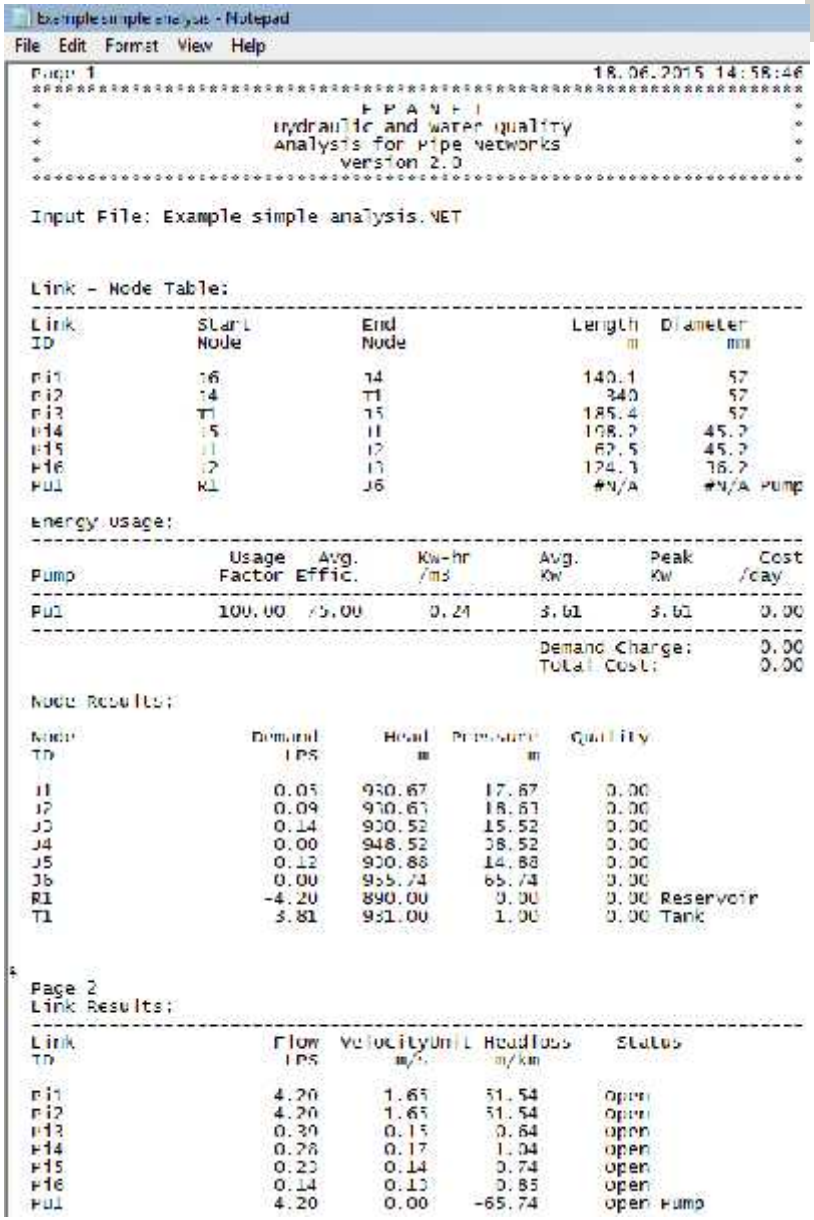
Introduction to Epanet

Running the system (single analysis)

Read the full report for full understanding of the system





Example simple analysis - Notepad

File Edit Format View Help

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```
*************************************************************
*                        E P A N E T                        *
*               Hydraulic and Water Quality                 *
*               Analysis for Pipe Networks                  *
*                     Version 2.0                           *
*************************************************************

Input File: Example simple analysis.NET


Link - Node Table:
-------------------------------------------------------------
Link         Start        End          Length    Diameter
ID           Node         Node            m          mm

P11          J6           J4             140.1        57
P12          J4           T1             340          57
P13          T1           J5             185.4        57
P14          J5           J1             198.2        45.2
P15          J1           J2              67.5        45.2
P16          J2           J3             124.3        76.2
Pu1          R1           J6             #N/A       #N/A Pump

Energy Usage:
-------------------------------------------------------------
                Usage    Avg.     Kw-hr       Avg.       Peak       Cost
Pump            Factor   Effic.   /m3         Kw         Kw         /day
-------------------------------------------------------------
Pu1           100.00    75.00       0.24       3.61       3.61       0.00
-------------------------------------------------------------
                                             Demand Charge:           0.00
                                             Total Cost:              0.00

Node Results:

Node         Demand      Head      Pressure    Quality
ID             LPS         m           m

J1            0.05     930.67       17.67       0.00
J2            0.09     930.61       18.61       0.00
J3            0.14     930.52       15.52       0.00
J4            0.00     948.52       38.52       0.00
J5            0.12     930.88       14.88       0.00
J6            0.00     965.74       65.74       0.00
R1           -4.20     890.00        0.00       0.00 Reservoir
T1            3.81     951.00        1.00       0.00 Tank


Page 2
Link Results:
-------------------------------------------------------------
Link         Flow     Velocity     Unit Headloss    Status
ID            LPS       m/s          m/km

P11           4.20      1.65        51.54          Open
P12           4.20      1.65        51.54          Open
P13           0.30      0.15         0.64          Open
P14           0.26      0.17         1.04          Open
P15           0.20      0.14         0.74          Open
P16           0.14      0.13         0.85          Open
Pu1           4.20      0.00       -65.74          Open Pump
```

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Introduction to Epanet

Running the system (single analysis)

The single analysis helps you to identify the main characteristics and ev. misstakes on the system, but doesn't give you a realistic overview of the behaviour of your system over time.

An analysis over time (i.e. 3 days; 72 hs) helps you to understand better the system.

For such analysis, we need to develop pattern (behaviour changes over time)

This after the break

Thanks

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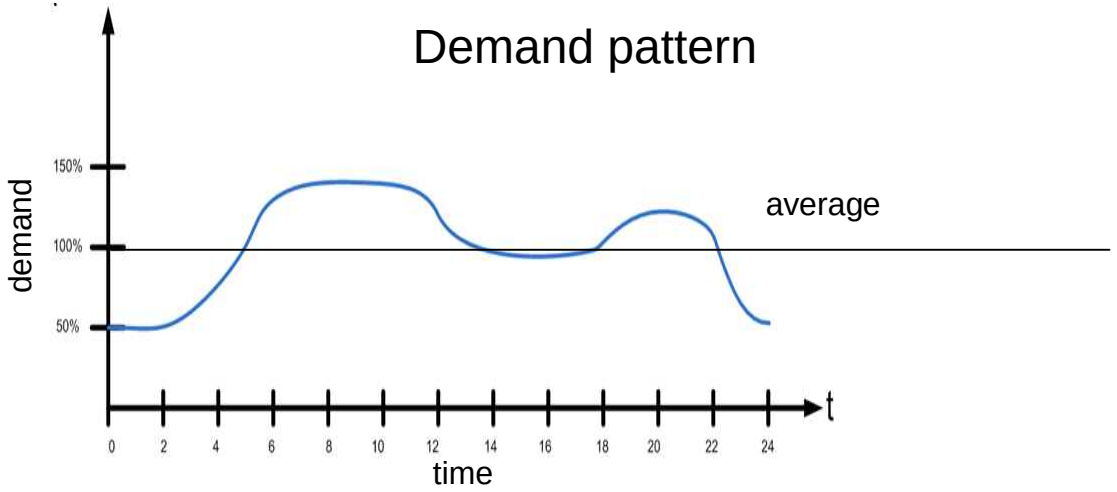
Introduction to Epanet

Part 3, *developing a simulation over time with Epanet*

The network previously developped was simulated in a single time period. The demand and the pump behaviour was considered as constant over time. A rather unrealistic situation!

In reality, the demand varies during the day (i.e. with peak's demand in the morning between 6 and 12 and afternoon from 18 to 22) and the pump works only max 6 hours in a day.



Introduction to Epanet

Simulation over a time

- Epanet allows simulation of constant flow, only

- Therefore, a simulation over longer time with different constant flows allows to analyse different behaviours of the same network.

- For this purpose we have to create **time pattern**.
  Pattern for the demand
  Pattern for the pump's running times

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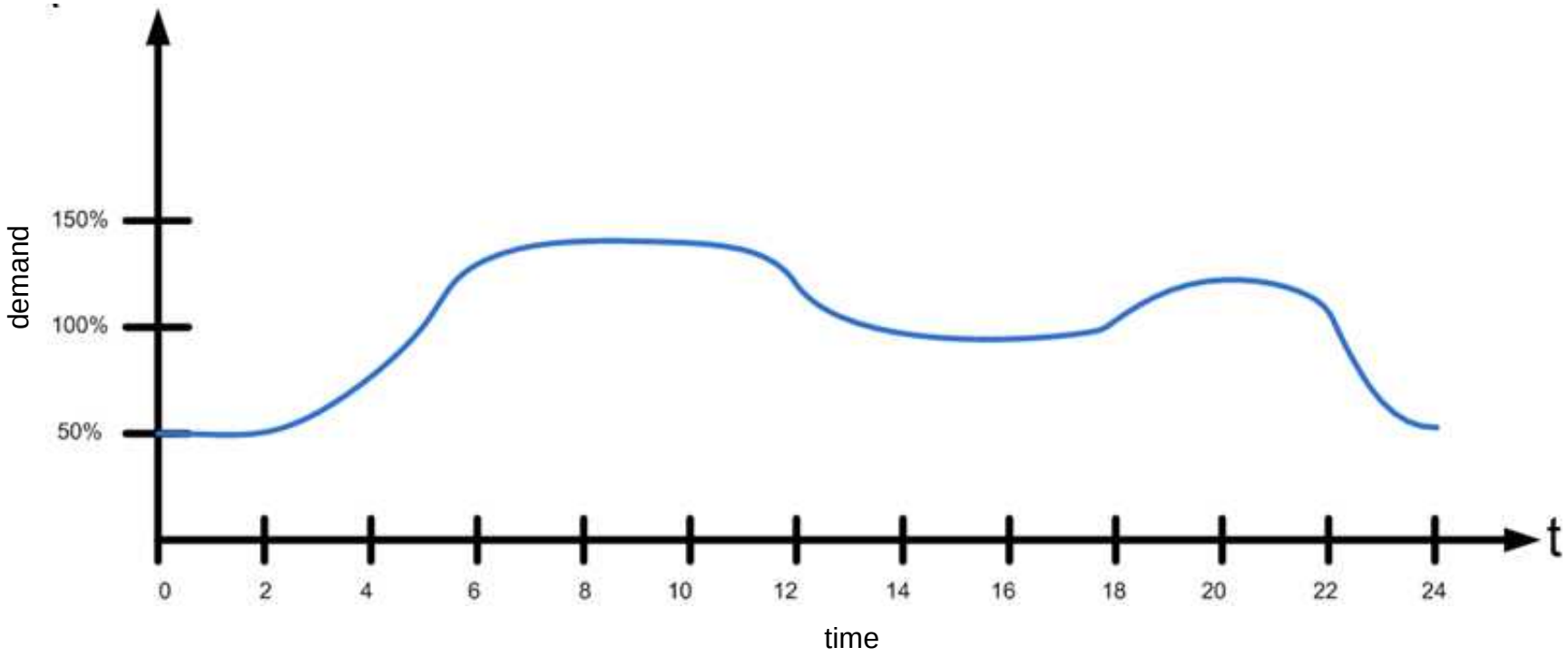
Introduction to Epanet

Simulation over a time

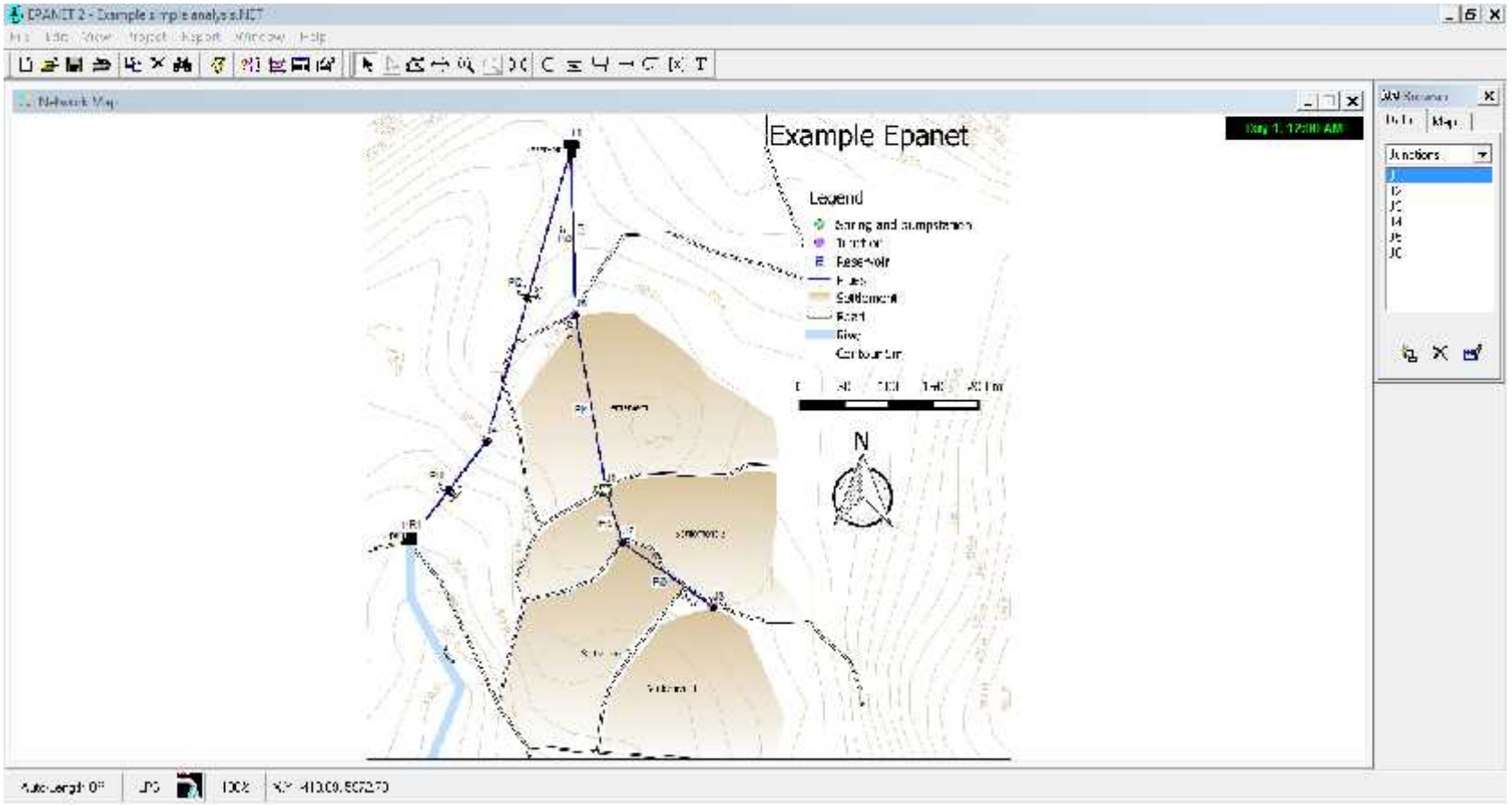
For our demand example, a 2 hours long pattern is used (24hr / 2 = 12 hrs period time. With this pattern you can modify the behaviours max 12 times during the day.



Introduction to Epanet

Simulation over a time

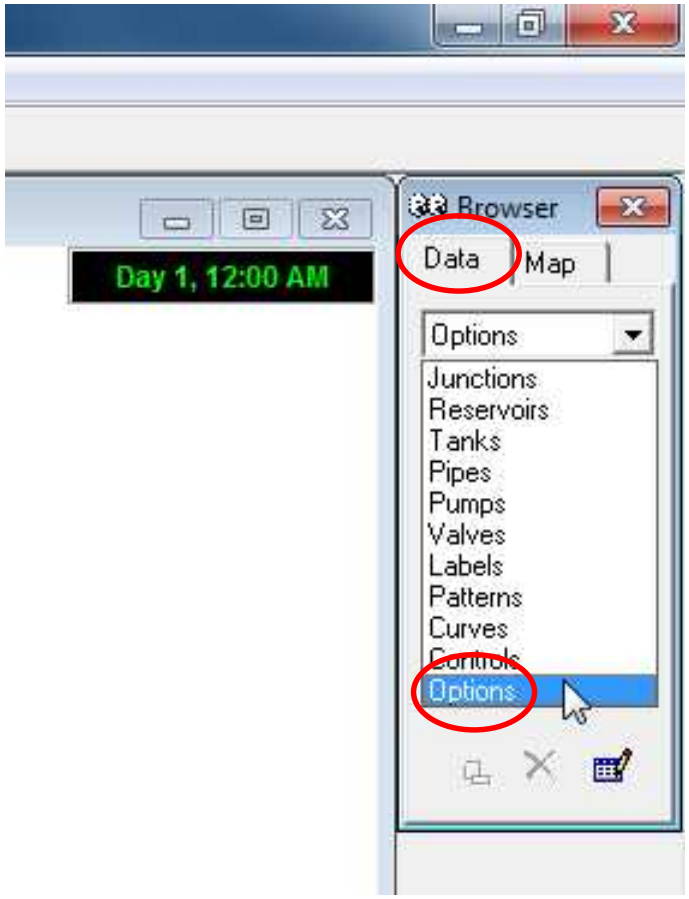
Open with Epanet your previous exercise and save it with a different name, i.e. example time analysis.

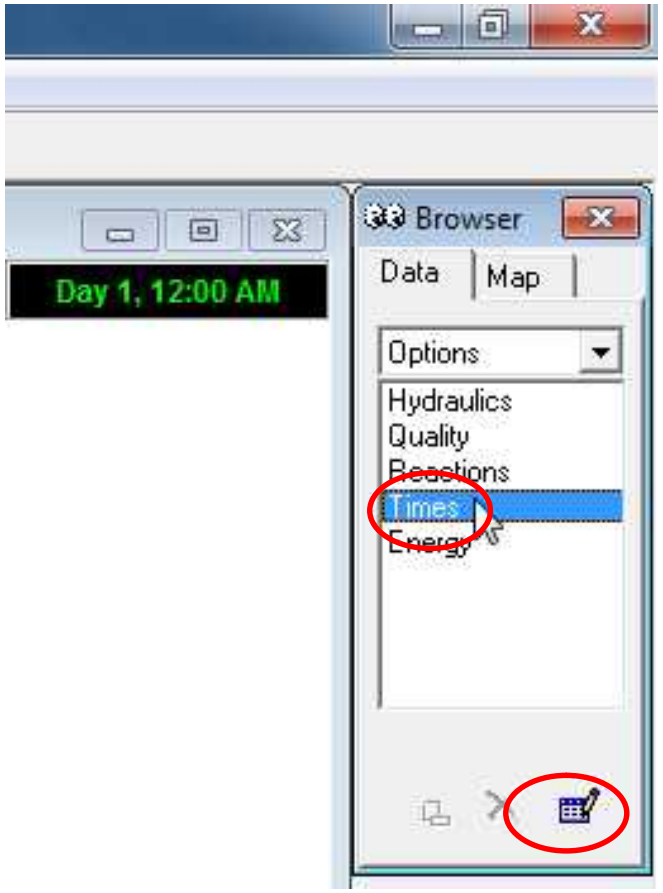


Introduction to Epanet

Simulation over a time (Pattern Time Step)

1. Select **Options - Times** from **Data Browser -> Edit**





Introduction to Epanet

Simulation over a time

3. Write 2 for the value of “Pattern Time Step”

Every 2 hours the behaviour changes. It can be from 1 to 12

Introduction to Epanet

Simulation over a time

4. Write **72 (hours, 3 days) in "Total Duration"** field**.** This will be the period length of the simulation.

Introduction to Epanet

Simulation over a time

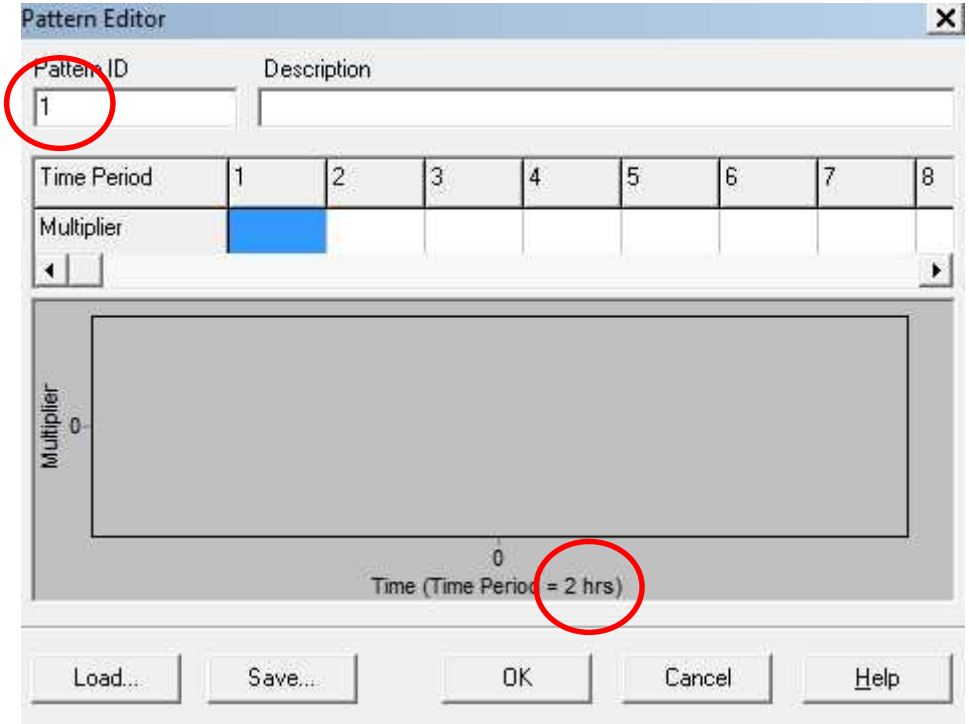
Develop the time pattern

1. Select in the Browser / **Patterns** and add a new pattern

Introduction to Epanet

Simulation over a time

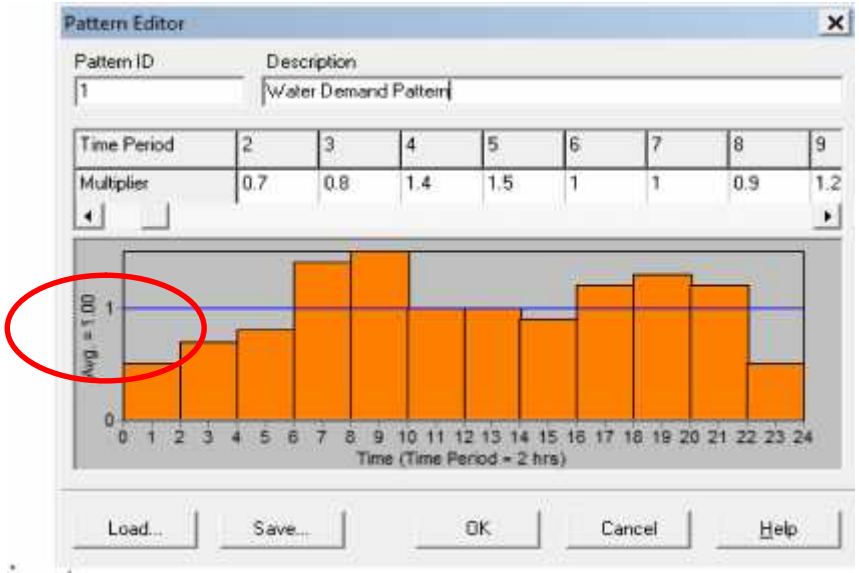
The Pattern Editor will appear, with per default pattern ID 1.
You can add a description (optional)

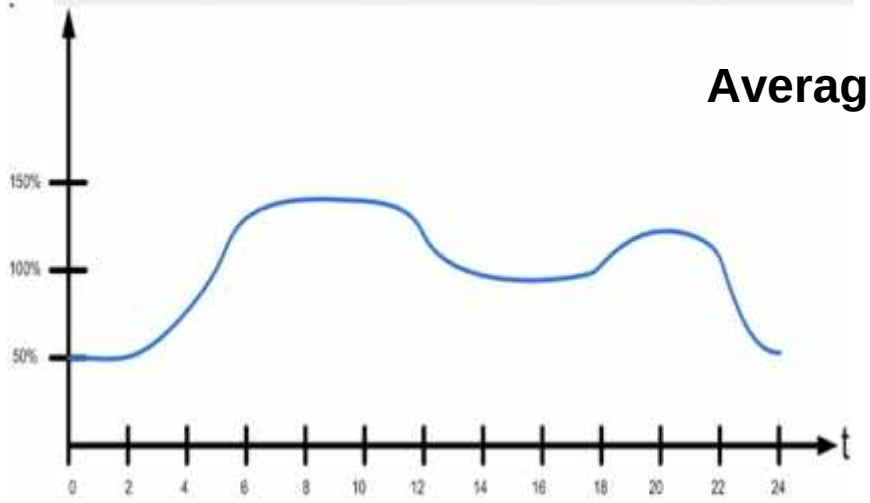


Introduction to Epanet

Simulation over a time

You will add the multiplier of the demand in function of the estimated behaviour





Average of pattern must be „1“

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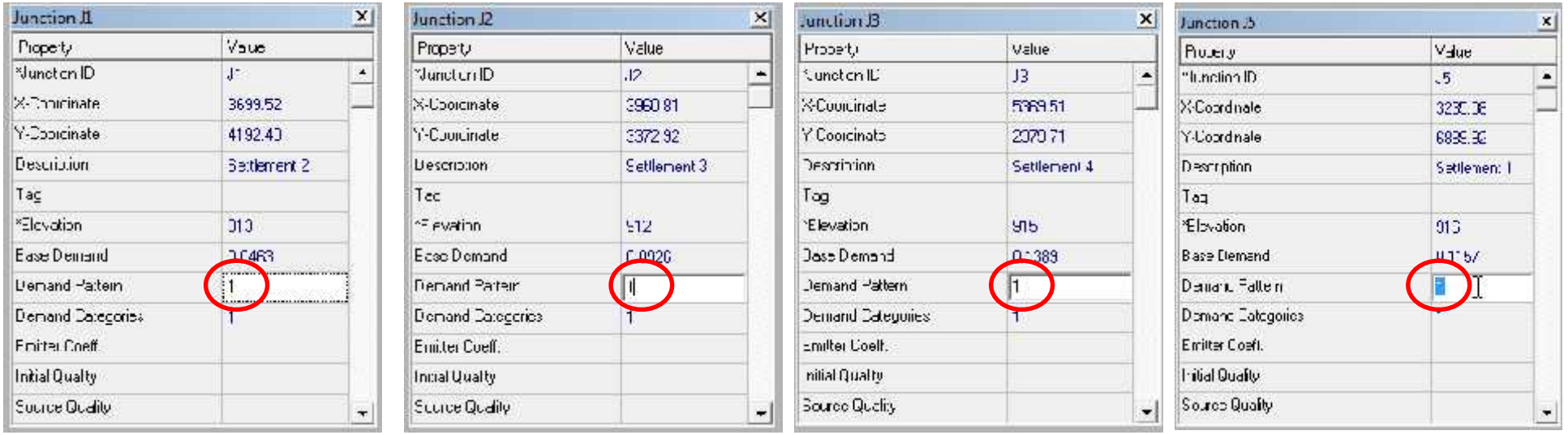
Introduction to Epanet

For each junction where there is a demand you must specify the pattern
J1, J2, J3 and J5



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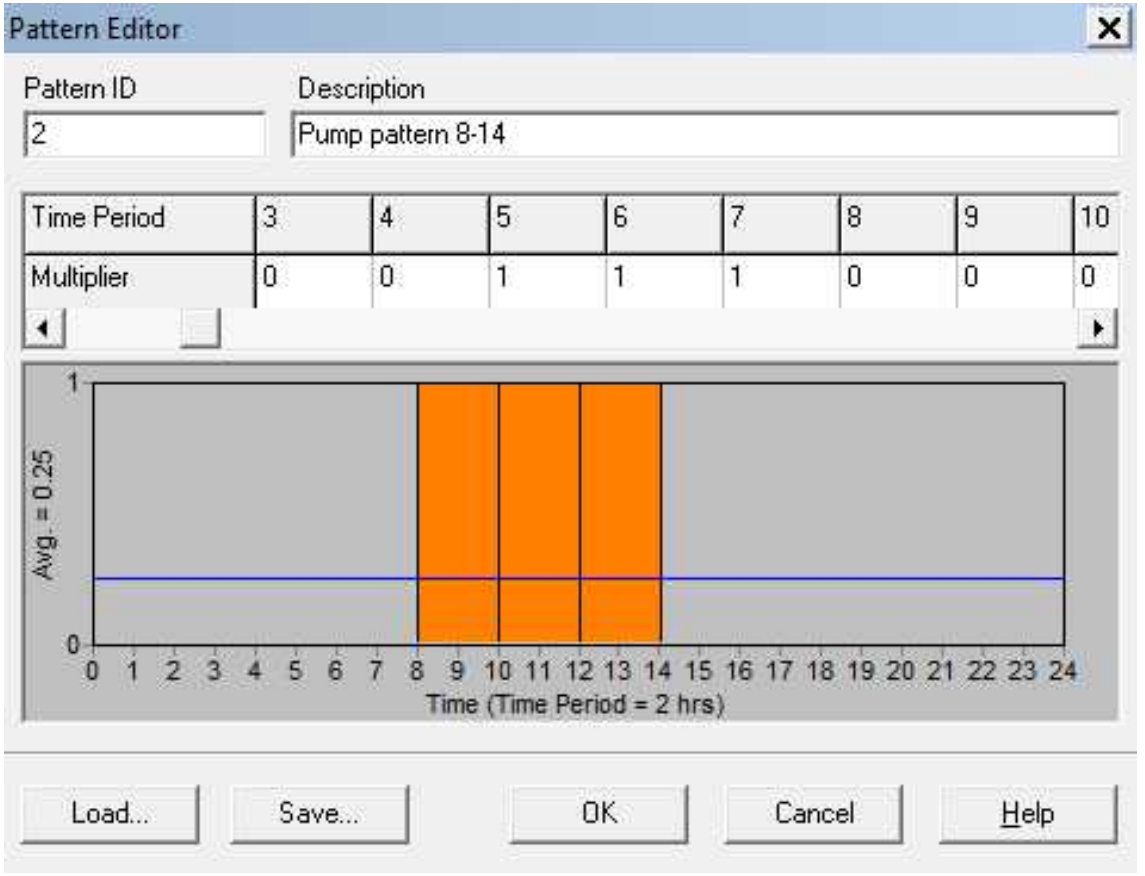
Introduction to Epanet

Pattern for the pumping time

We assume that the pump pumps once a day for 6 hours. It starts at 8.00 and stops at 14.00.
Add a second Pattern for the pump (Pattern 2)



Average must not be 1 as like the demand

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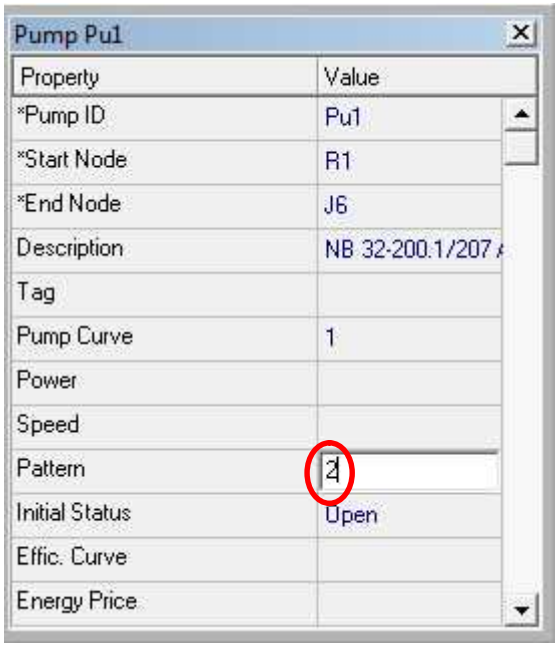
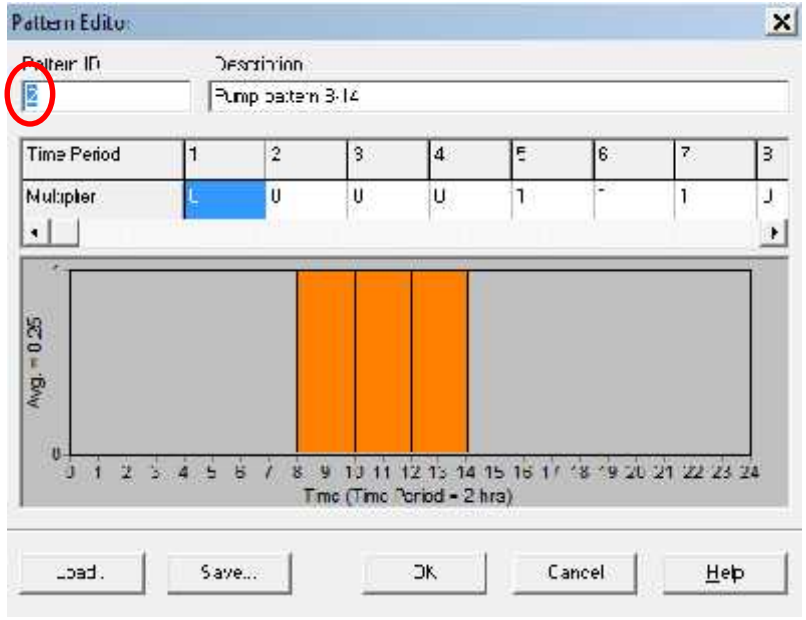
Introduction to Epanet

Insert the pattern n° at the pump parameter





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Introduction to Epanet

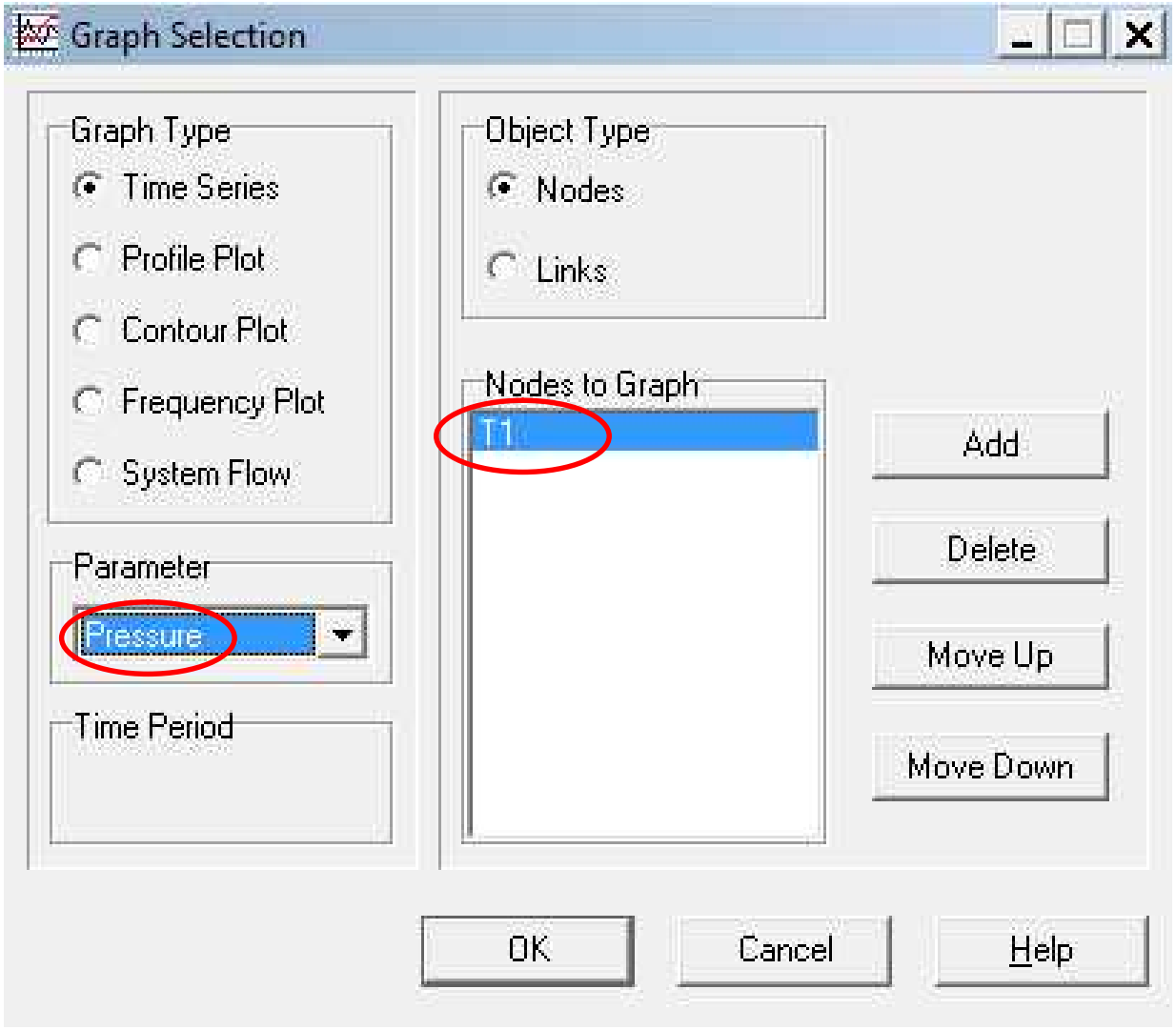
Run the analysis 

OK to see the error

See Epanet Manual page 37 for error message

Introduction to Epanet

Look at the graph for the tank T1 clicking 



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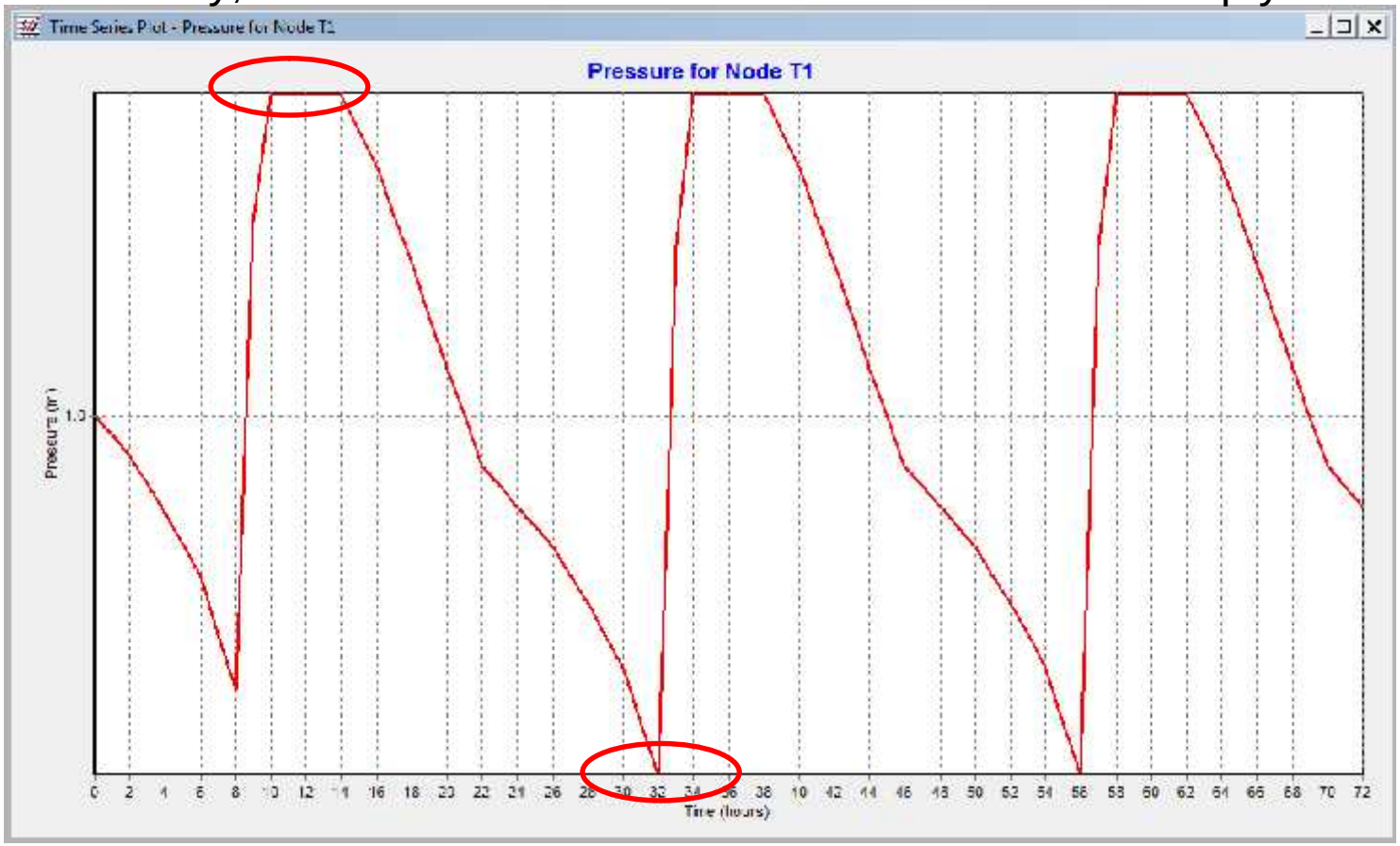
Introduction to Epanet

Evidentely, the tank is overfilled at 10.00 and 32.00 hr is empty



In this case, either you make a bigger tank or or change the pump Pattern.

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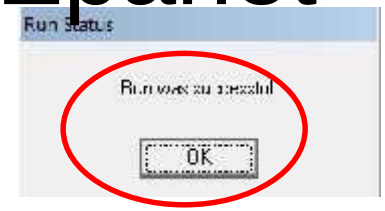
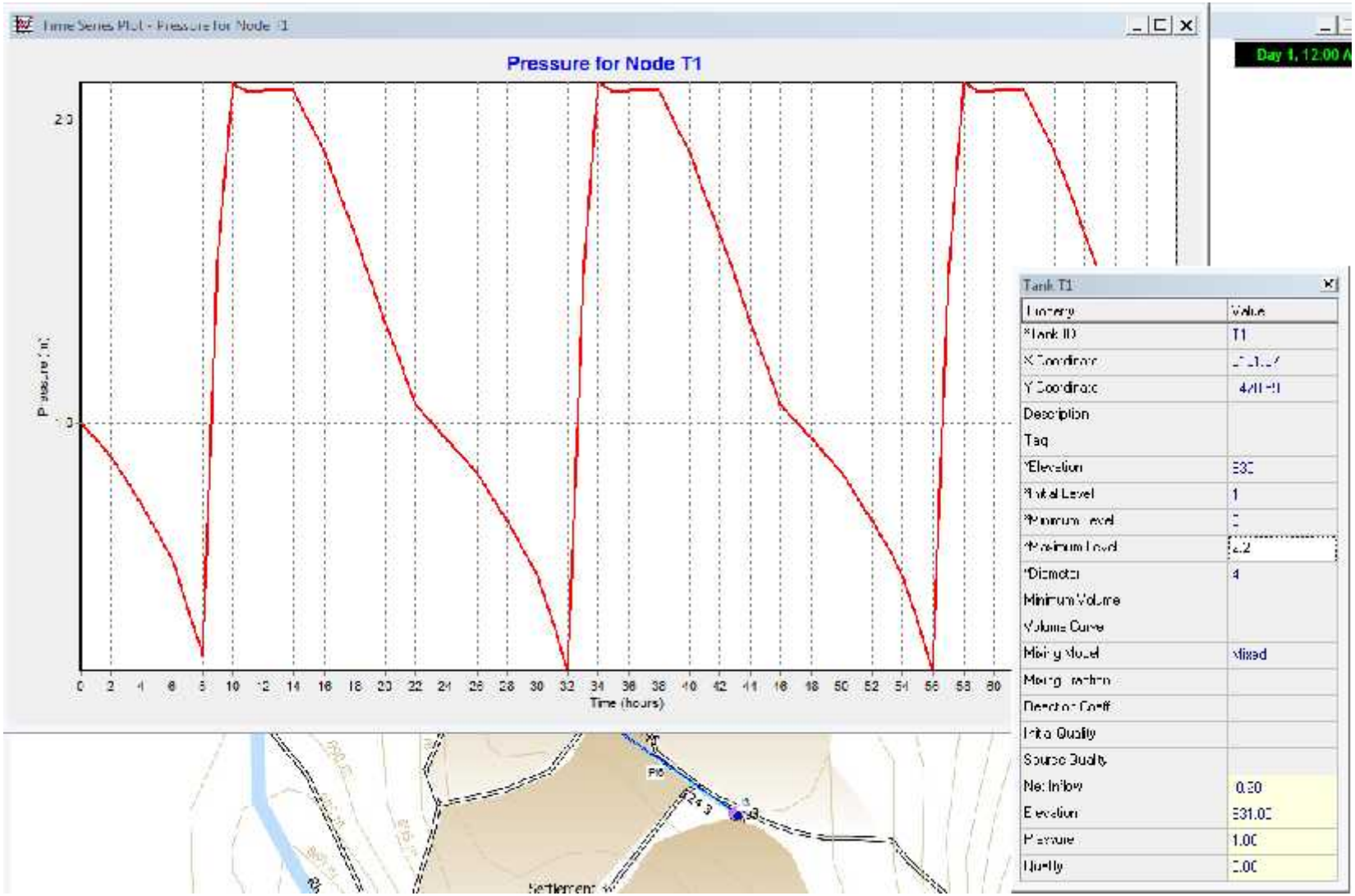
Introduction to Epanet

A) Make the tank bigger (Hmax 2.2m Volume 27.6m3)





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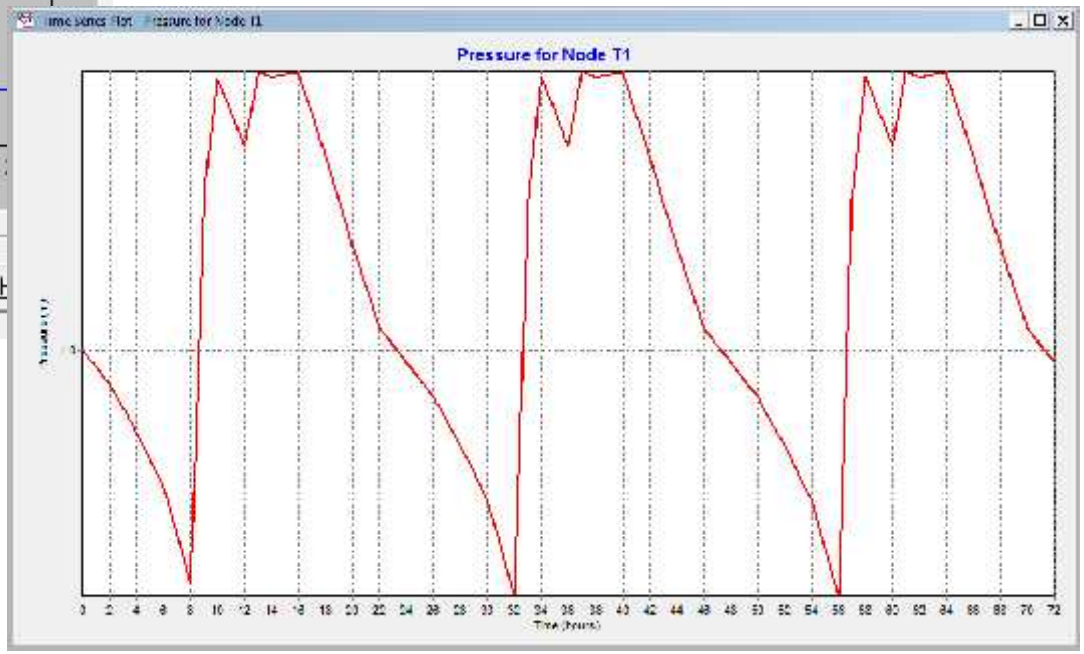
Introduction to Epanet

B) Change the pattern of the pump



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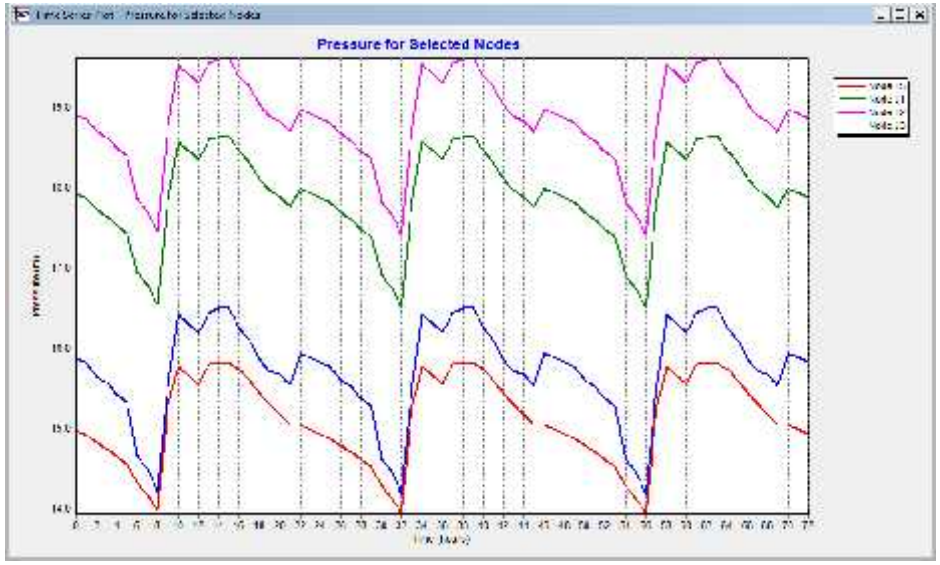
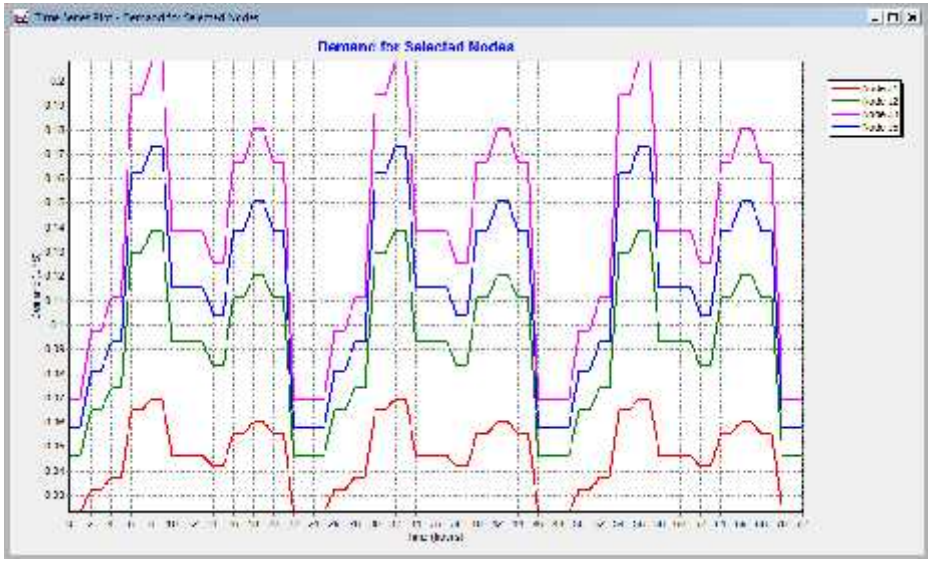
Introduction to Epanet

Each element of the network can be analized over time, grafically or with report/tables

Pressure behaviour at Junctions



Demand behaviour at Junctions



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Introduction to Epanet

Full report


```
*************************************************************
*                        E P A N E T                        *
*                Hydraulic and Water Quality                *
*                Analysis for Pipe Networks                 *
*                      Version 2.0                          *
*************************************************************

Input File: Example Time Analysis.NET


Link - Node Table:
-------------------------------------------------------------
Link     Start    End      Length   Diameter
ID       Node     Node          m         mm
-------------------------------------------------------------
P11      J6       J4        140.1         57
P12      J4       T1        340.1         57
P13      J1       J5        185.4         57
P14      J5       J1        198.2       45.2
P15      J1       J2         62.5       45.2
P16      J2       J3        124.3       76.2
PU1      R1       J6          #N/A     #N/A Pump

Energy Usage:

                 Usage    Avg.     Kw-hr      Avg.      Peak      Cost
Pump            Factor  Effic.      /m3        Kw        Kw      /day
-------------------------------------------------------------
PU1              25.00   75.00      0.32      1.56      5.12      0.00
-------------------------------------------------------------
                                          Demand Charge:          0.00
                                          Total Cost:             0.00

Node Results at 0:00 Hrs:
-------------------------------------------------------------
Node         Demand       Head   Pressure   Quality
ID              LPS          m          m
-------------------------------------------------------------
J1              0.02     930.91      17.91      0.00
J2              0.05     930.90      18.90      0.00
J3              0.07     930.87      15.87      0.00
J4              0.00     931.00      91.00      0.00
J5              0.06     930.97      14.97      0.00
J6              0.00     931.00      41.00      0.00
R1             -0.09     890.00       0.00      0.00 Reservoir
T1              0.20     931.00       1.00      0.00 Tank


Page 2
Link Results at 0:00 Hrs:
-------------------------------------------------------------
Link         Flow  VelocityUnit  Headloss   Status
ID            LPS          m/s       m/km
-------------------------------------------------------------
P11          0.00         0.00       0.00   Open
P12          0.00         0.00       0.00   Open
P13          0.20         0.08       0.18   Open
P14          0.14         0.09       0.29   Open
P15          0.12         0.07       0.21   Open
P16          0.07         0.07       0.24   Open
PU1          0.00         0.00       0.00   Closed Pump

Node Results at 1:00 Hrs:

Node         Demand       Head   Pressure   Quality
ID              LPS          m          m
```

Table report

Network Table - Nodes at 8:00 Hrs

Node ID	Demand LPS	Head m	Pressure m	Quality
Junc J1	0.07	929.54	16.54	0.00
Junc J2	0.14	929.44	17.44	0.00
Junc J3	0.21	929.22	14.22	0.00
Junc J4	0.00	955.70	45.70	0.00
Junc J5	0.17	929.98	13.98	0.00
Junc J6	0.00	966.20	76.20	0.00
Resvr R1	-5.14	890.00	0.00	0.00
Tank T1	4.55	930.23	0.23	0.00

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Introduction to Epanet

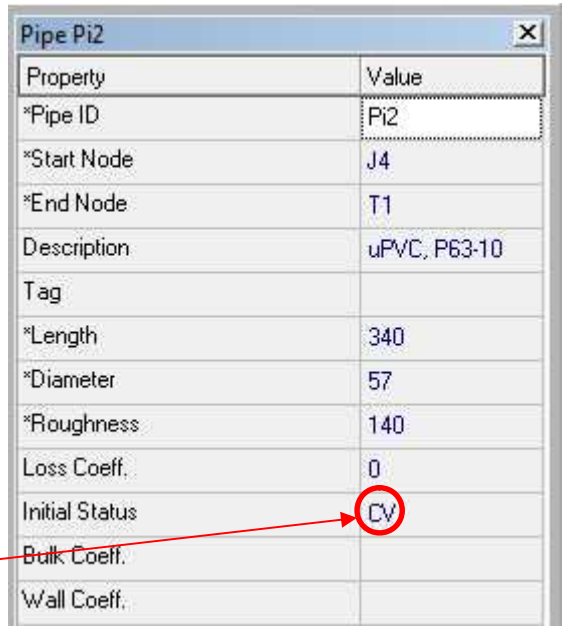
Note:

Valves ⋈ are not installed in this example.
Valves need to be installed between two Junctions
Epantet considers 6 types of valves:

- PRV Pressure Reducing Valve
- PSV Pressure Sustaininb Valve
- PBV Pressure Breaker valve
- FCV Flow Control Valve
- TCV Throttle Control Valves
- GPV General Purpose Valve

For setting and info about the use and parameters of the valves see Epanet user manual

Flow control valve are included in the parameter of the pipes



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Introduction to Epanet

Note: **Fire Water request:**

To determine the maximum flow available at a particular pressure, set the emitter coefficient at the node to a large value (e.g., 100 times the maximum expected flow) to the node's elevation. After running the analysis, the available fire flow equals the actual demand reported for the node minus any consumer demand that was assigned to it.

Each country might have its own regulation!

Wasserbedarf gemäss Schweiz. Feuerwehrverband

Wasserbedarf für die Brandbekämpfung gemäss Schweiz. Feuerwehrverbund:

Gefährdungsklasse	Kl.	Kat	Überbauungsart	Anz. Rohre	Erforderliche Wasserlieferung bei 3.5 bar		Einsatzdauer	Min. Löschreserve
				Stk.	l/s	l/min	Std	m3
Kleinrisiken	I	1	Einzelnes Wohnhaus	2	10	600	¾	30
Einzelobjekte		2	Einzelnes landwirtschaftliches Gut	2-3	12.5	750	1	50
		3	Weiler mit offener Bauweise	3	15	900	1½	100
		4	Kleines Dorf mit offener Bauweise	4	20	1200	1½	125
Mittelrisiken	II	5	Dorf mit offener Bauweise	5	25	1500	1¾	150
Wohn- und Gewerbezone		6	Dorf mit teilweise geschlossener Bauweise	6	30	1800	2	200
		7	Städtische Quartiere und Dörfer mit Gewerbezonen	8	40	2400	2¼	300
Grossrisiken	III	8	Städtische Überbauung	10	50	3000	2½	450
Geschlossene Überbauungen - Städte		9	Stadtgebiete, Warenhäuser, Grosshotels, Theater, Spitäler, Industriezonen ohne Sonderrisiko	12	60	3600	2¾	600
		10	Stadtgebiete mit hoher Brandgefährdung, wie Altstadt, Hochhäuser, Industriezonen mit Sonderrisiken (Chemiebetriebe, Lagerhäuser usw.)	16	80	4800	3	800

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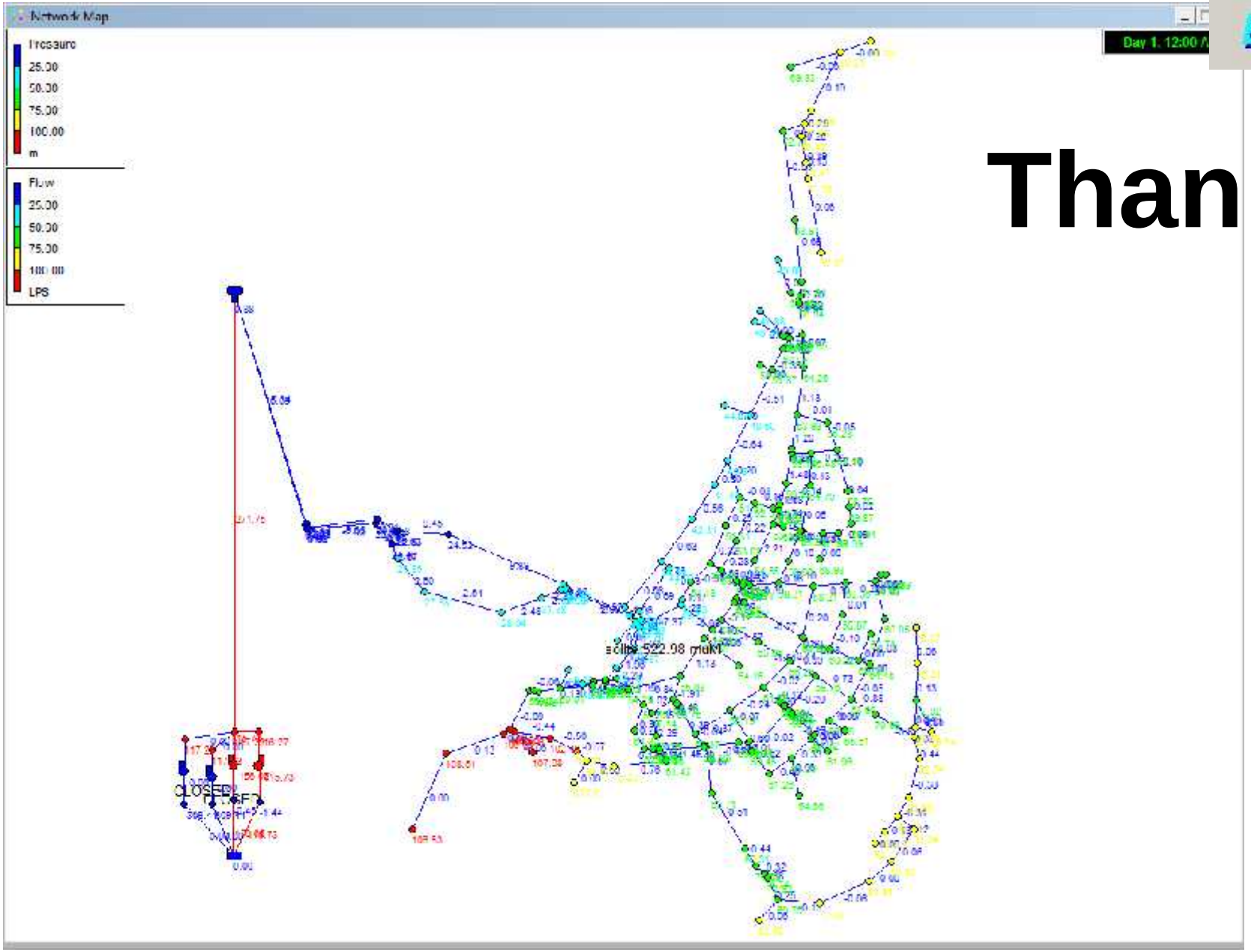
Introduction to Epanet



Thanks

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Backdrop map for Epanet

Objective:

Produce a back drop map for Epanet

•*A map is existing, you want to make the backdrop and introduce it (not geo – referenced) in Epanet*

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Geo-reference Epanet with qGis

- Scan the map and save it in *.Jpeg format.
- Open it with Irfanview* and save it as *.**emf** format

(you might use other software)

emf format = Enhanced Windows Metafile

metafiles work better since they will not loose resolution when re-scaled.

*Irfanview = Free software at www.irfanview.com (available in CD, software folder)

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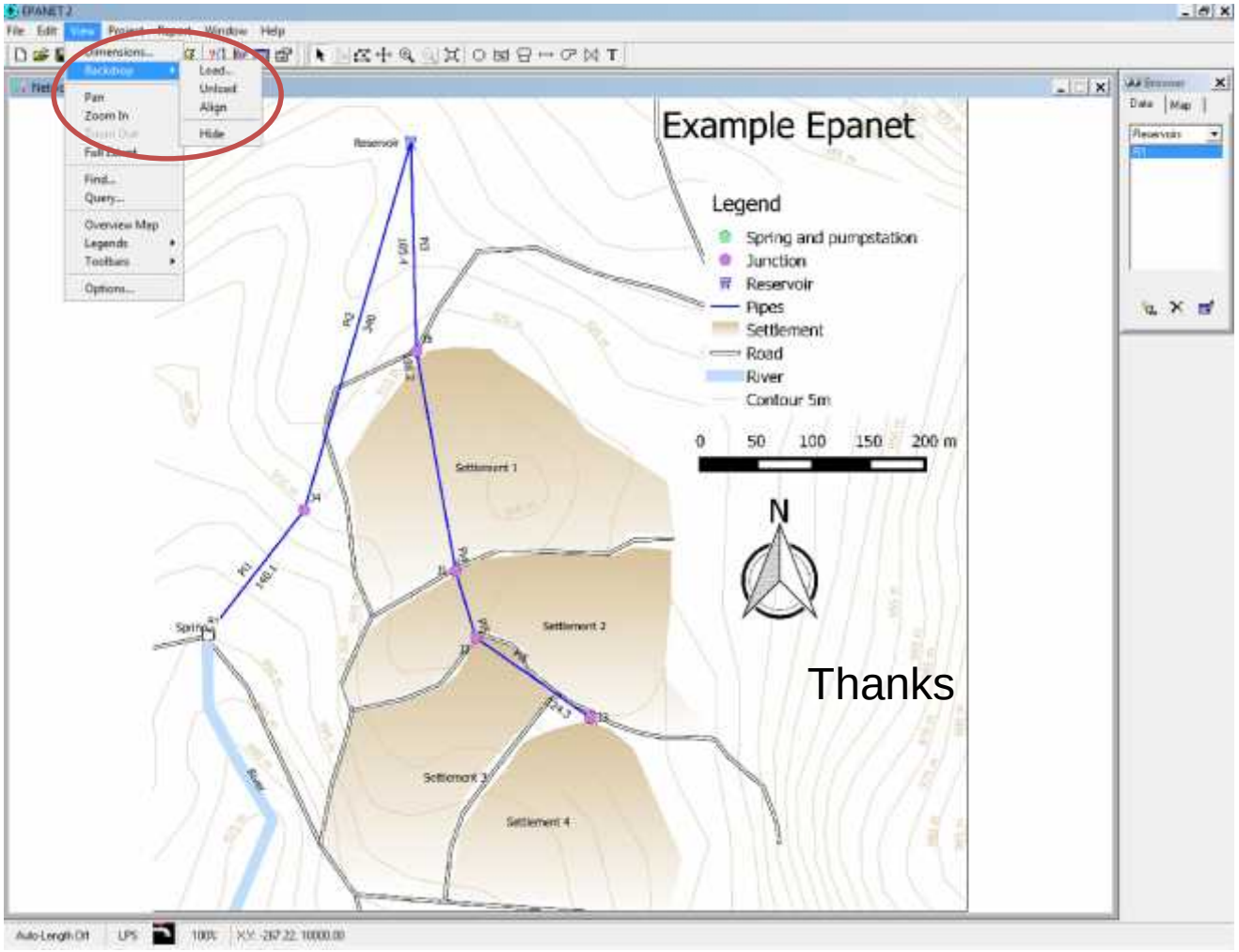
Introduction to Epanet



Insert the backdrop map

1.Select **New / backdrop**
2.Load (select example.emf)

NOTE:
- The map is not geo-reference yet.
- Auto-length is off.
- Best extension for backdrop map is *.emf (best resolution)

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Geo-reference backdrop map in Epanet

Objective:

Introduce a geo-referenced backdrop map in Epanet and use auto-length on for drawing the network

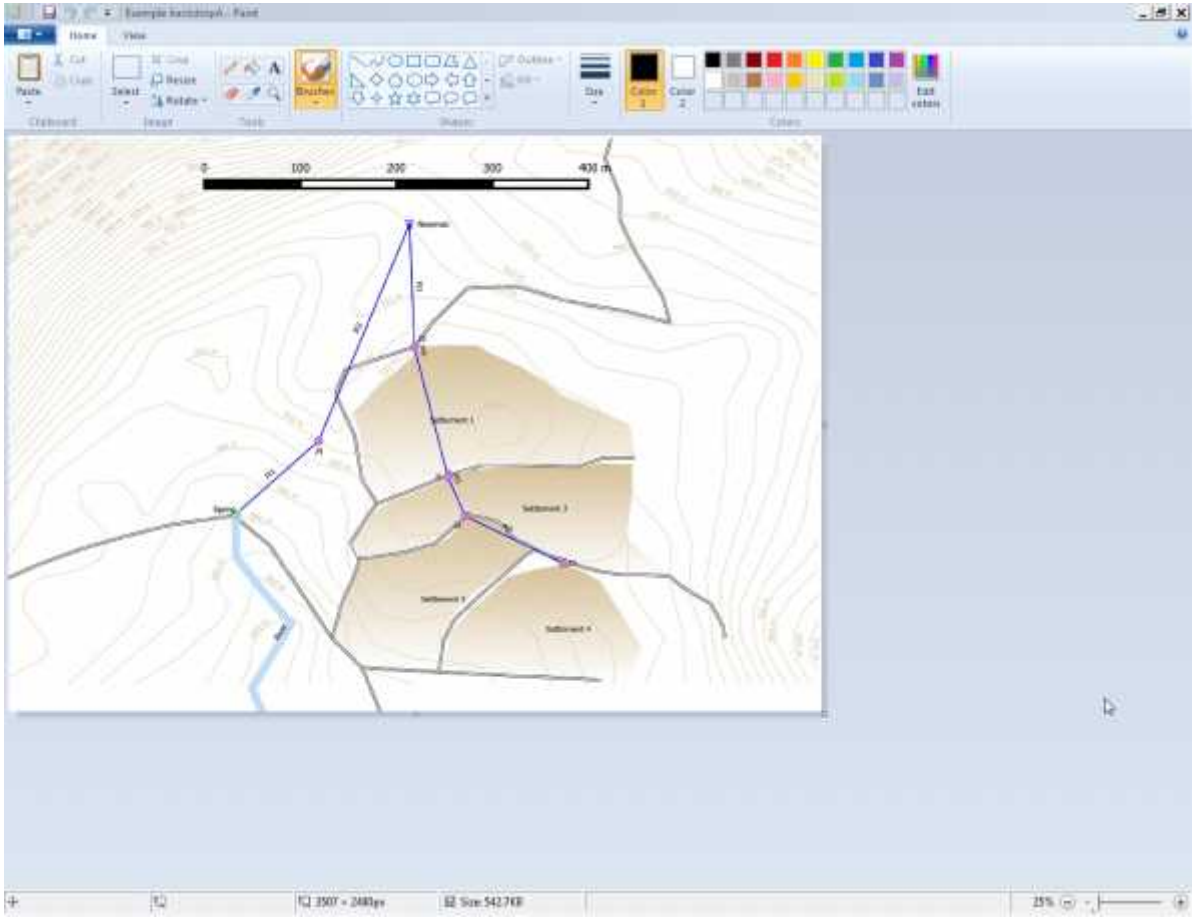
- *You have the map with **scale bar** on paper and scanned.*
- *You do not have shape files and do not know how to use GIS (time to learn it ☺).*
- *You want to use the back drop map and draw the junctions and pipes direct into Epanet using **auto-length on** without typing (knowing) the exact coordinates of the points and the length of the pipes.*
- *Elevation of the junctions is either known or the map has contour lines.*

Geo-reference backdrop map in Epanet

Step1

Open the scanned map with any raster graphic editor (i.e. MS paint, Photoshop)

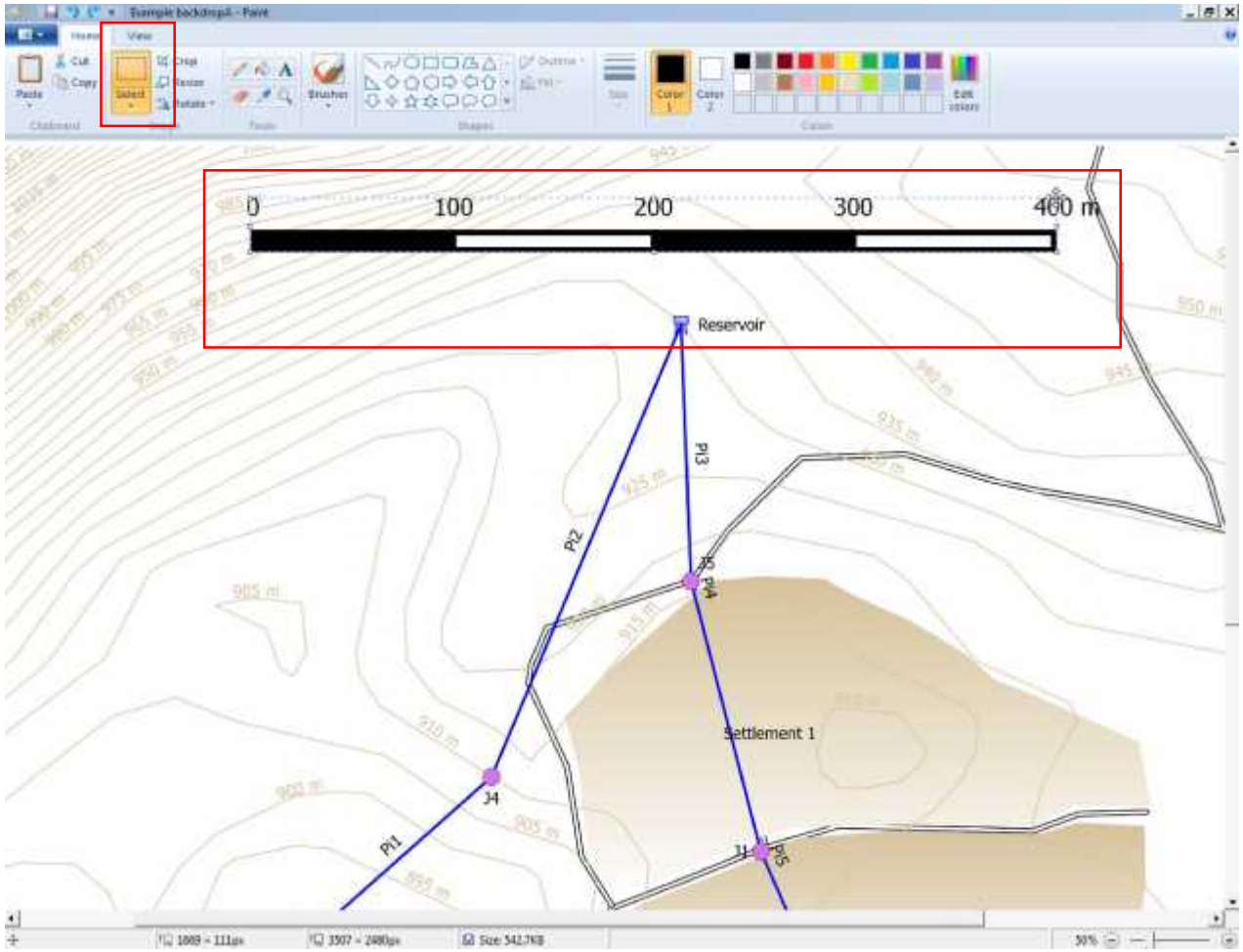
The scale bar **MUST** be visible



Geo-reference backdrop map in Epanet

Step2

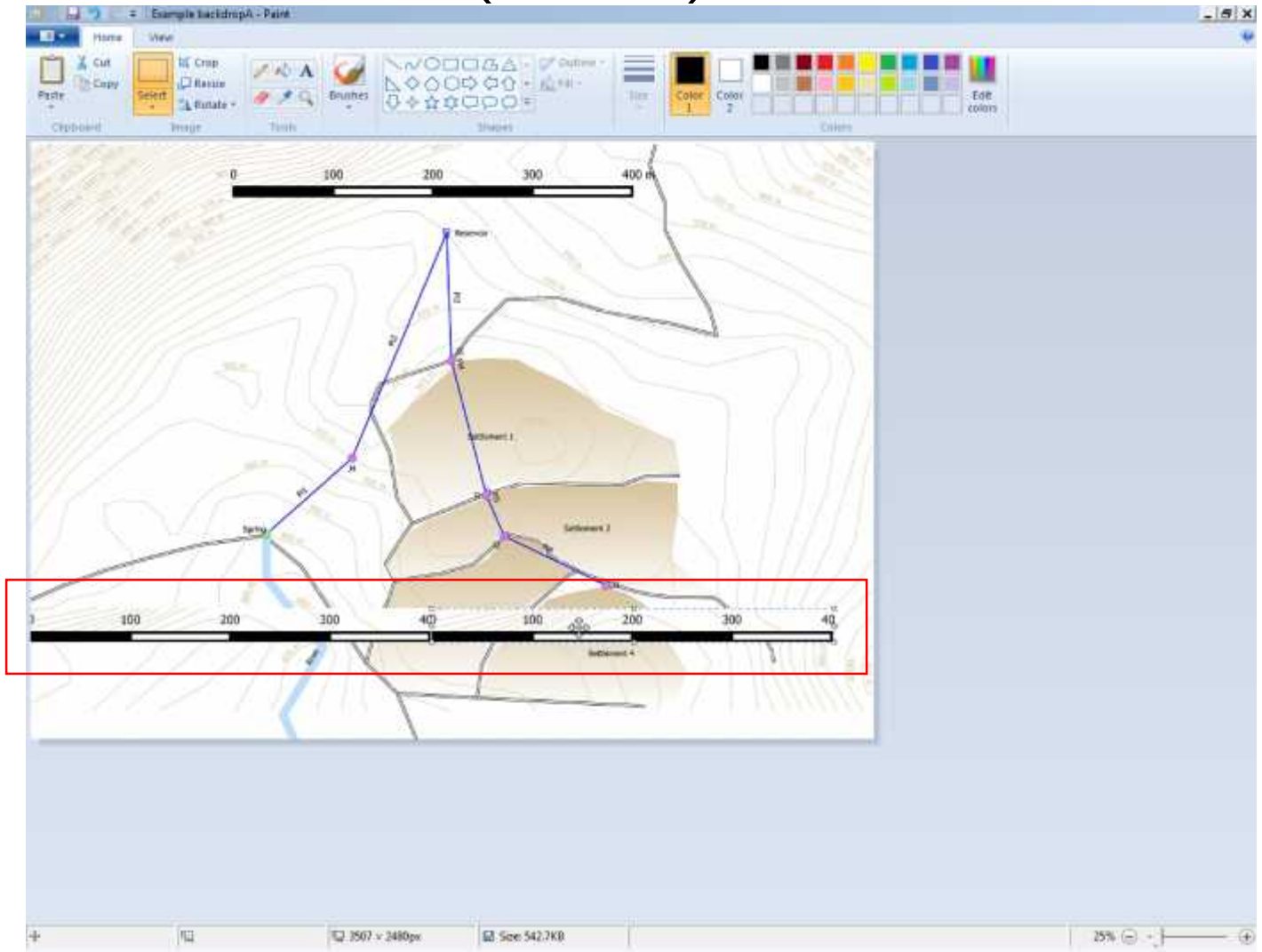
Select with select tool the scale bar as precise as you can (zoom in as best you can) and copy the selection (alt ctrl c).



Geo-reference backdrop map in Epanet

Step3

Paste the selection (alt ctrl v) as shown below

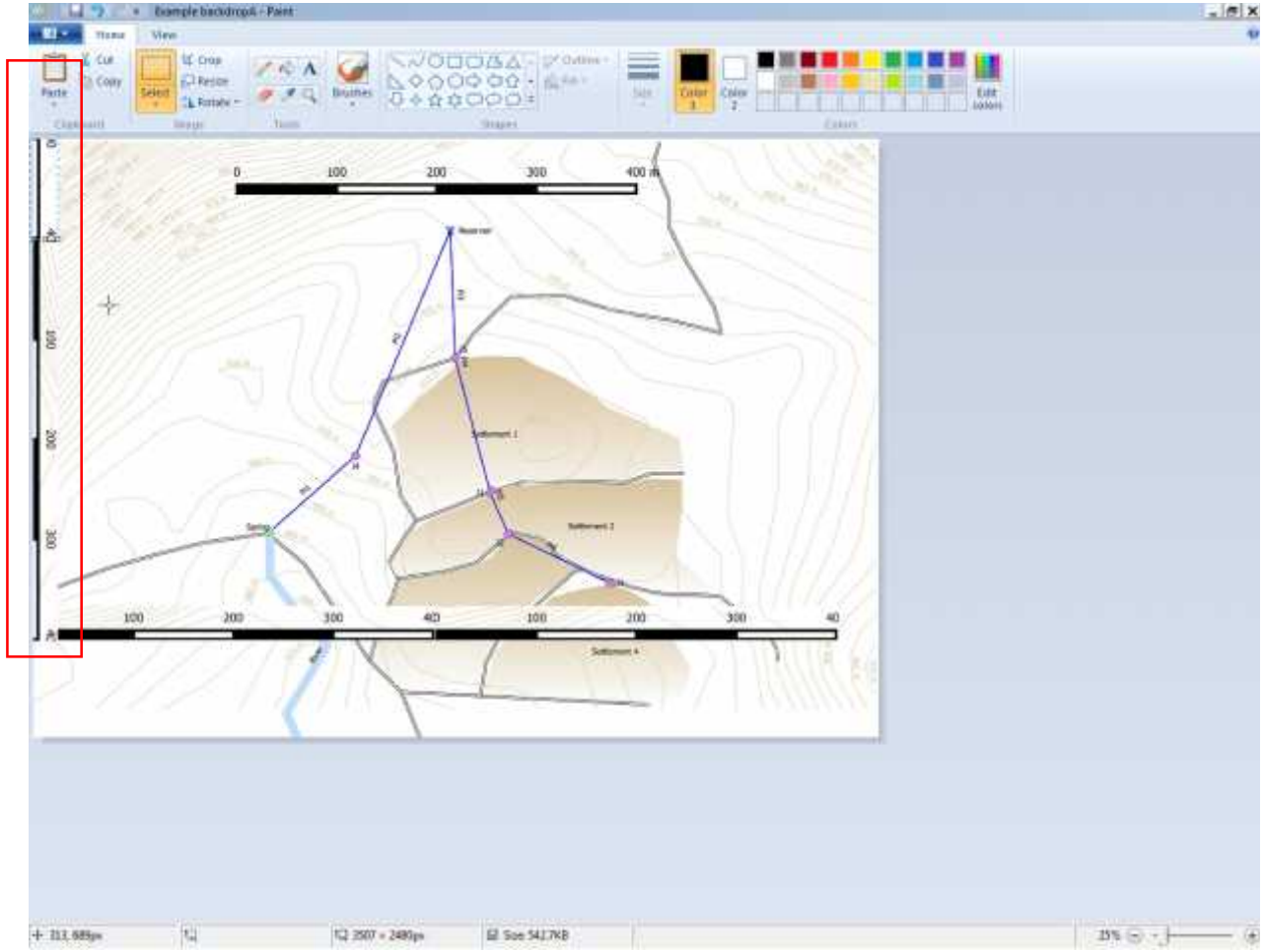


Geo-reference backdrop map in Epanet

Step4

Rotate the selected scale bar of 90° and paste it as below

Now you have the dimension of the map (x=800m X y=500m)



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Geo-reference backdrop map in Epanet

Step5

Save the image

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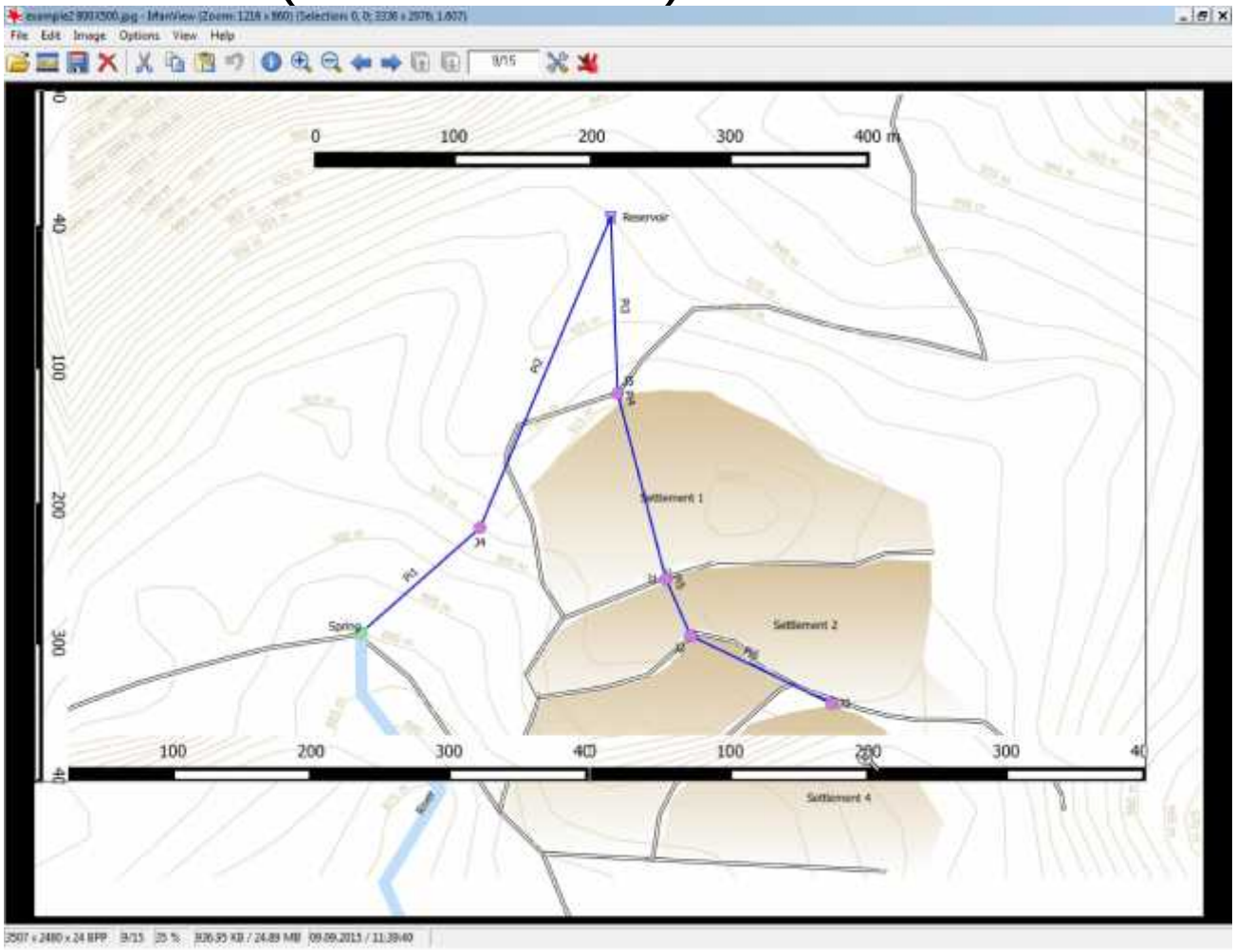
Geo-reference backdrop map in Epanet

Step6

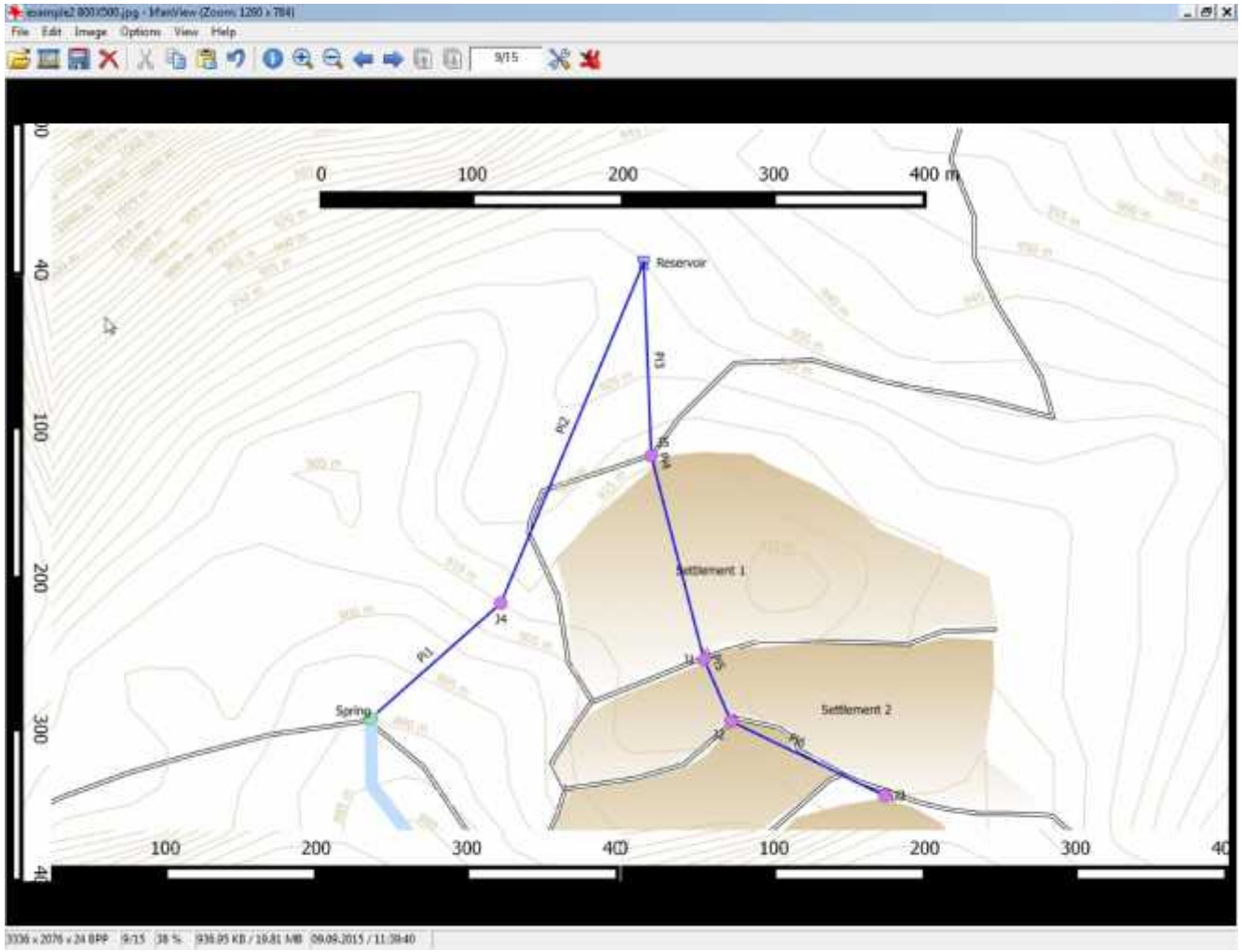
Open the image with irfanview and crop it exactly as the dimensions (800m x 500m)



Geo-reference backdrop map in Epanet

Step7

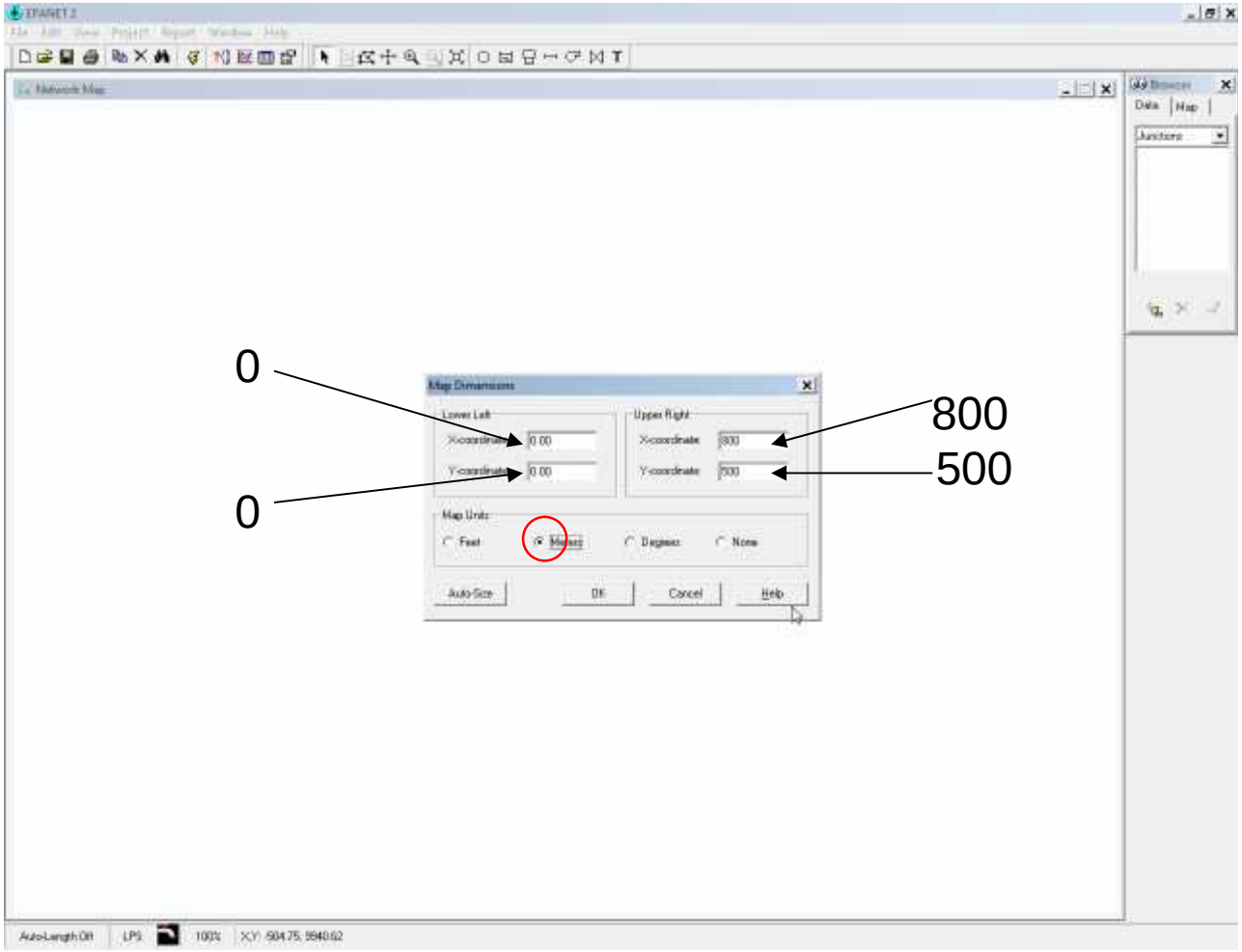
Save it in *.emf format



Geo-reference backdrop map in Epanet

Step8

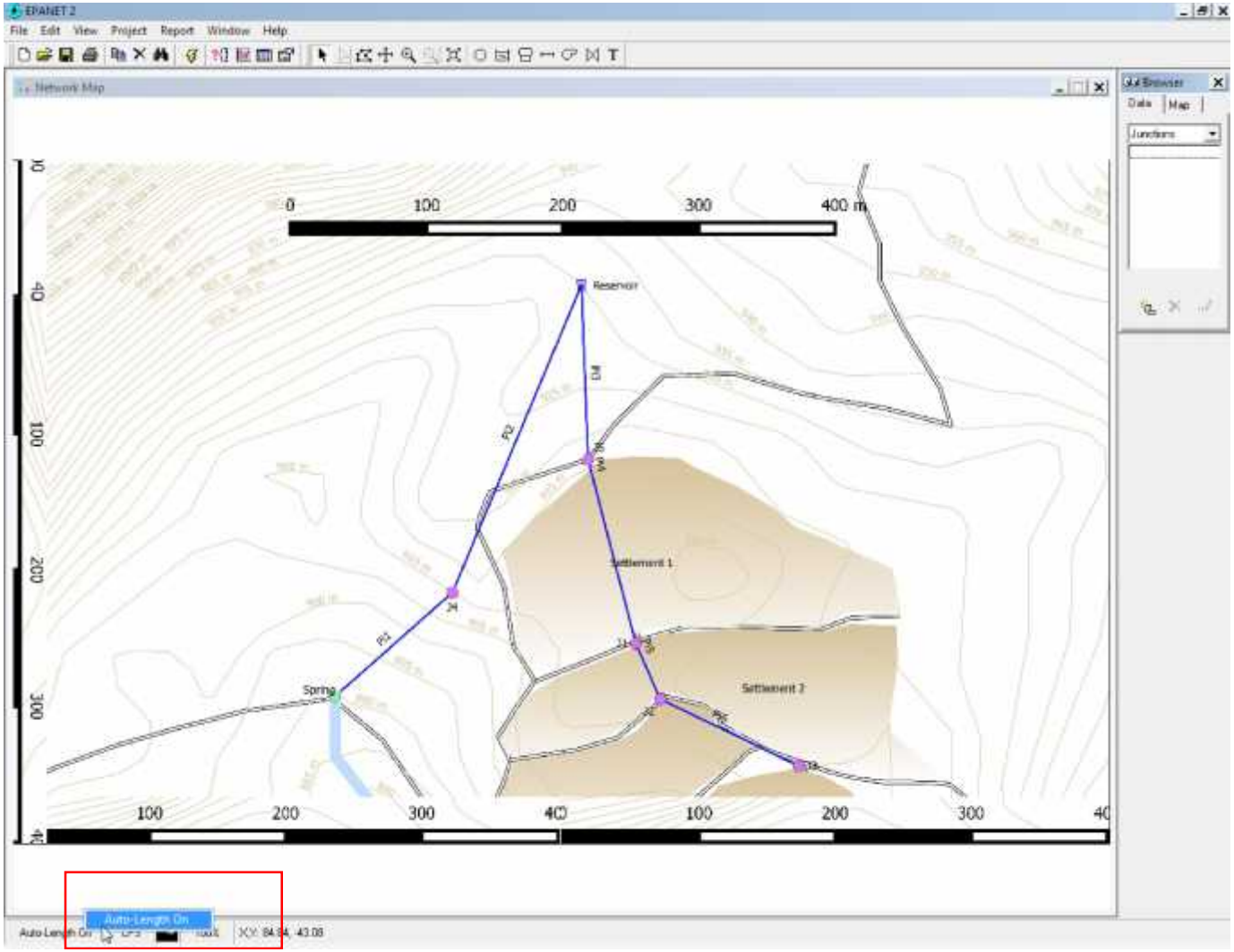
Open Epanet and insert the dimension of the backdrop map in Epanet as seen before (View -> Map Dimension)



Geo-reference backdrop map in Epanet

Step8

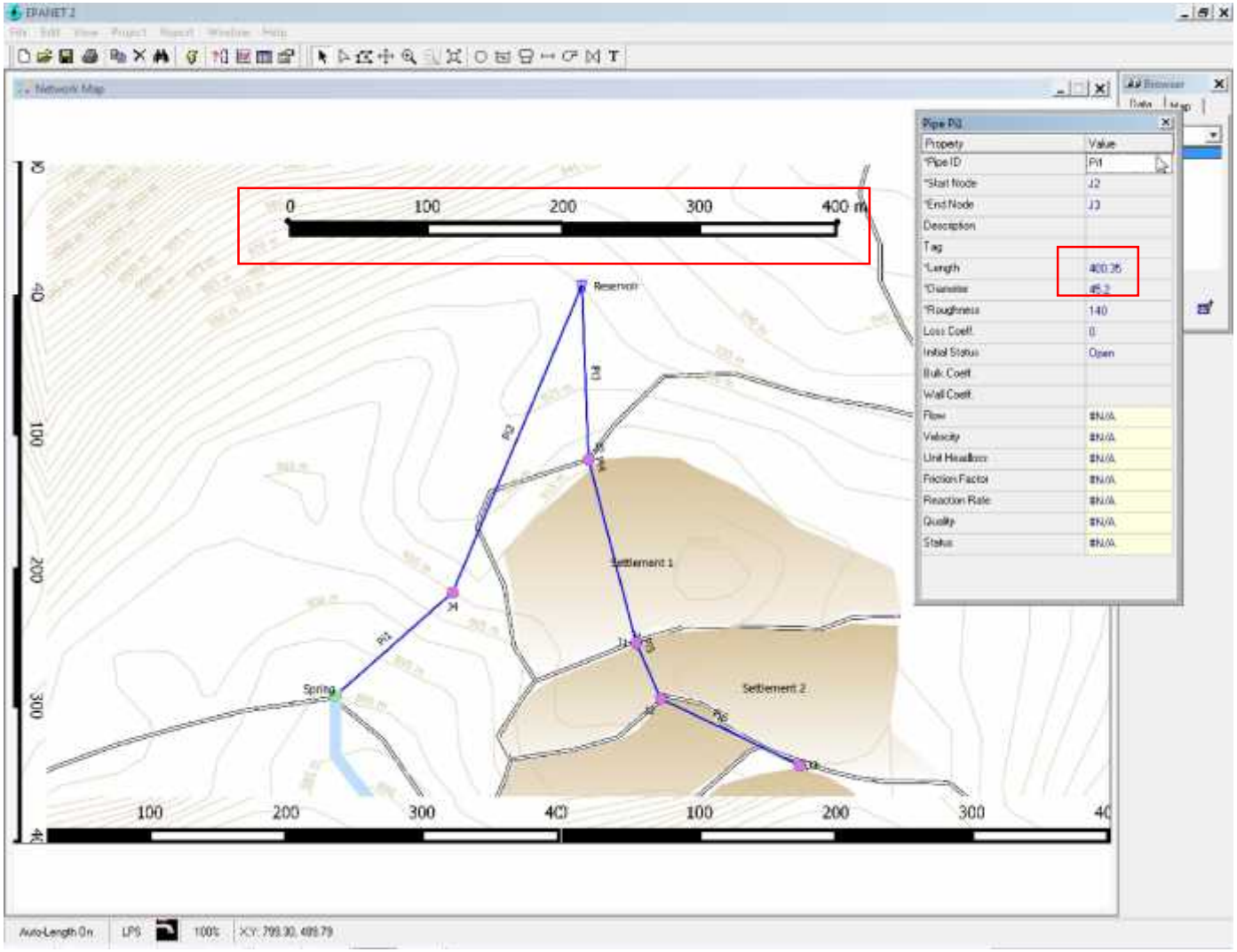
Insert the map and switch auto-length on (right click on left bottom)



Geo-reference backdrop map in Epanet

Step9

Crosscheck the correctness of the length with a new pipe on the scale bar or a known length.



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Geo-reference backdrop map in Epanet

Note:

- The elevation of the junctions must be known and inserted manually into Epanet at each element.

- This system is not precise, but in case you do not have the shape files it is still a way to make the simulation.

Thanks

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Geo-reference backdrop map in Epanet

Objective:

Introduce a geo-referenced backdrop map in Epanet and use auto-length for drawing the network

- *You have basic knowledge of GIS (i.e qGis or Global Mapper).*
- *You have the map in a GIS software (i.e. qGis) with respective shape files.*
- *You want to draw the junctions and pipes direct into Epanet using **auto-length on** without typing the exact coordinates of the points and the length of the pipe.*
- *You need a software for the transformation of Longitude/Latitude (degrees) coordinates into UTM (meters) coordinates. (i.e. Global Mapper).*

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Geo-reference backdrop map in Epanet

Step1

Install Global Mapper (1) in your PC and
Reproduce the map with it.

Needed shape files:

- Spring.shp
- Junction.shp
- Pipesnews.shp
- Tank.shp
- Settlement.shp
- Road.shp
- Settlement.shp
- Contour 5m.shp

(1)

- Global Mapper is a commercial GIS software (http://www.globalmapper.com/)
- Evaluation is free for 30 days. CD\Software\Global Mapper 15
- Cracked version available in P2P network

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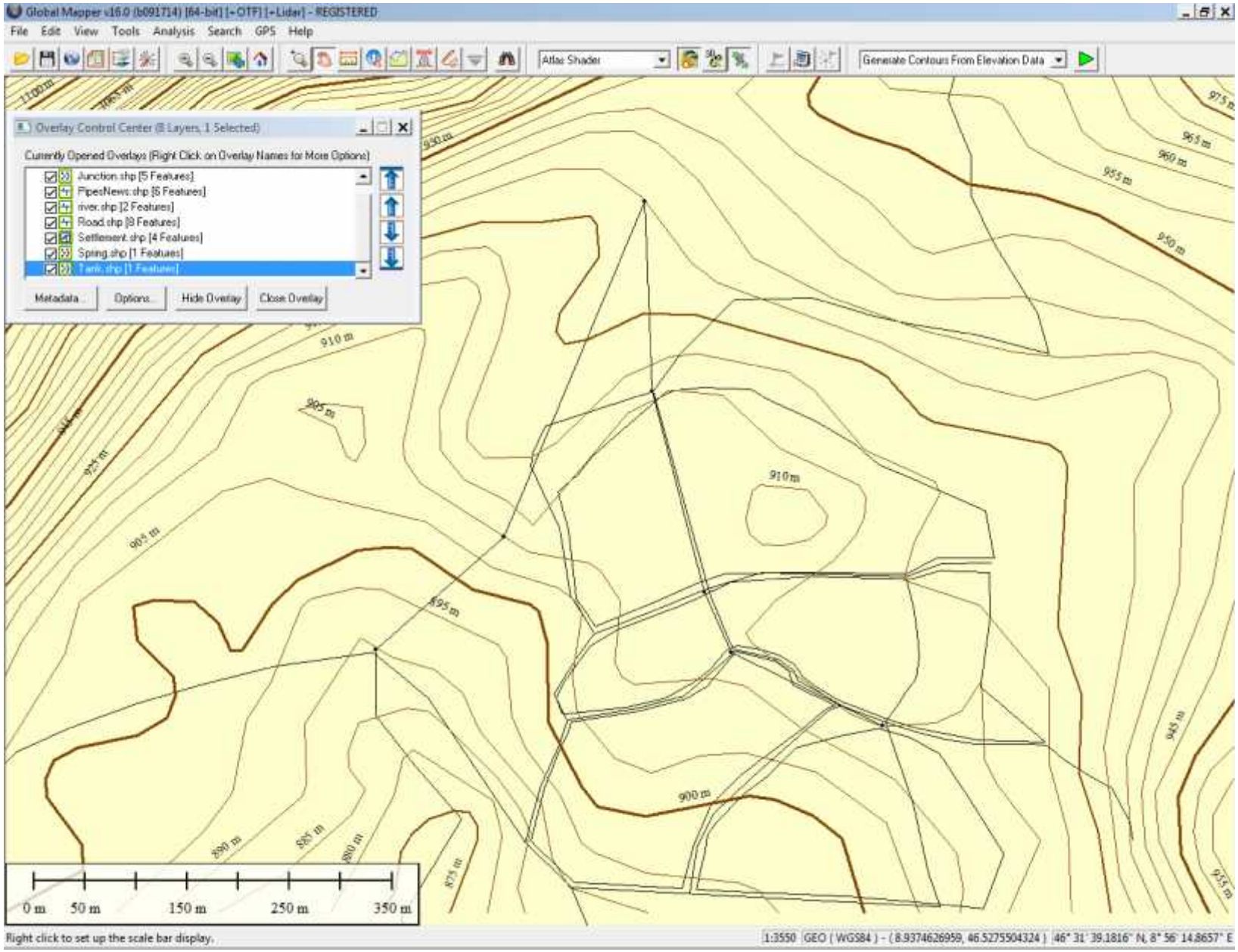
Geo-reference backdrop map in Epanet



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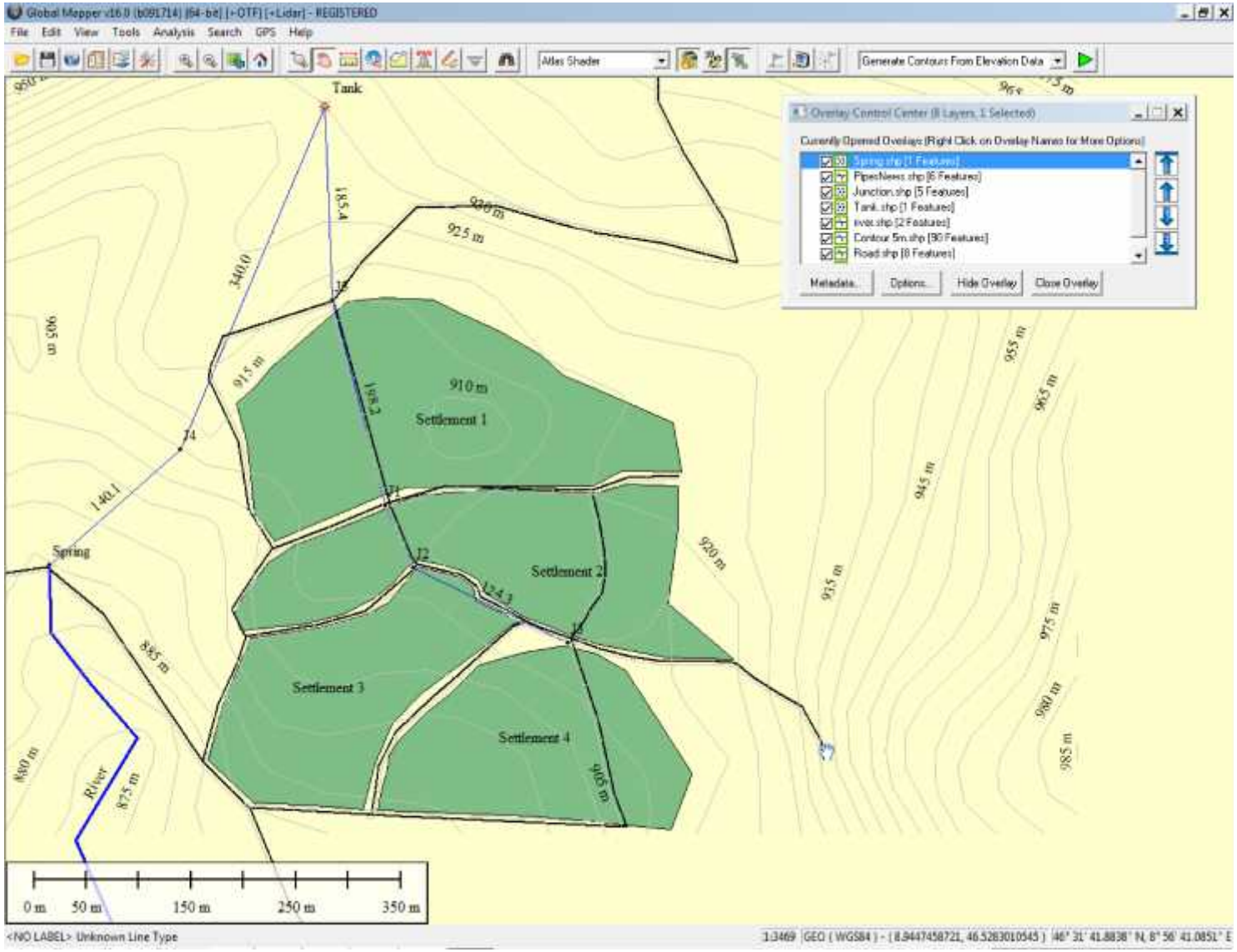
Geo-reference backdrop map in Epanet

Make a comprehensive map with style and labels



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Geo-reference backdrop map in Epanet

Step2

Convert the Global Mapper map

from **Geographical Coordinates (Latitude/Longitude)** into **UTM[(1)] Coordinates (Meters)**

[(1)] The Universal Transverse Mercator (UTM) conformal projection uses a 2-dimensional Cartesian coordinate system to give locations on the surface of the Earth. Like the traditional method of latitude and longitude, it is a horizontal position representation.

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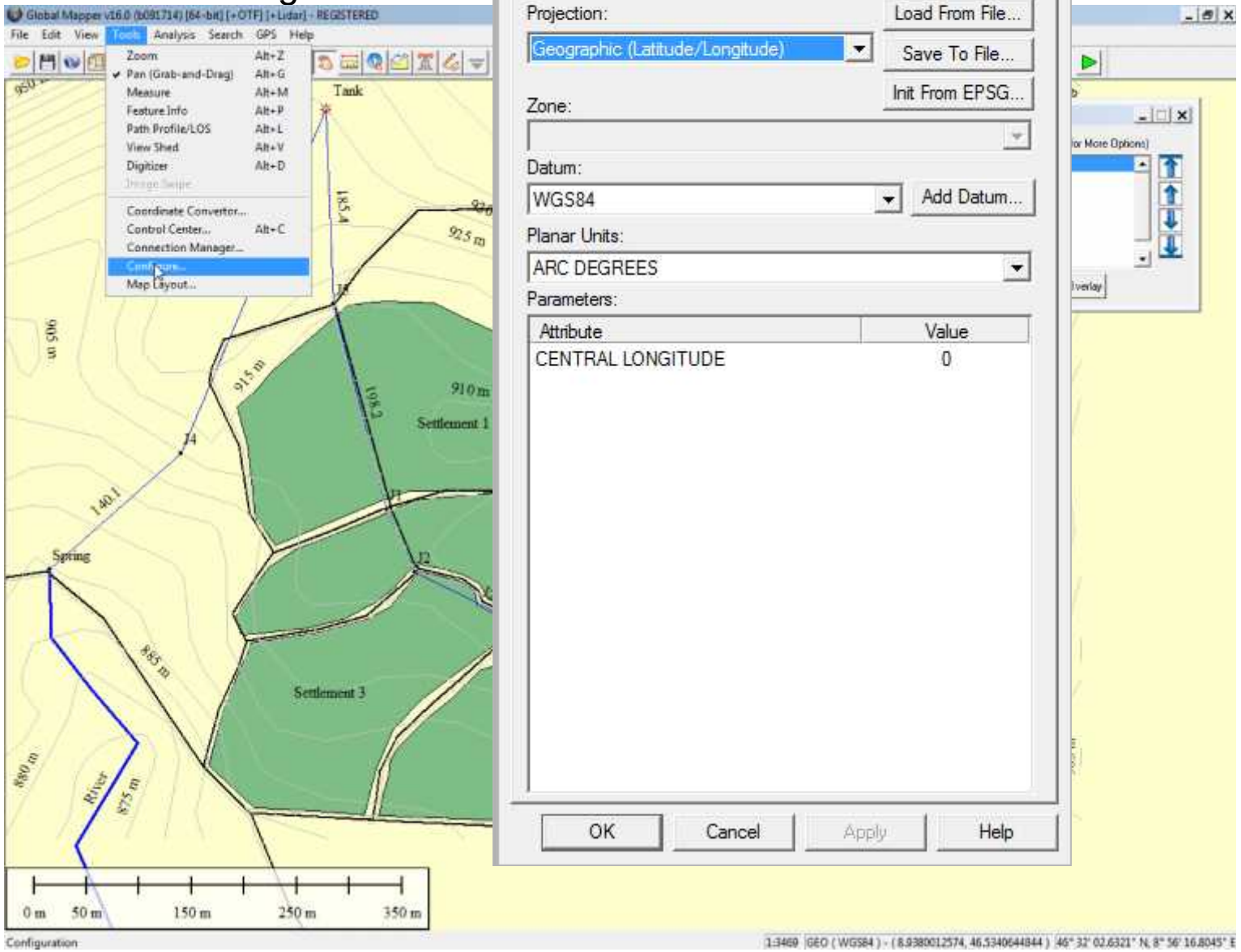
Geo-reference backdrop map in Epanet

Tools -> Configure ->



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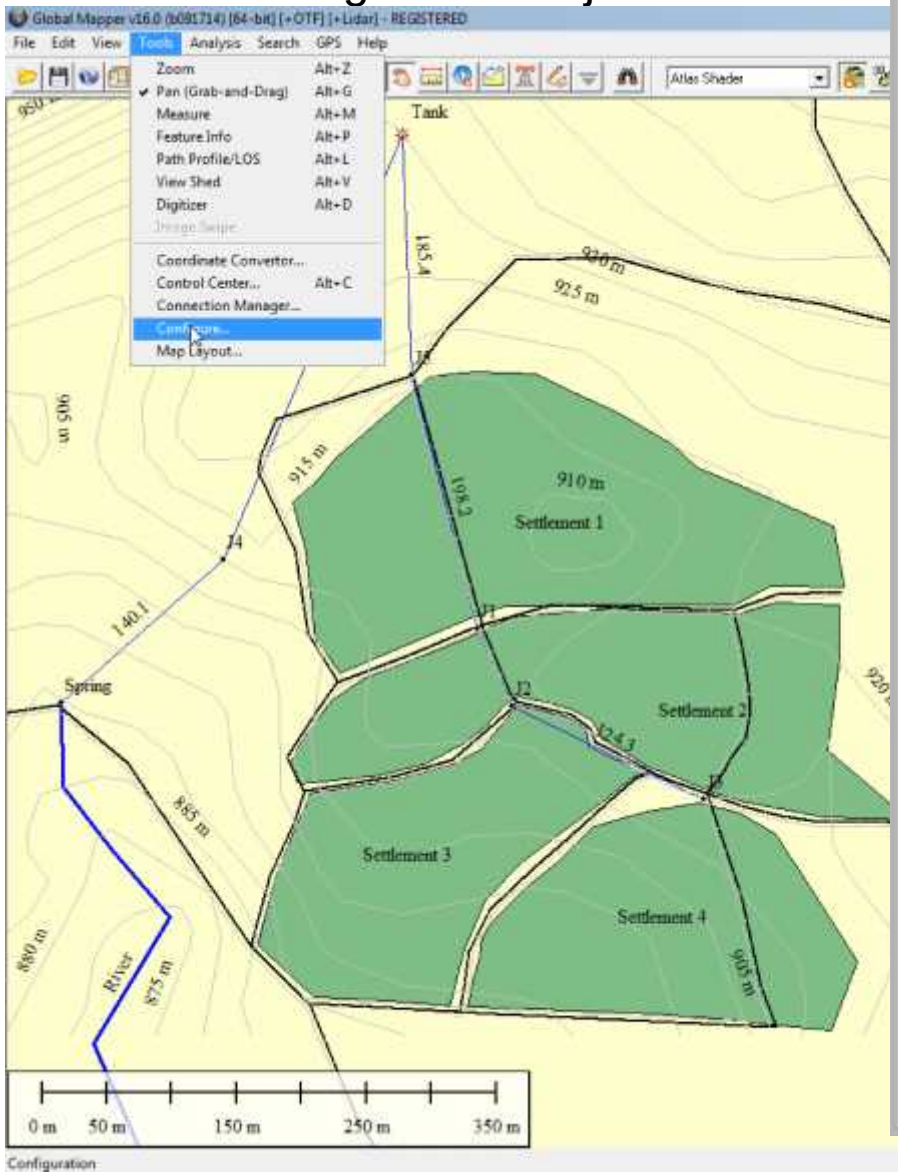
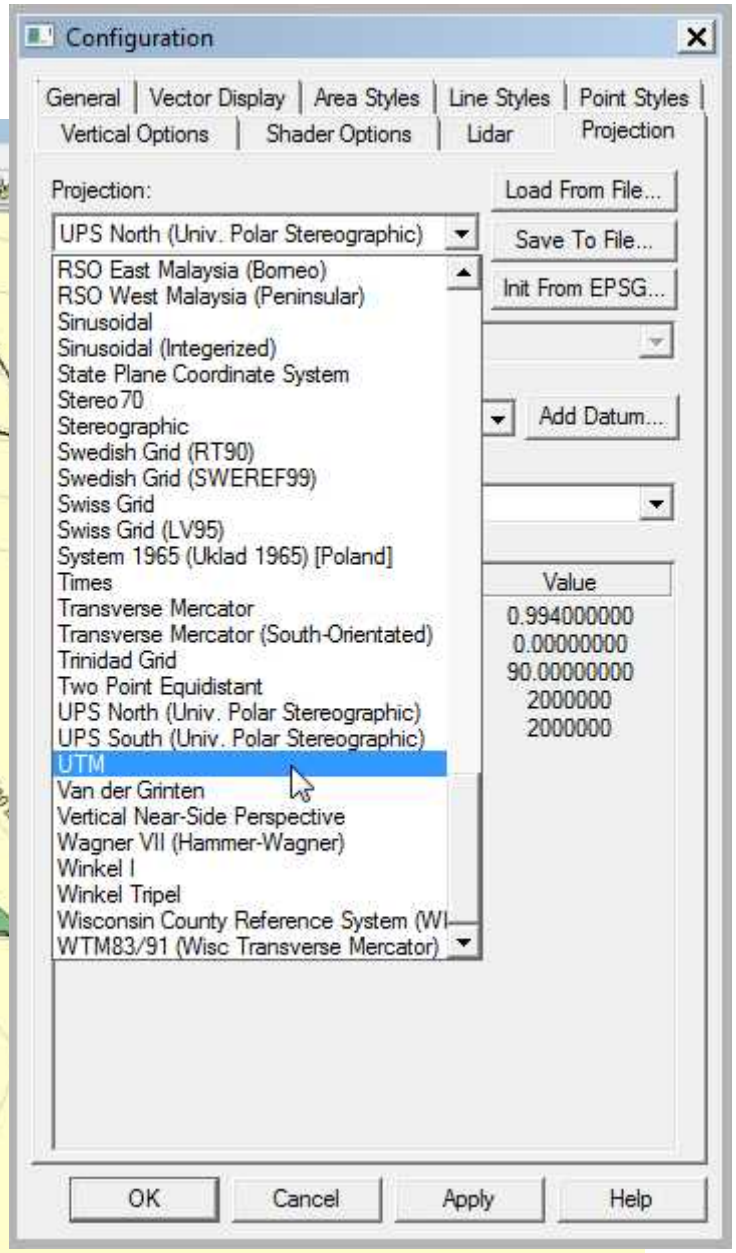
Geo-reference backdrop map in Epanet

Tools -> Configure -> Projection UTM





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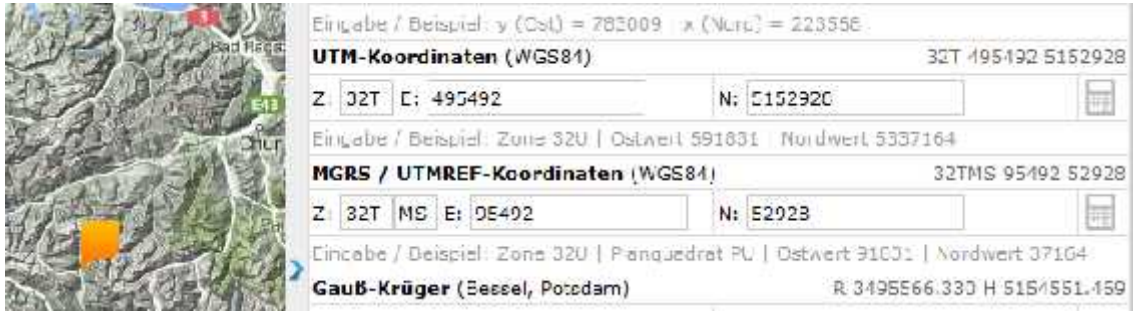
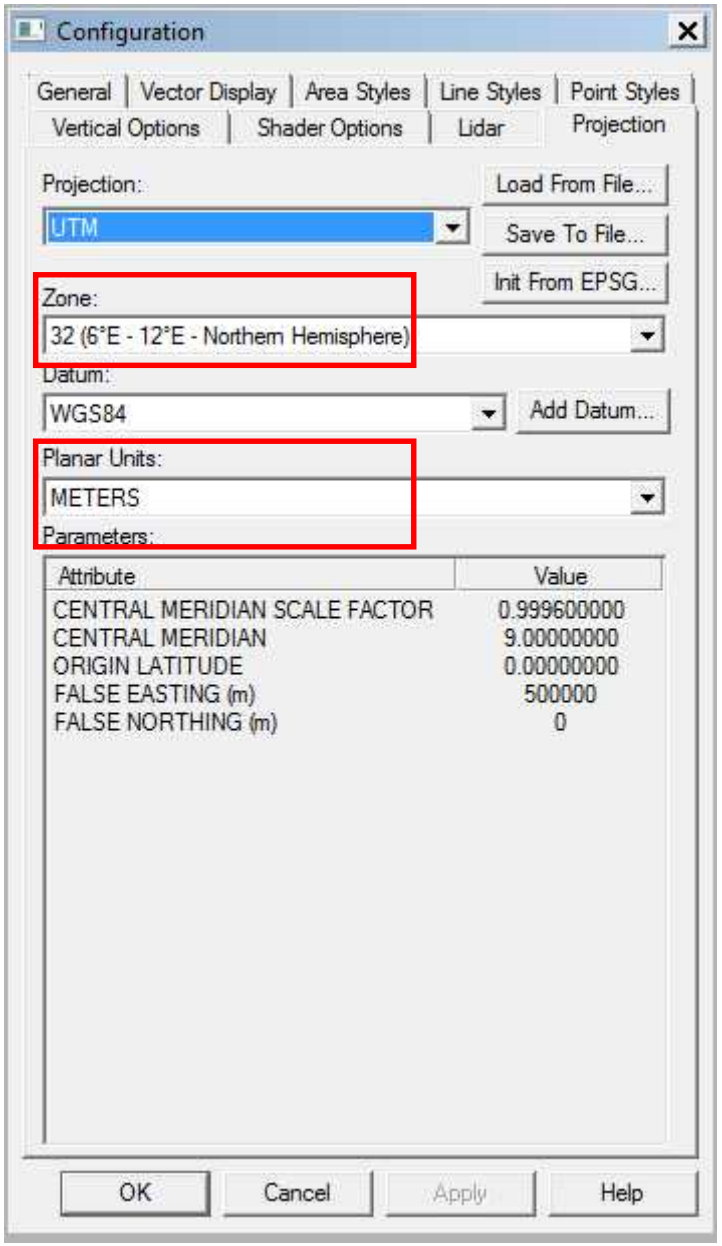
Geo-reference backdrop map in Epanet

Tools -> Configure -> Projection -> UTM ->
Zone 32 Northern Hemisphere ->
Planar Units „Meters“ ->
OK

UTM coordinates
Zone: check in WEB
Datum: WGS84
Planar unit: Meter

Zone to be defined with Web
(Google search “Place UTM Zone”
i.e UTM Olivone Zone)





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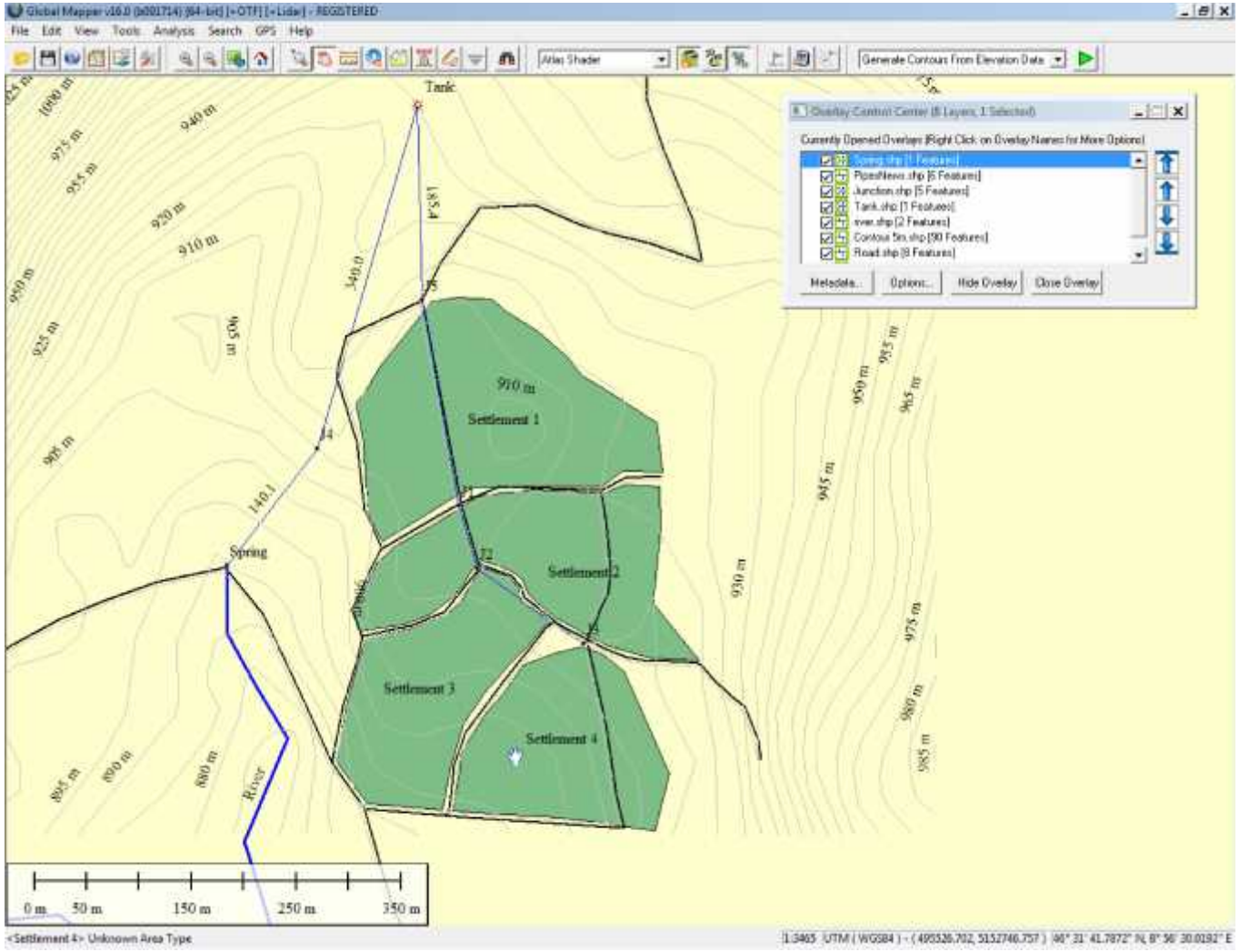
Geo-reference backdrop map in Epanet

Tools -> Configure -> Projection -> UTM -> OK

The map changes slightly



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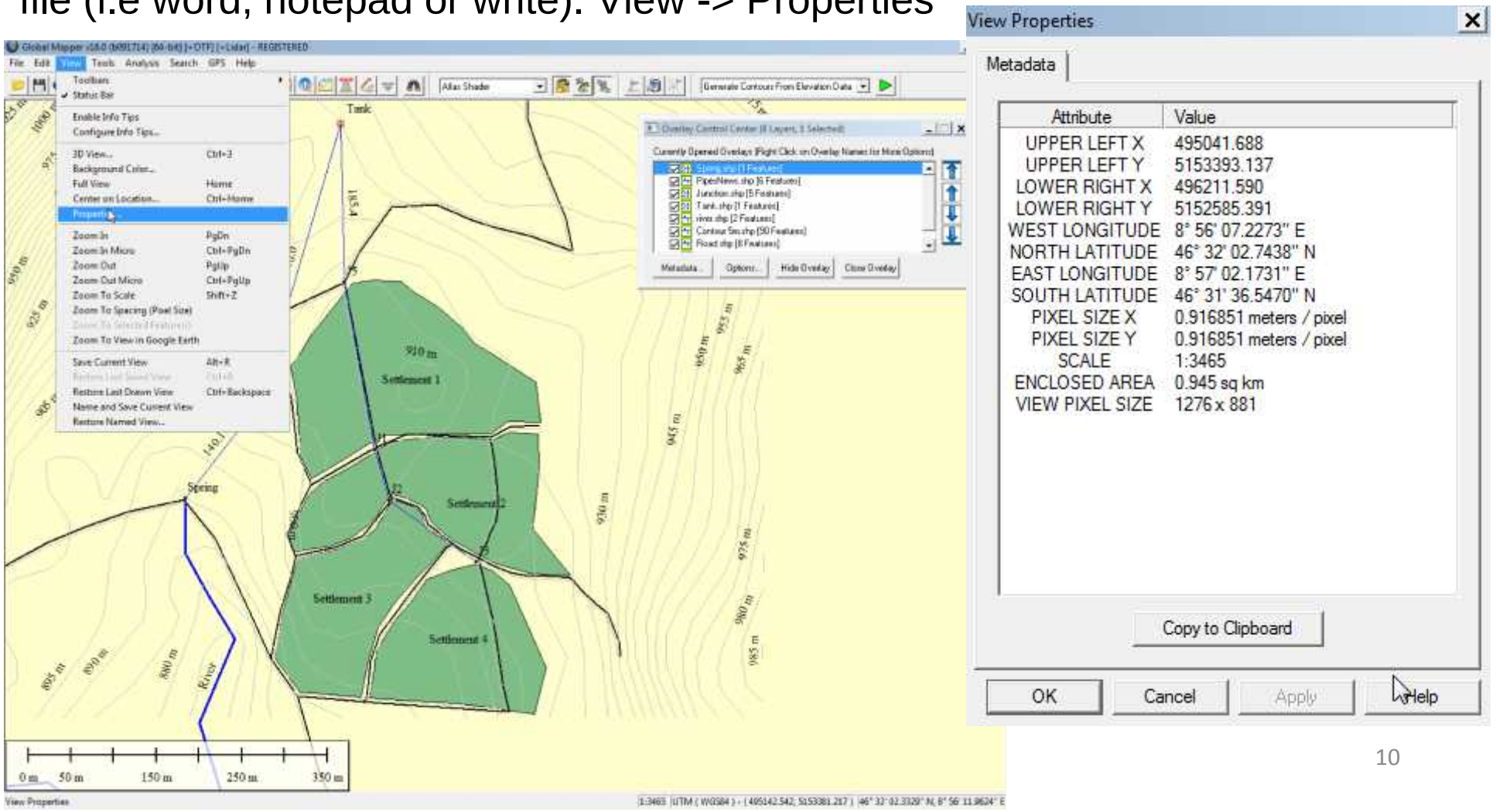
Geo-reference backdrop map in Epanet

Step3

Look at the characteristic of the map, copy to clipboard and save it in a editing file (i.e word, notepad or write). View -> Properties



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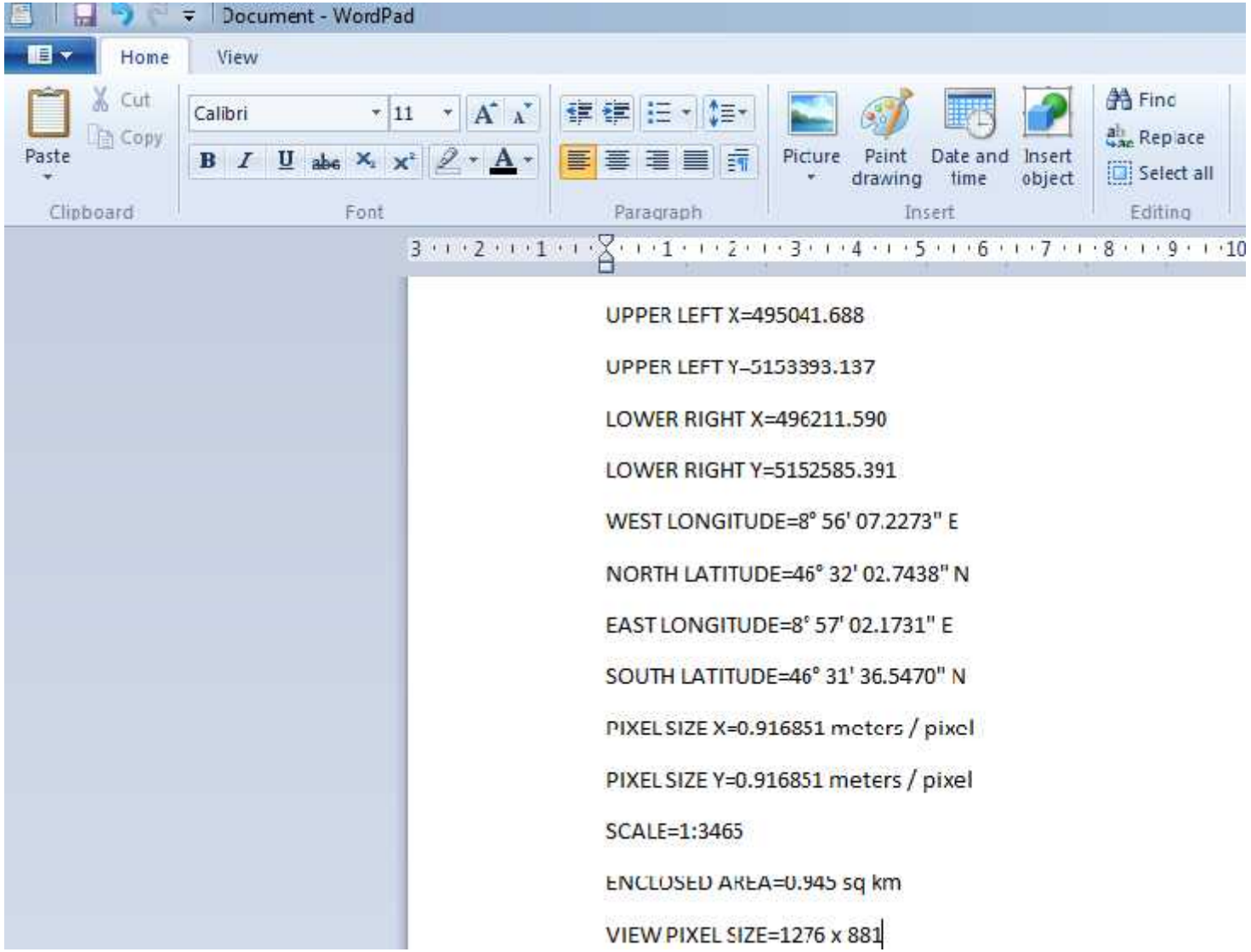
Geo-reference backdrop map in Epanet

Saved in a text file



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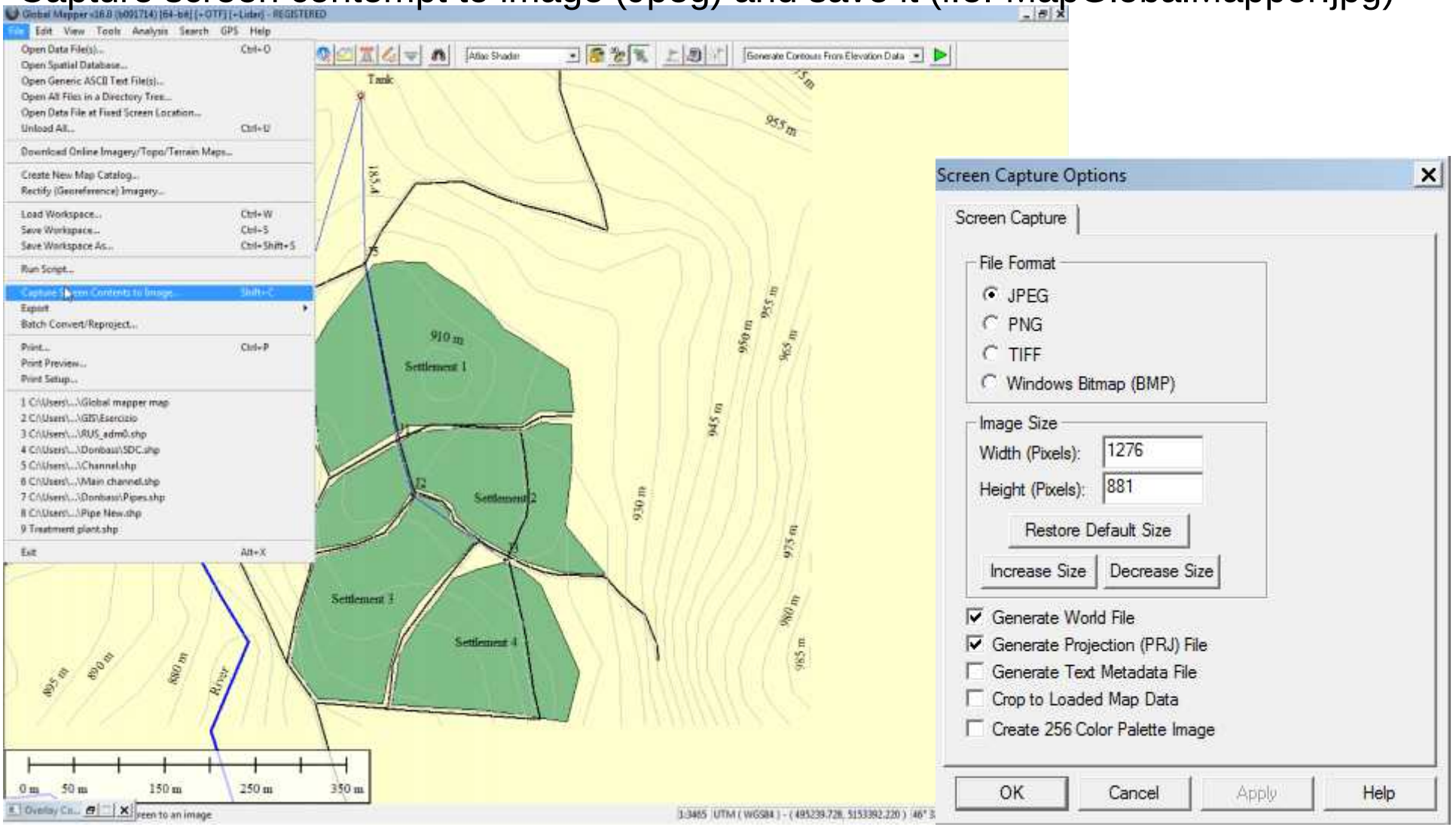
Geo-reference backdrop map in Epanet

Step4

Capture screen contempt to image (Jpeg) and save it (i.e. MapGlobalMapper.jpg)



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Geo-reference backdrop map in Epanet

Step5

Convert image (Jpeg) to *. emf as before

Open it with Irfanview* and save it into *.**emf** format

emf format = Enhanced Windows Metafile
metafiles work better since they will not loose resolution when re-scaled.

*Irfanview = Free software at www.irfanview.com

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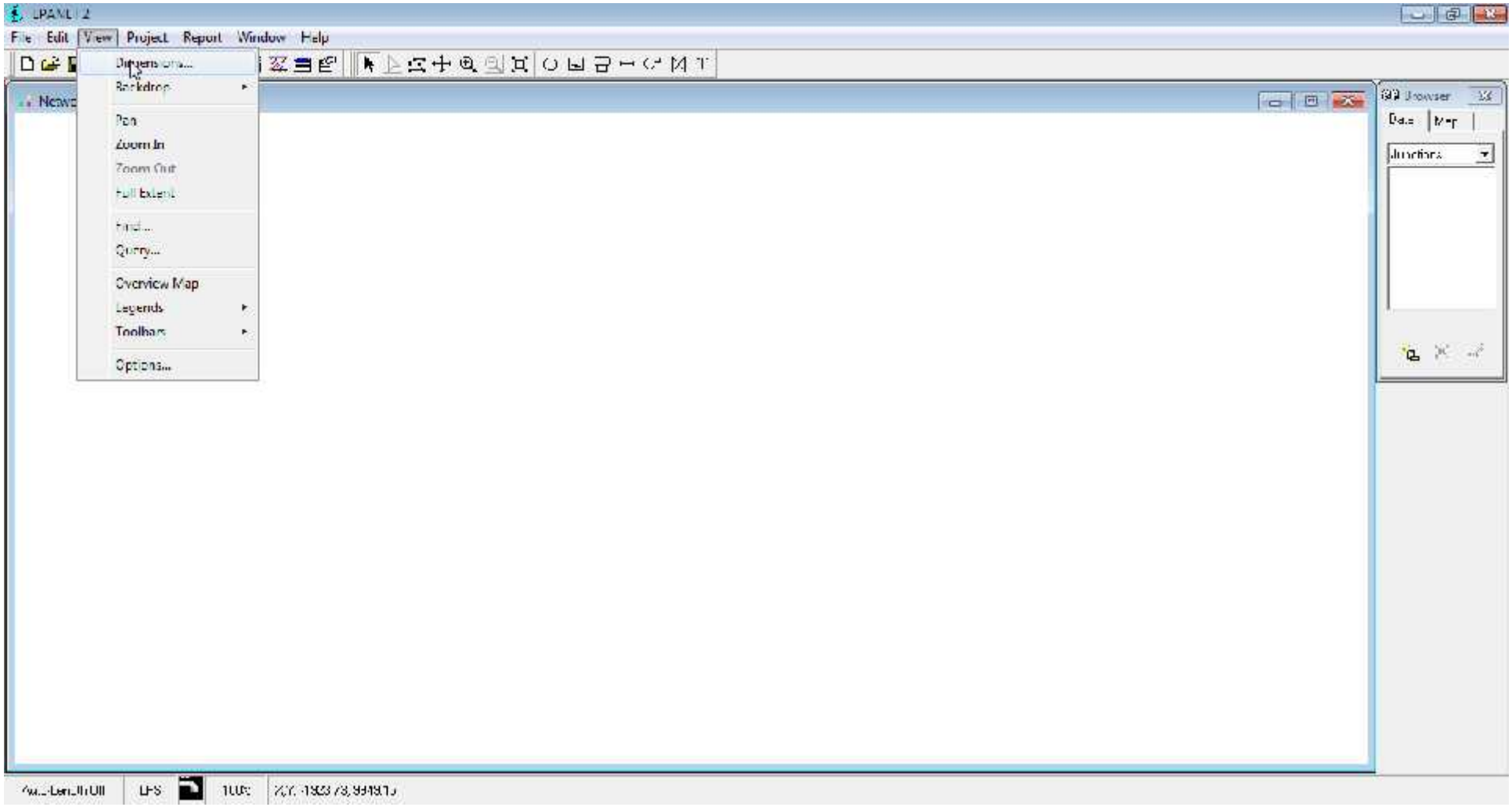
Geo-reference backdrop map in Epanet

Step6

In Epanet, configure the dimension of you background map



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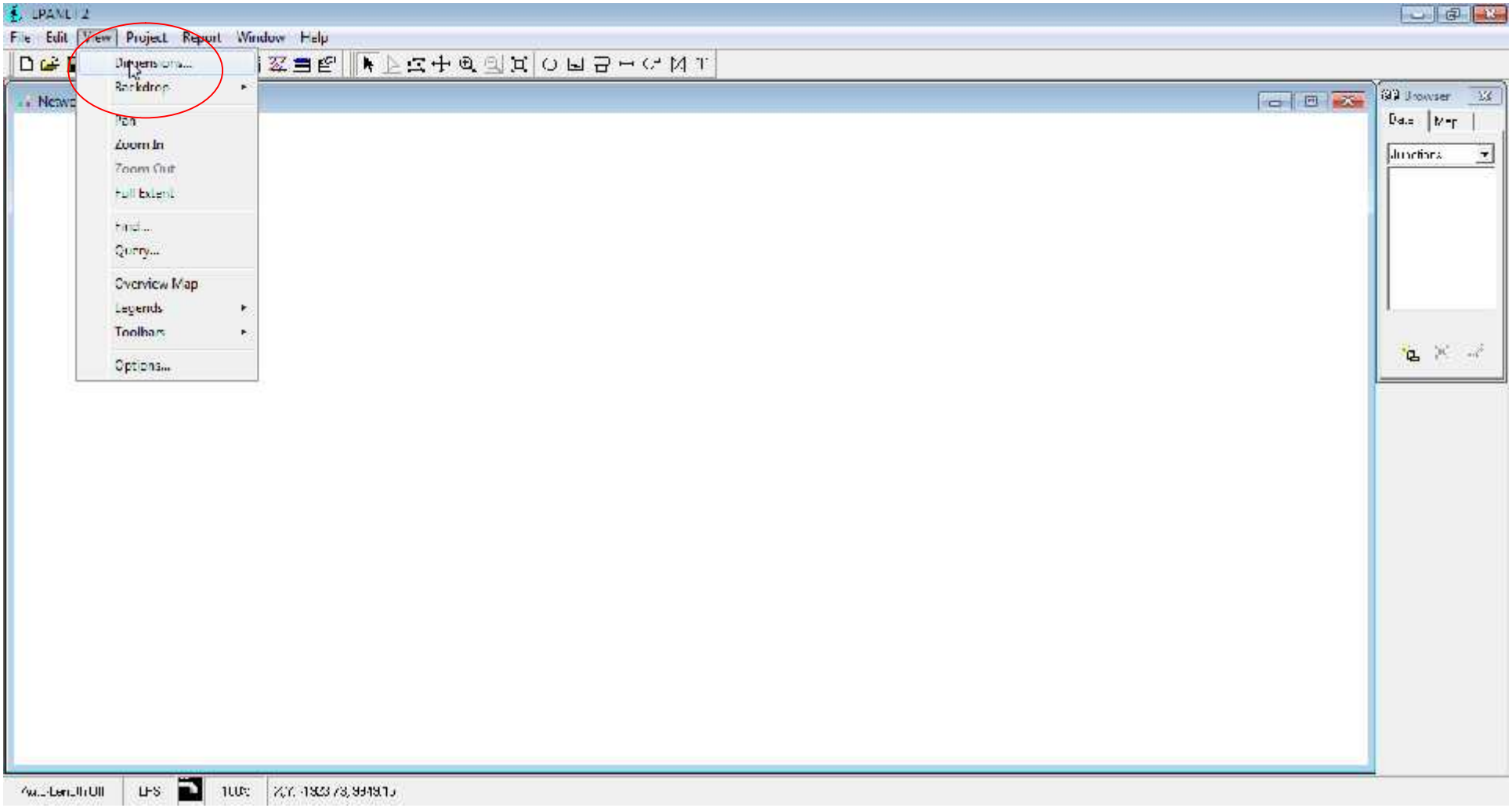
Geo-reference backdrop map in Epanet

Step6

Open Epanet -> View -> Dimension



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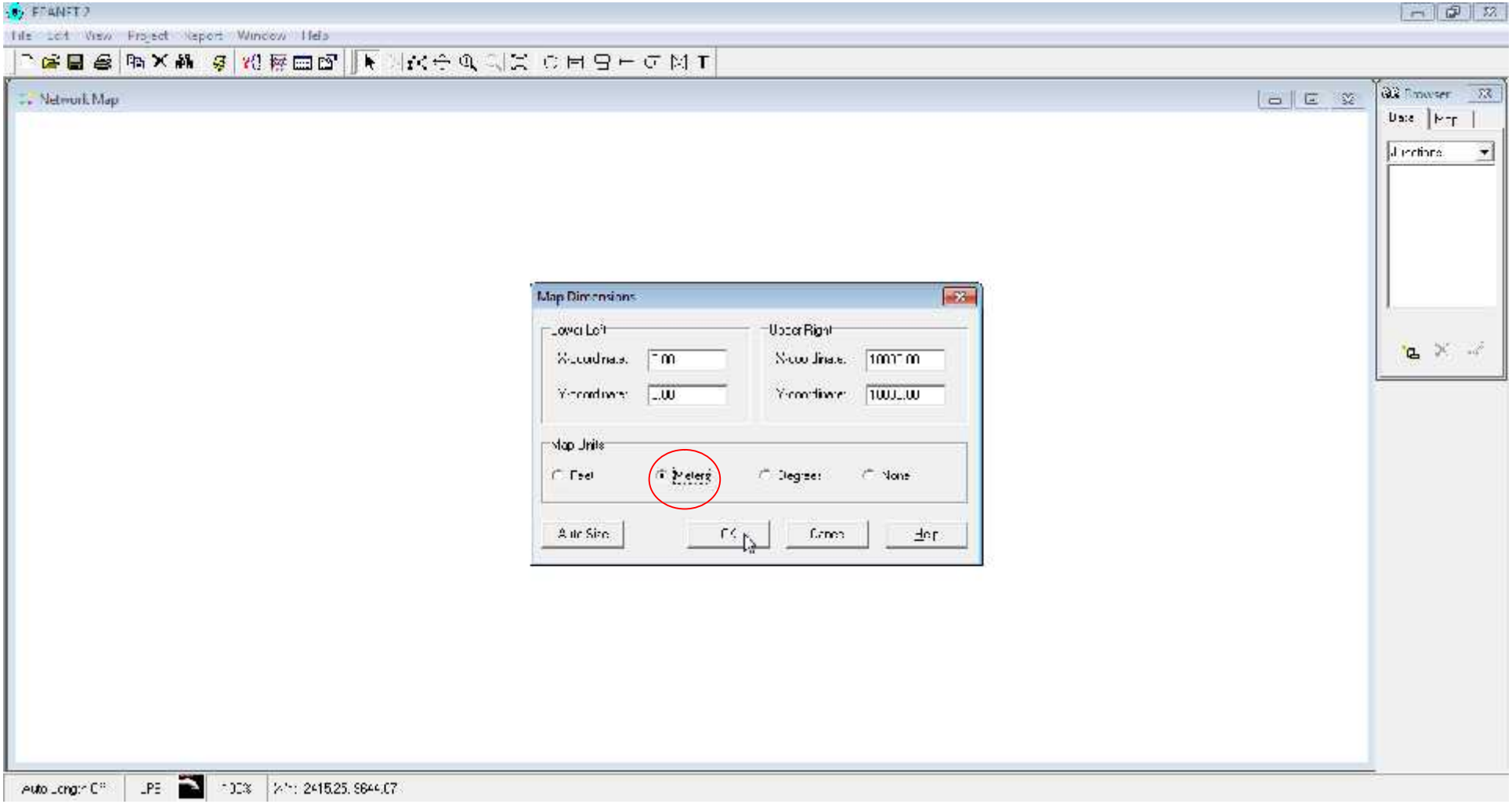
Geo-reference backdrop map in Epanet

Step6

Open Epanet -> View -> Dimension -> Meter



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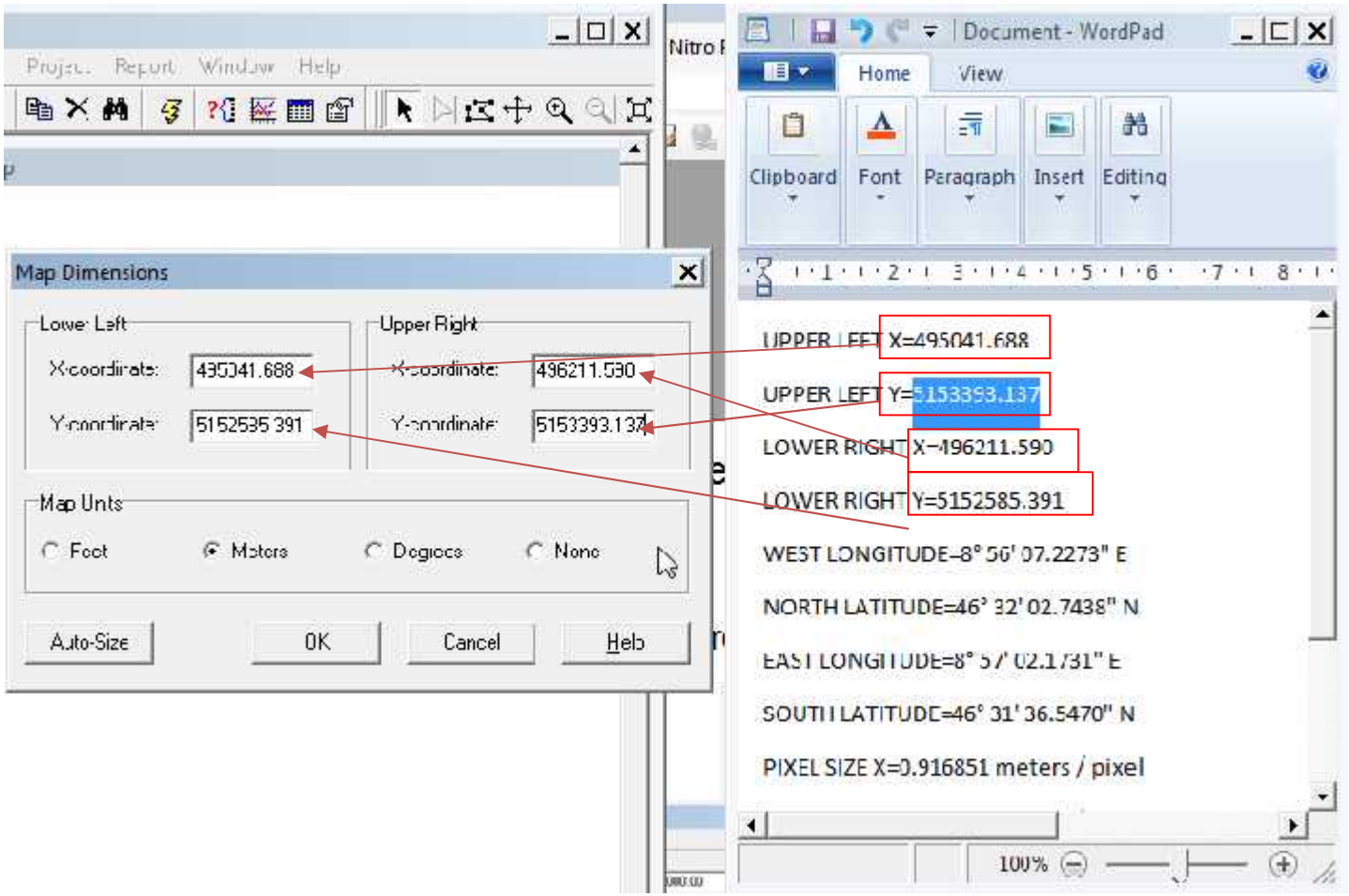
Geo-reference Epanet with qGis

Step 7:

•Insert map extension coordinates per text file into Epanet (copy&paste)



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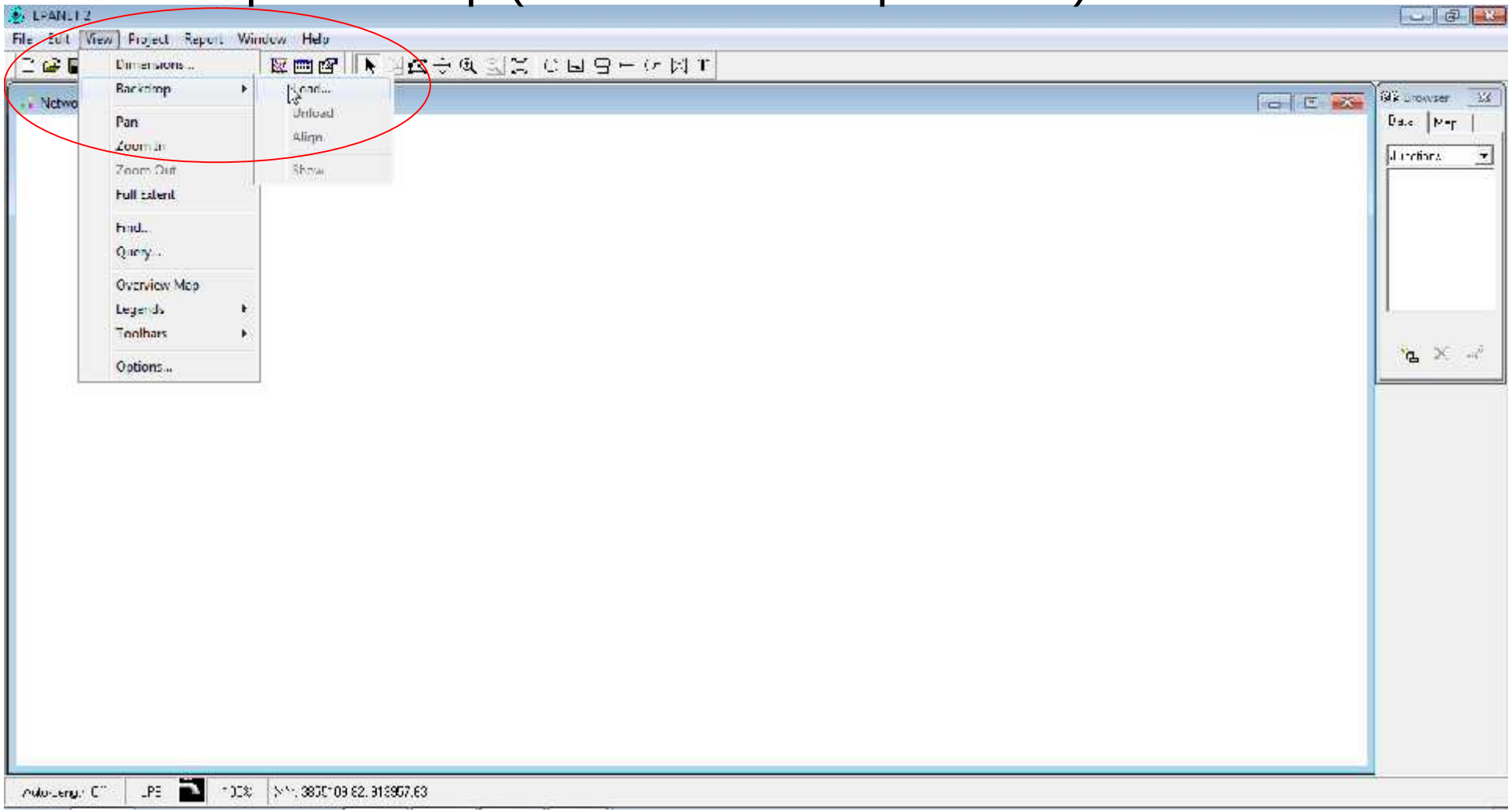
Geo-reference Epanet with qGis

Step 8:

- Insert map backdrop (View ->Backdrop -> load)



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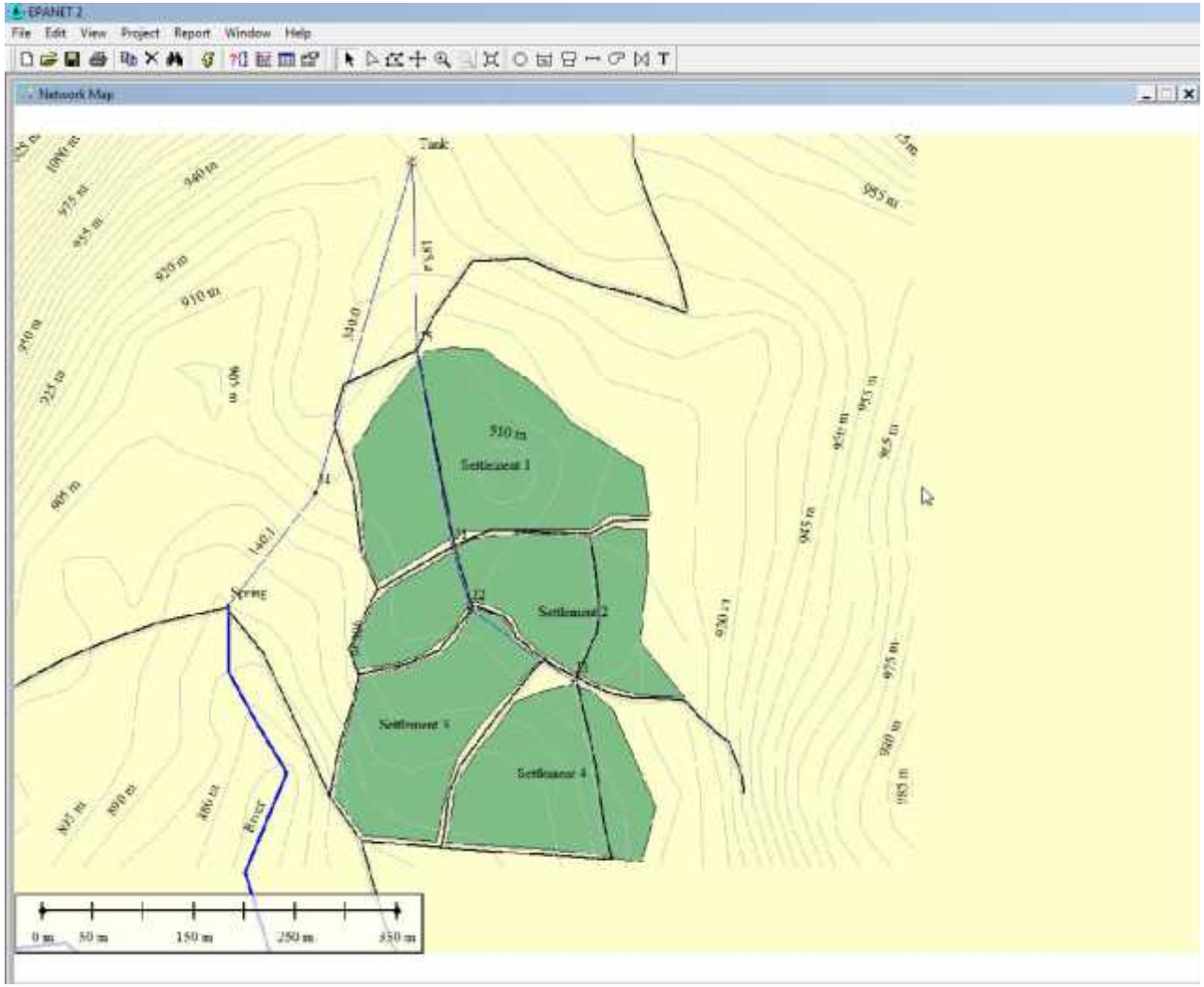
Geo-reference Epanet with qGis

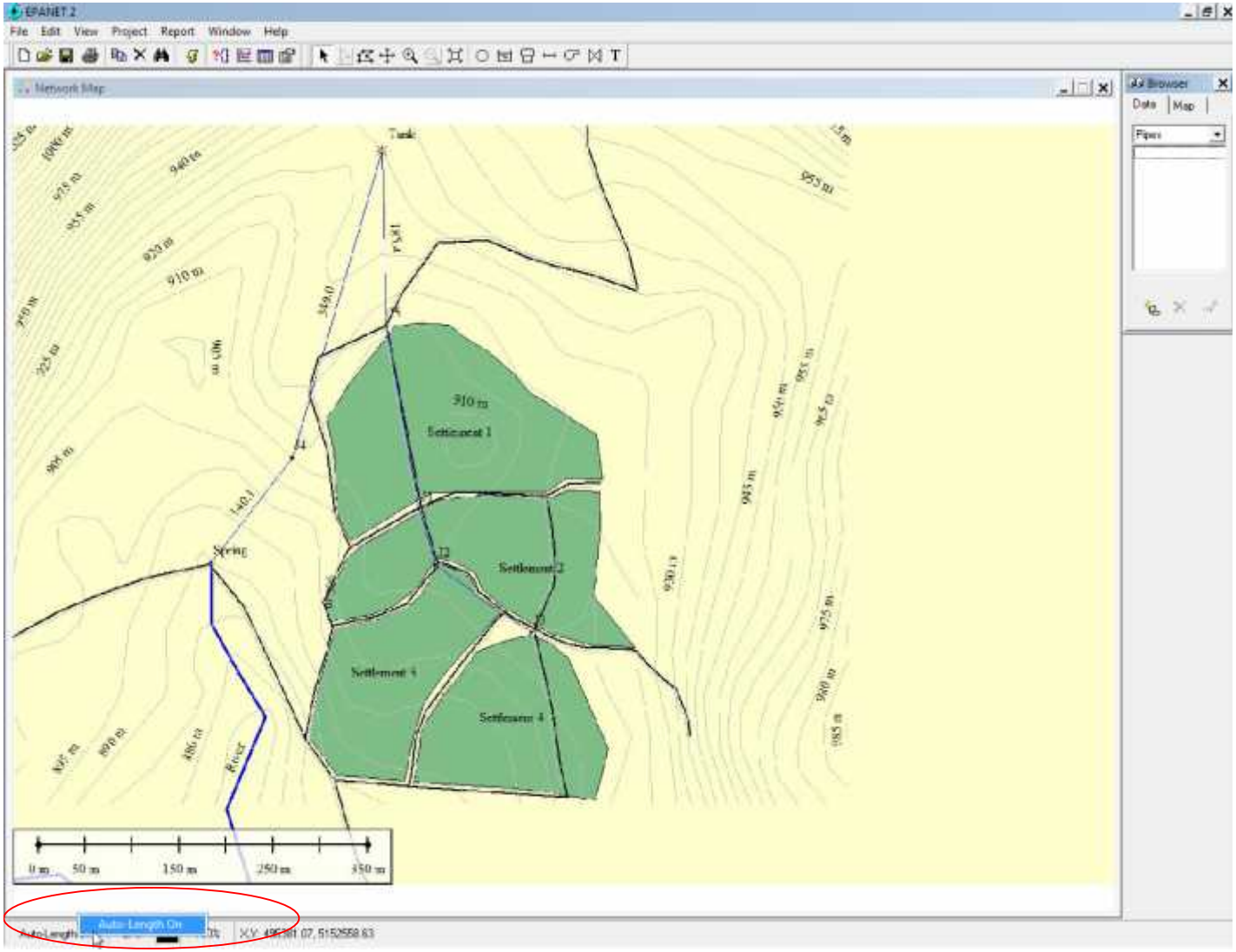
Select your *.emf map



Geo-reference Epanet with qGis

Step 9:

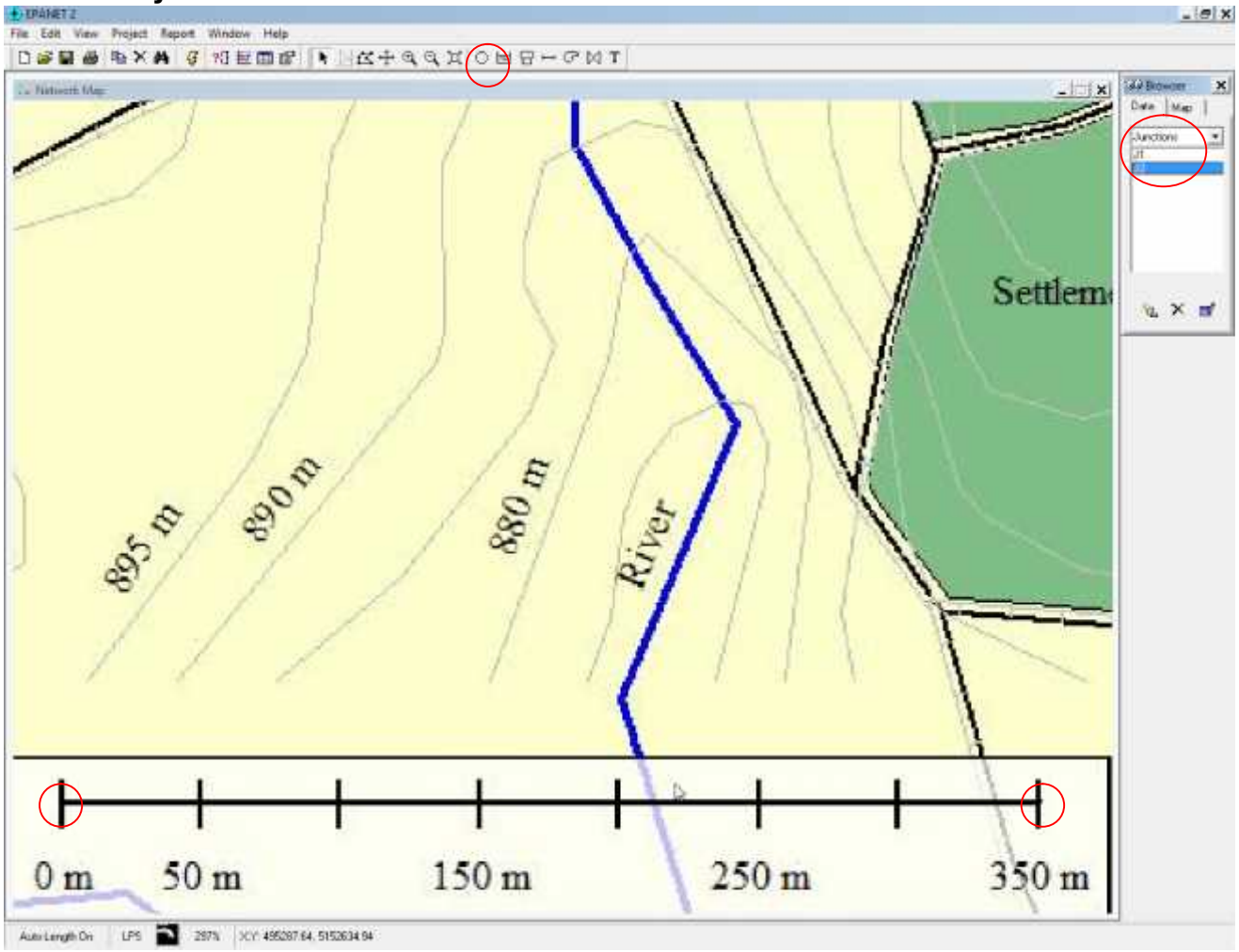
Turn auto length on (with right click)



Geo-reference Epanet with qGis

Step 10:

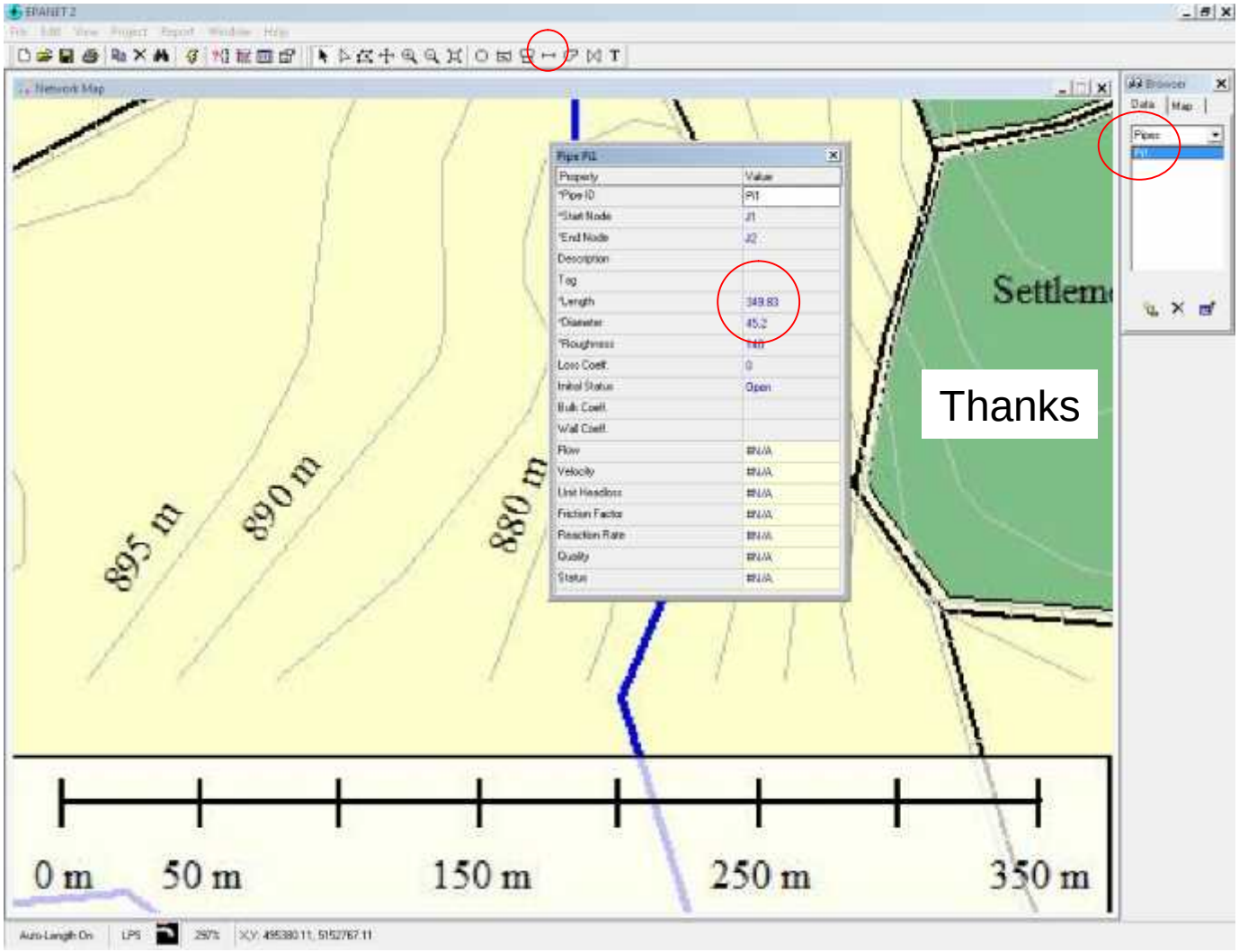
- **Verify if your backdrop map is correctly place and if auto-length works.**
- Zoom in into the scale bar
- Put 2 junctions at the extremities of the scale bar



Geo-reference Epanet with qGis

Step 11:

•Connect the two junctions with a pipe and see the length (it should be around 350m like the scale bar.



Before to draw your network do not forget to verify if the parameters of Epanet are set as you wish.

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Use of Epanet within qGis (plug-in GHydraulics)

Objective:

Introduction of **GHydrauilcs**, the Epanet plug-in for qGIS

- *You have good knowledge of qGis (free and open source at www.qgis.org)*
- *You have installed qGis in your PC*
- *You have displayed the map in qGis*
- *You have internet connection*

NOTE:

*This is **not** an introduction of qGis.*

- *The plugin GHydraulics is not fully functional yet, it has apparently some bugs.*
- *The following presentation is an introduction that will allow you to make a backdropmap.*
- *In the future the plugin might be fully functional.*

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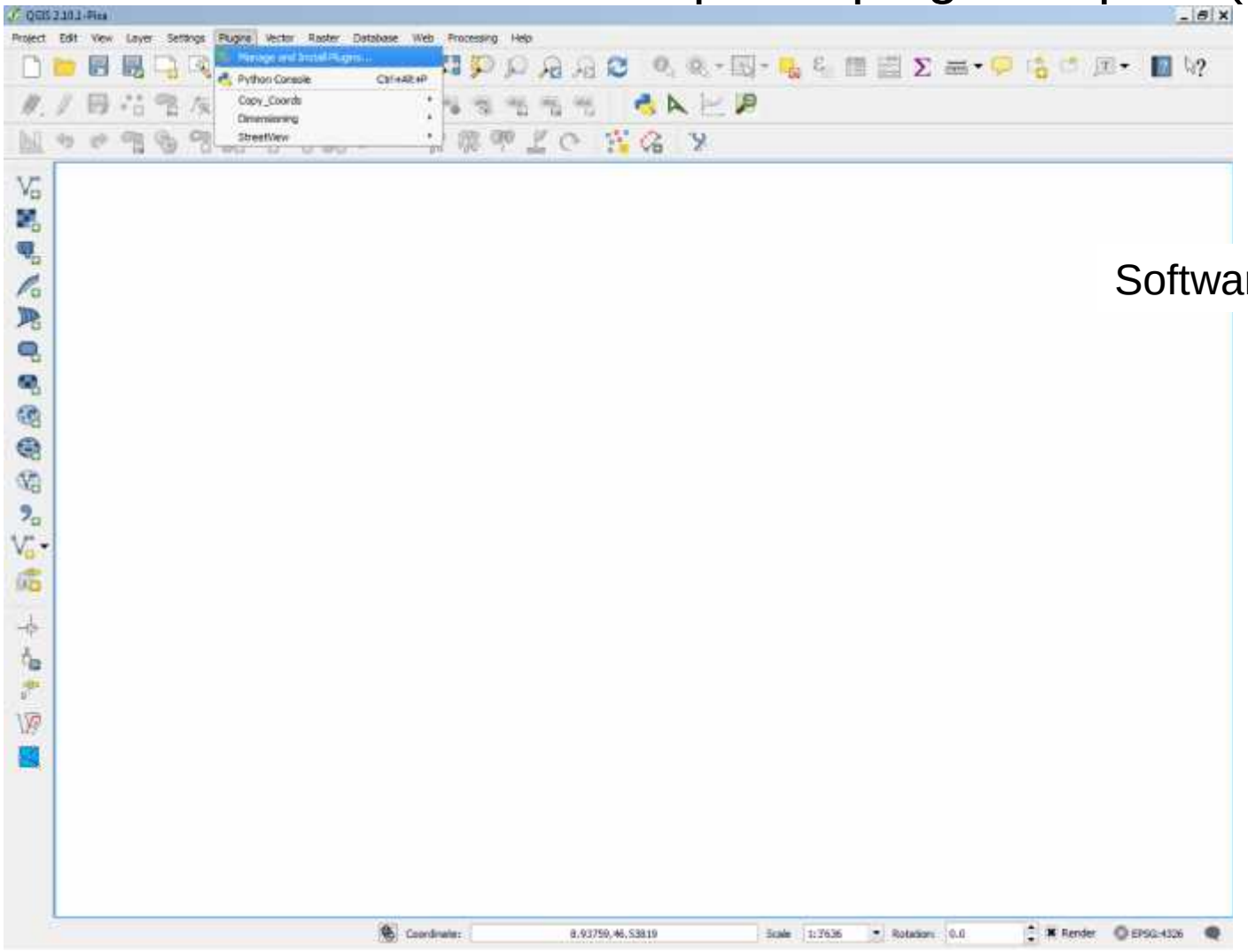
Use of Epanet within qGis (plug-in GHydraulics)

Step1

Download and install the Epanet plugin in qGIS (GHydraulics)



Plugins -> Manage and install plugins…

Software in CD\Software\qGIS

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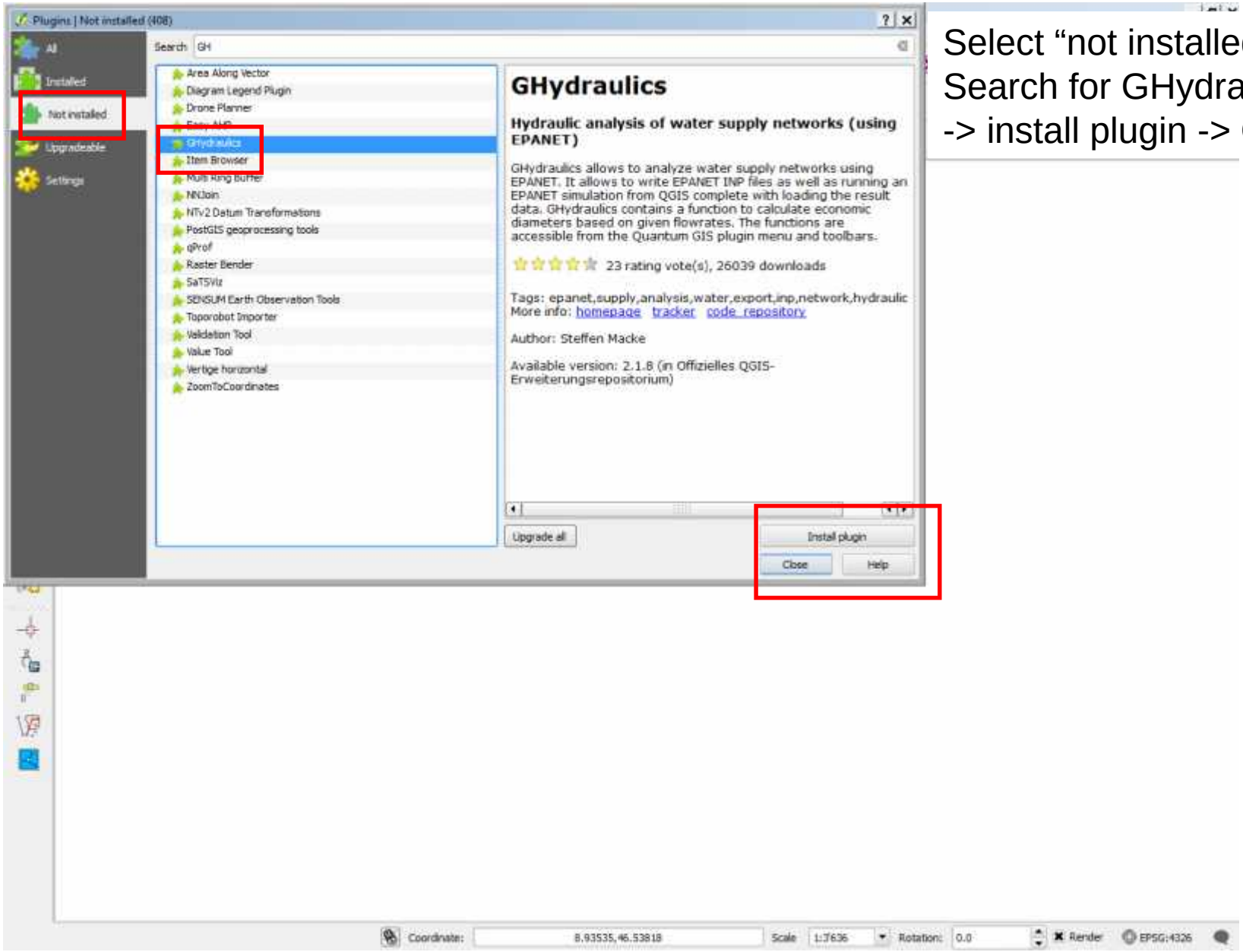
Use of Epanet within qGis (plug-in GHydraulics)

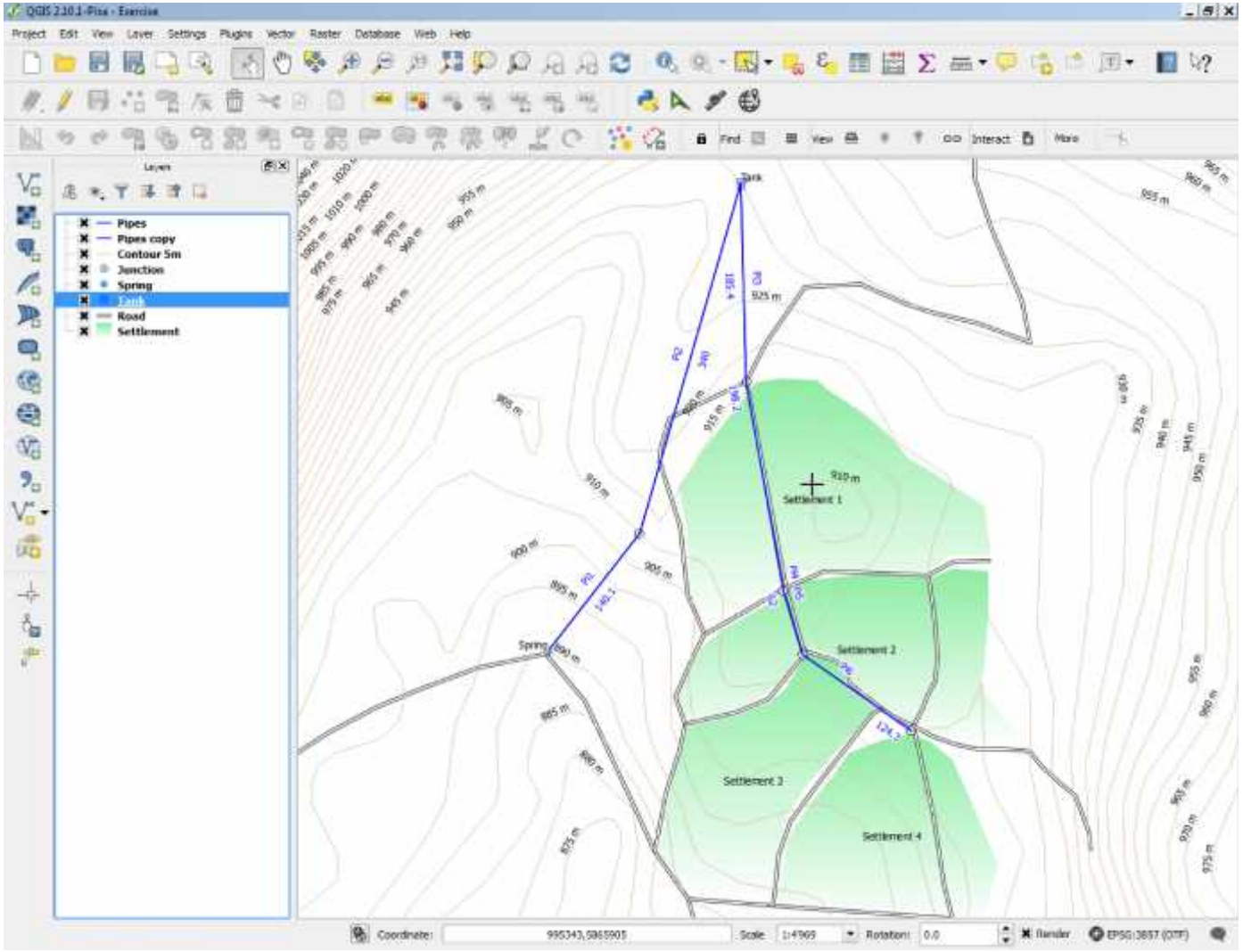


Select “not installed”
Search for GHydraulics
-> install plugin -> OK

Use of Epanet within qGis (plug-in GHydraulics)

Step2

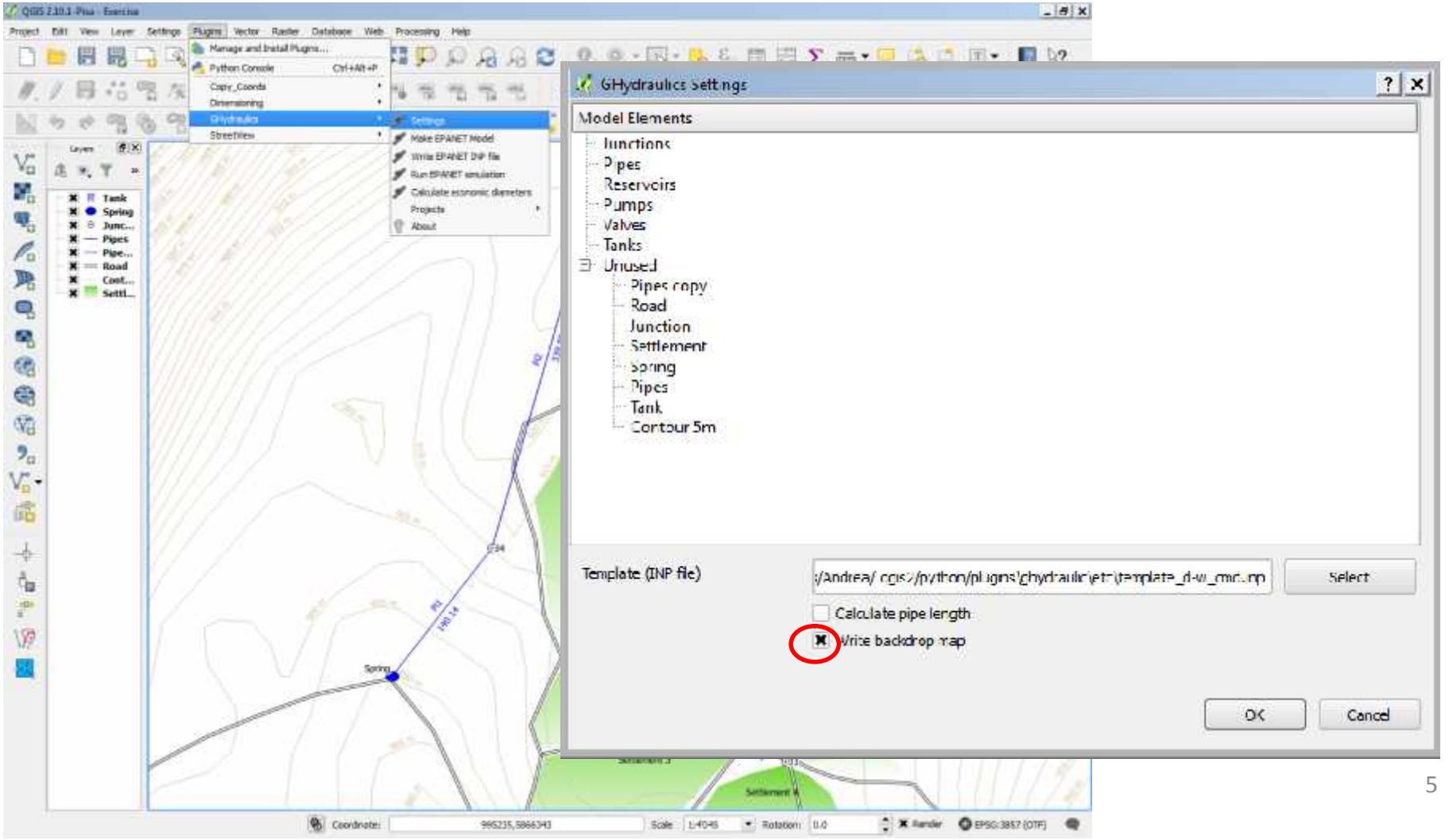
Display the map of the network in qGis (CD -> GIS directory -> Exercise)



Use of Epanet within qGis (plug-in GHydraulics)

Step3

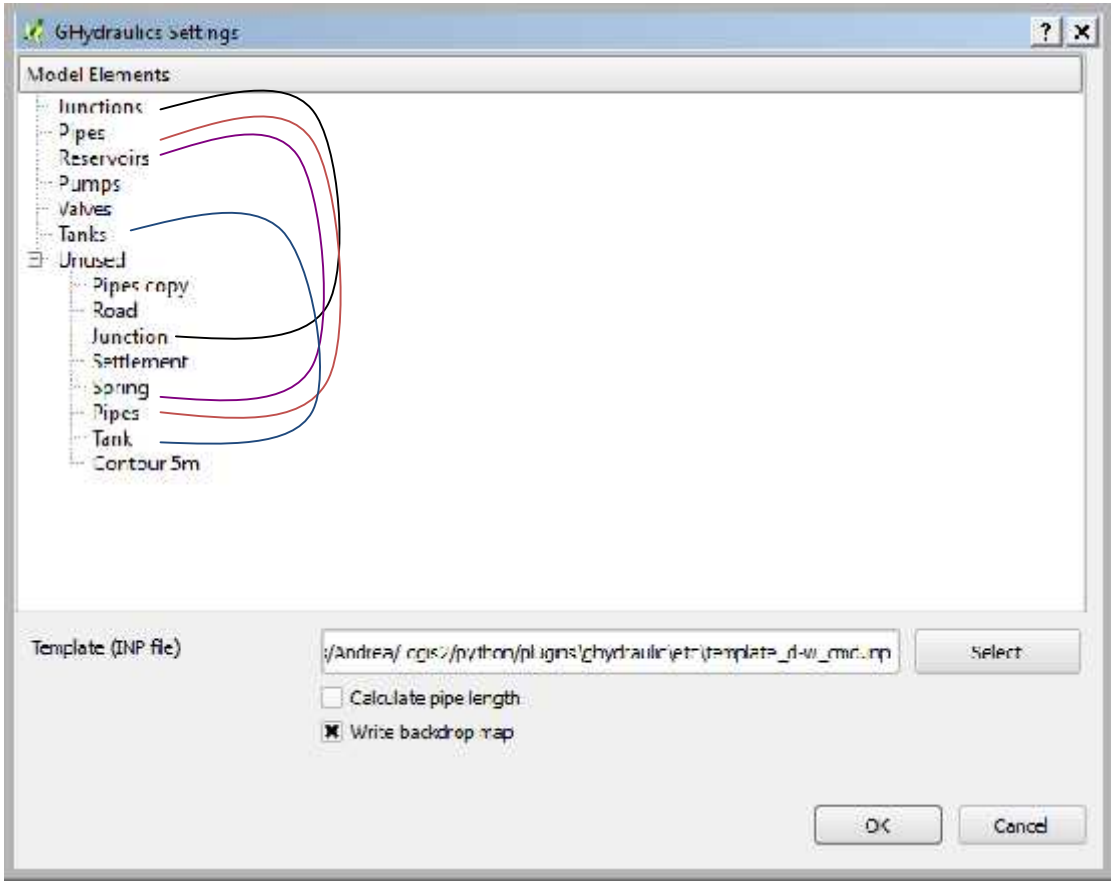
Plugins -> GHydraulics -> Settings



Use of Epanet within qGis (plug-in GHydraulics)

Step4

Drop the concerned unused shape files into the Model Elements

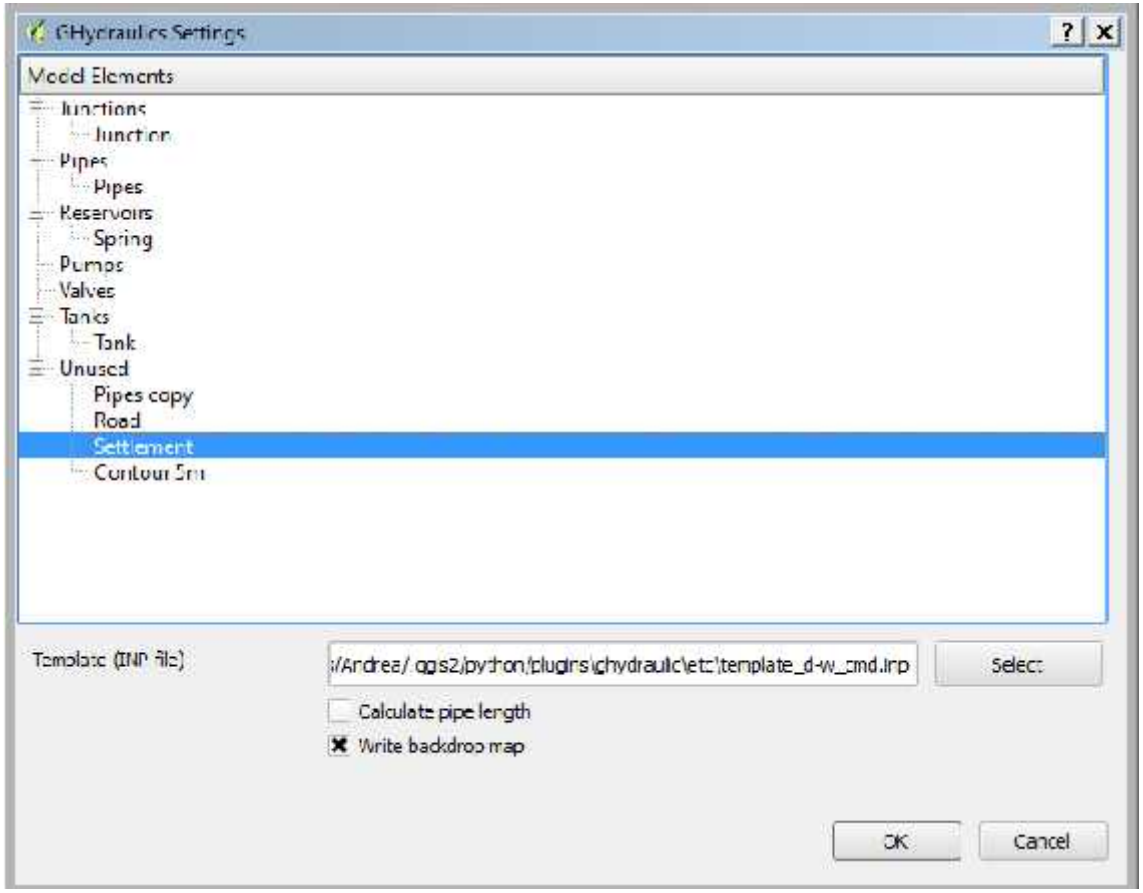


Use of Epanet within qGis (plug-in GHydraulics)

Step4

Drop the concerned unused shape files into the Model Elements

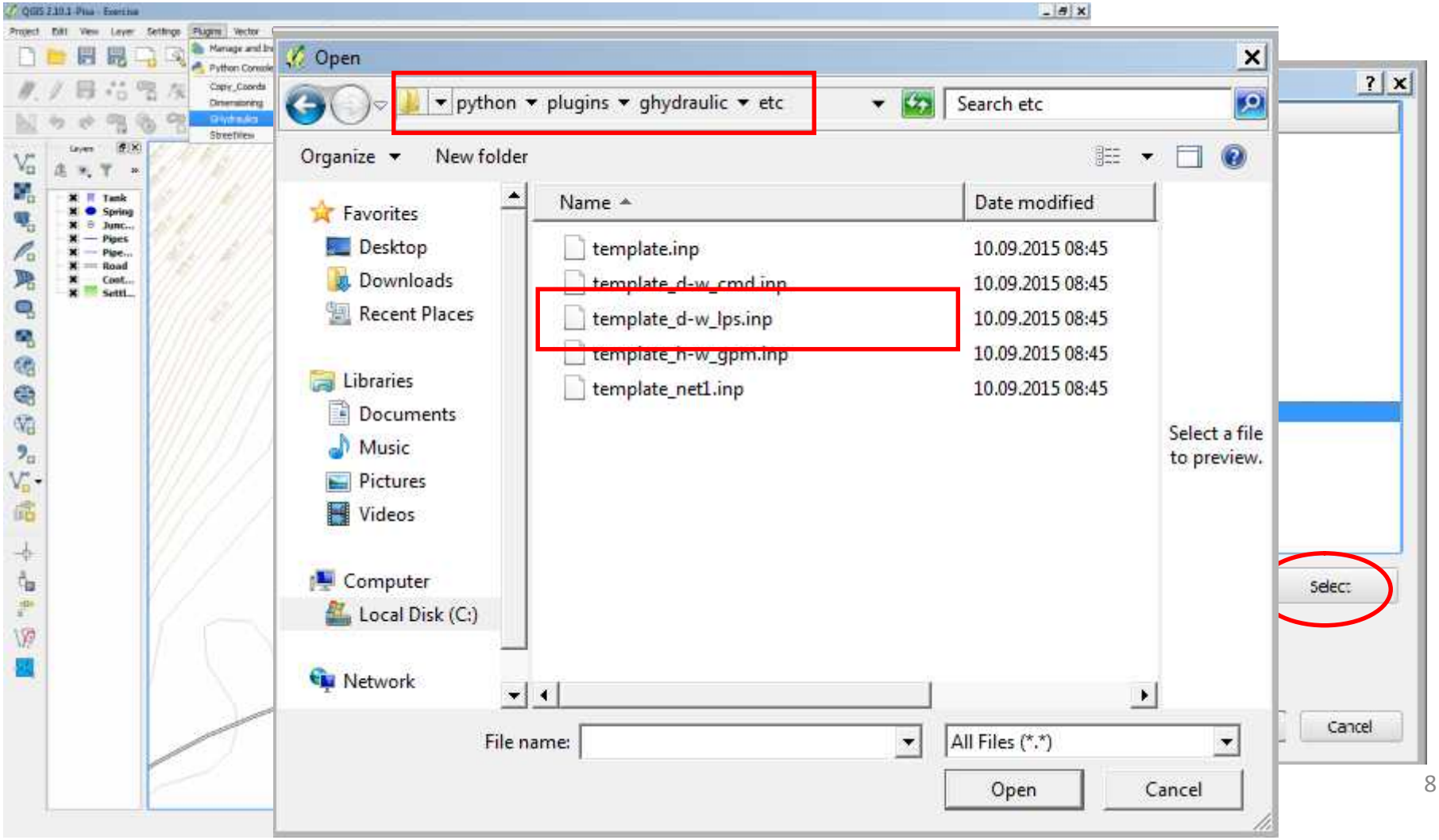
Note:
Element “Reservoir” is Currently not working



Use of Epanet within qGis (plug-in GHydraulics)

Step5

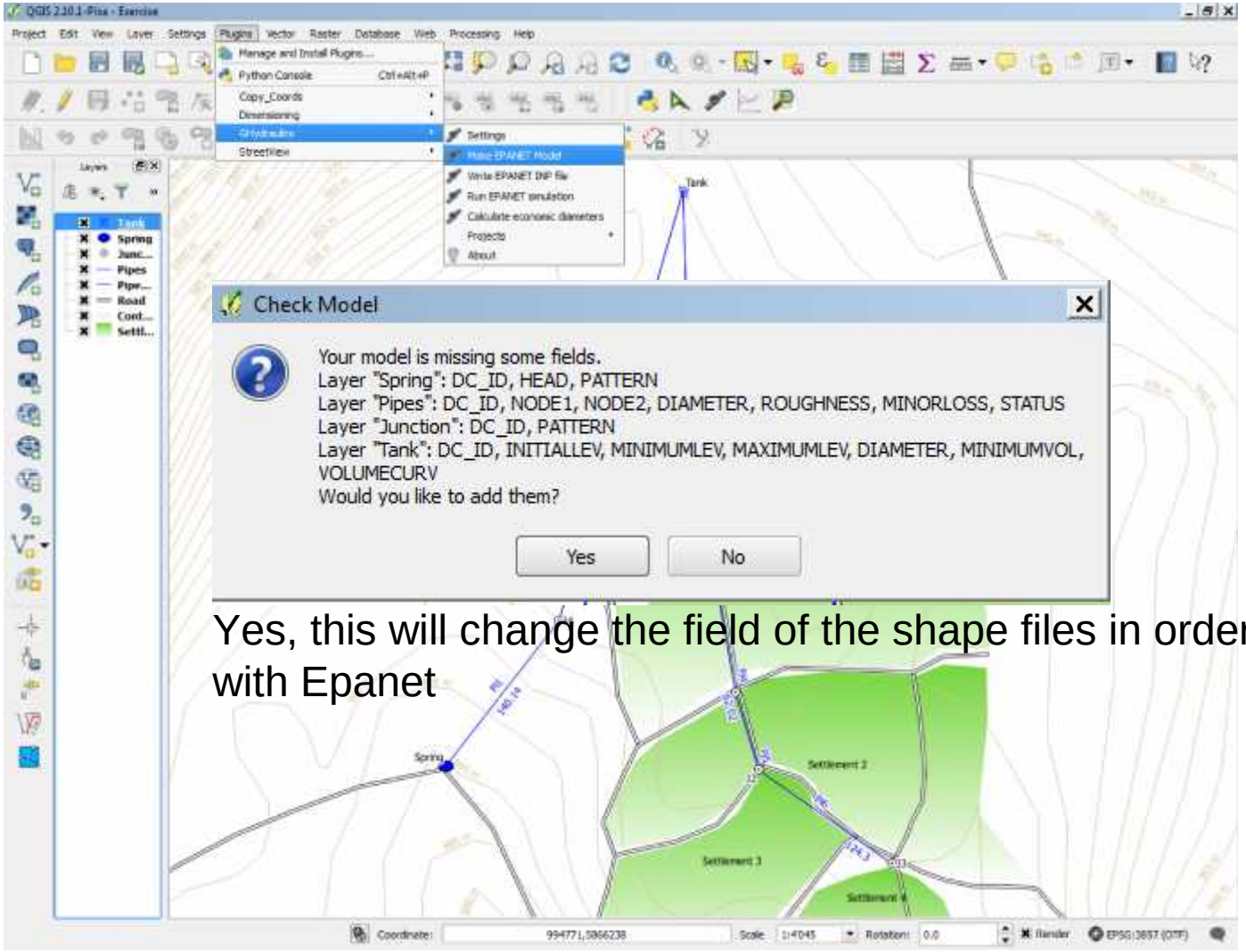
Select the template. Available only D-W cmd, D-W lps, H-W gpm



Use of Epanet within qGis (plug-in GHydraulics)

Step6

Make Epanet model

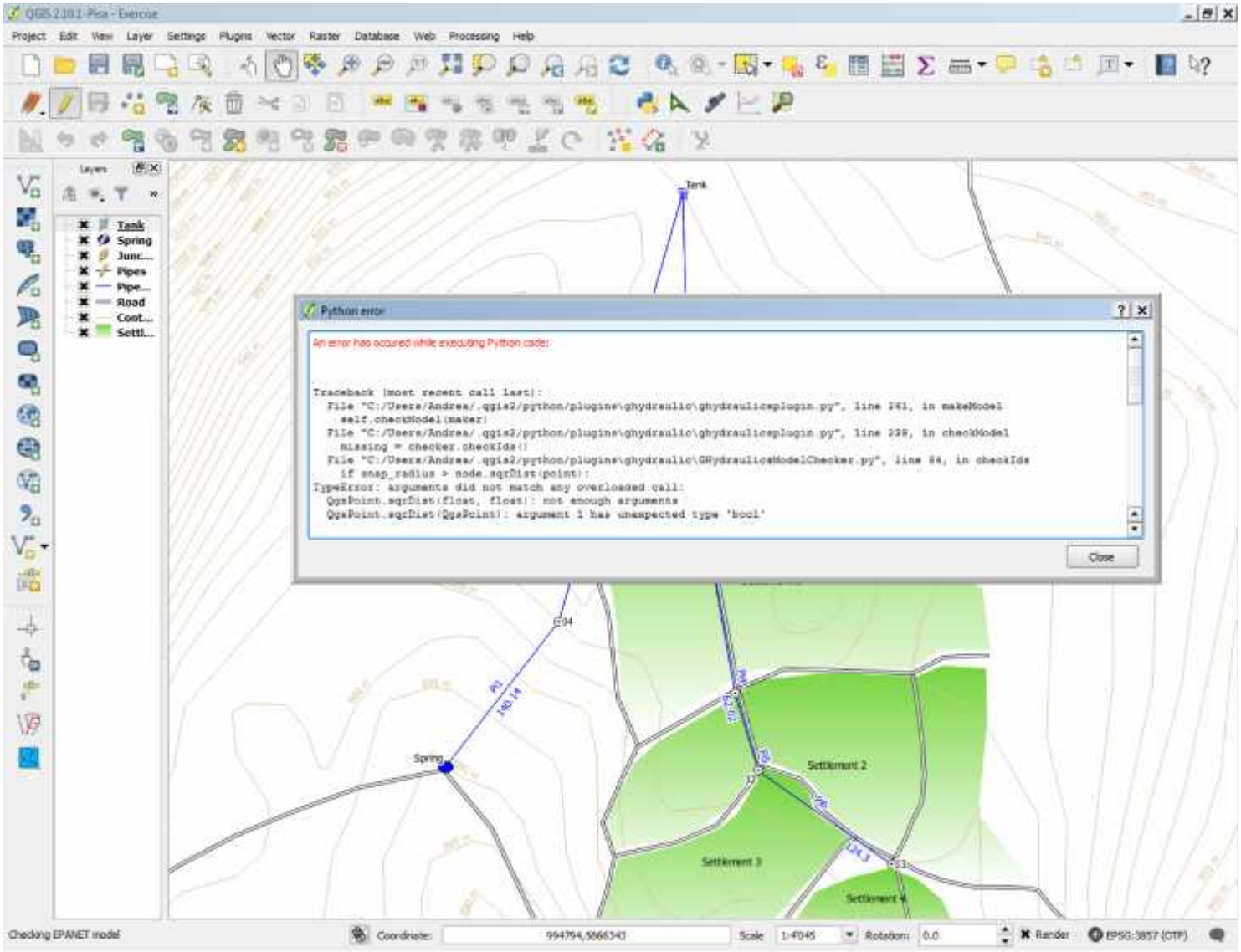


Plugins -> GHydraulics
-> Make Epanet model

Yes, this will change the field of the shape files in order to make it compatible with Epanet

Use of Epanet within qGis (plug-in GHydraulics)

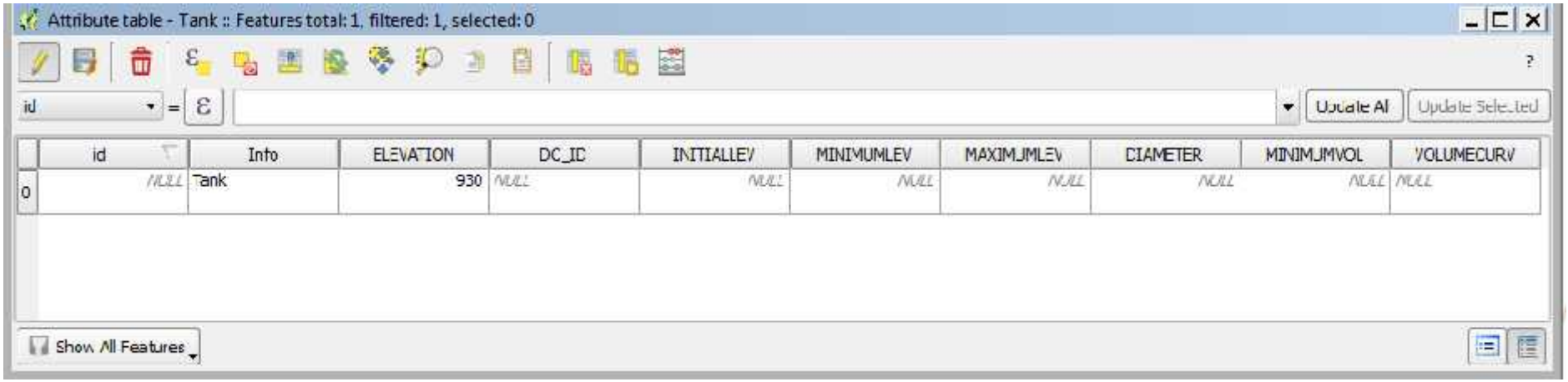
This error is given most probably due to a bug in the plugin



Use of Epanet within qGis (plug-in GHydraulics)

The shape files have been changed automatically and new columns have been added in order to make it compatible with Epanet

Tank



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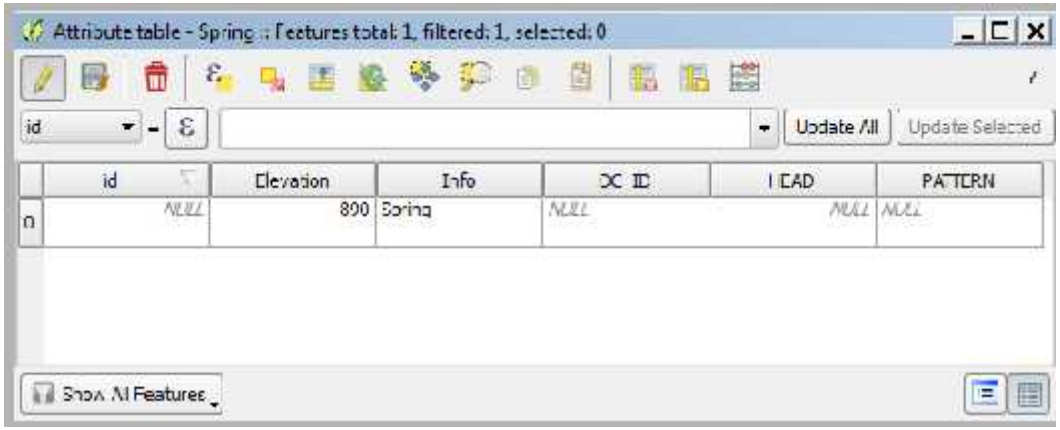
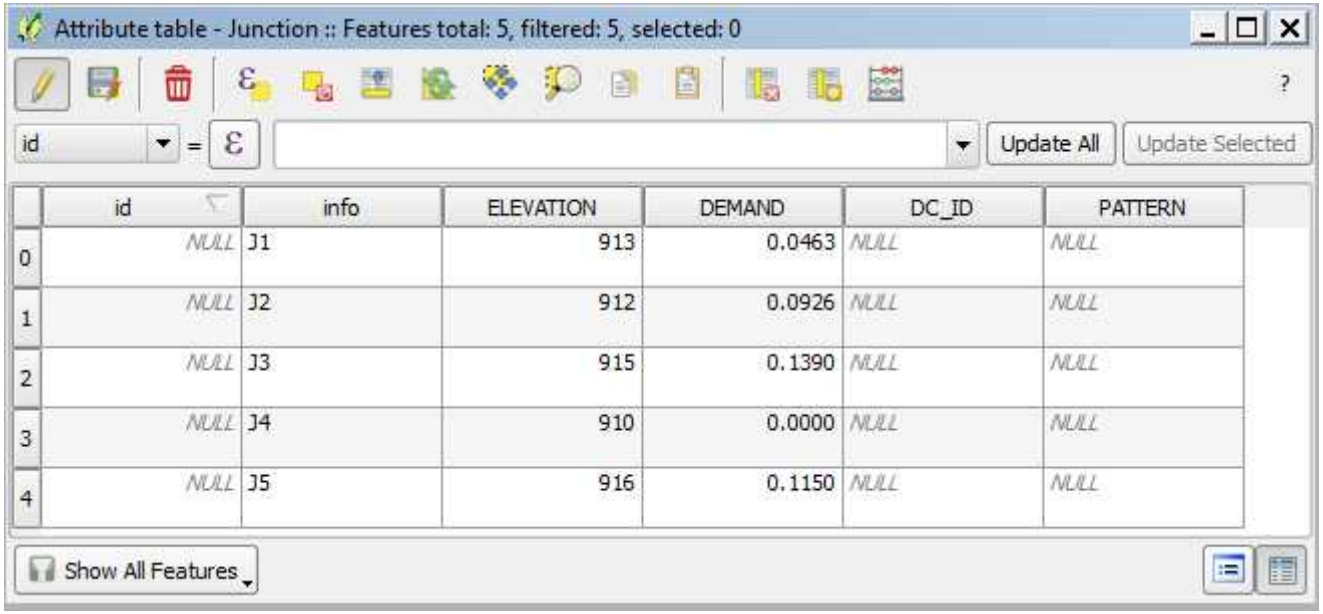
Use of Epanet within qGis (plug-in GHydraulics)

Spring / Reservoir



Junctions



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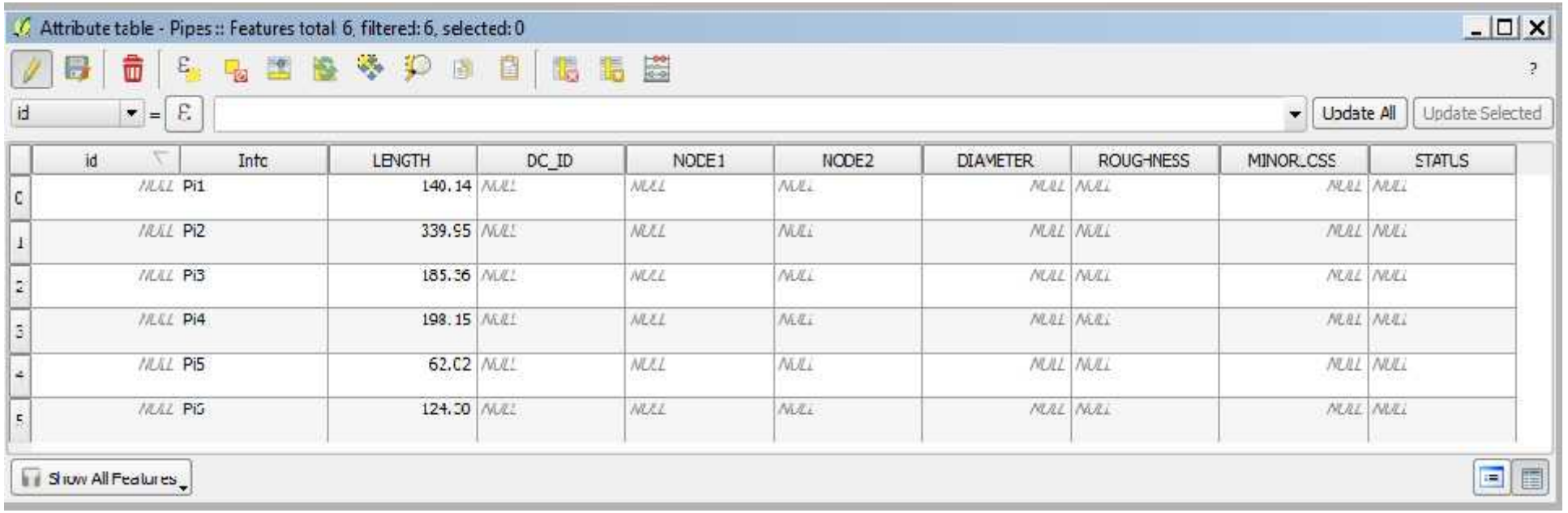
Use of Epanet within qGis (plug-in GHydraulics)

Pipes



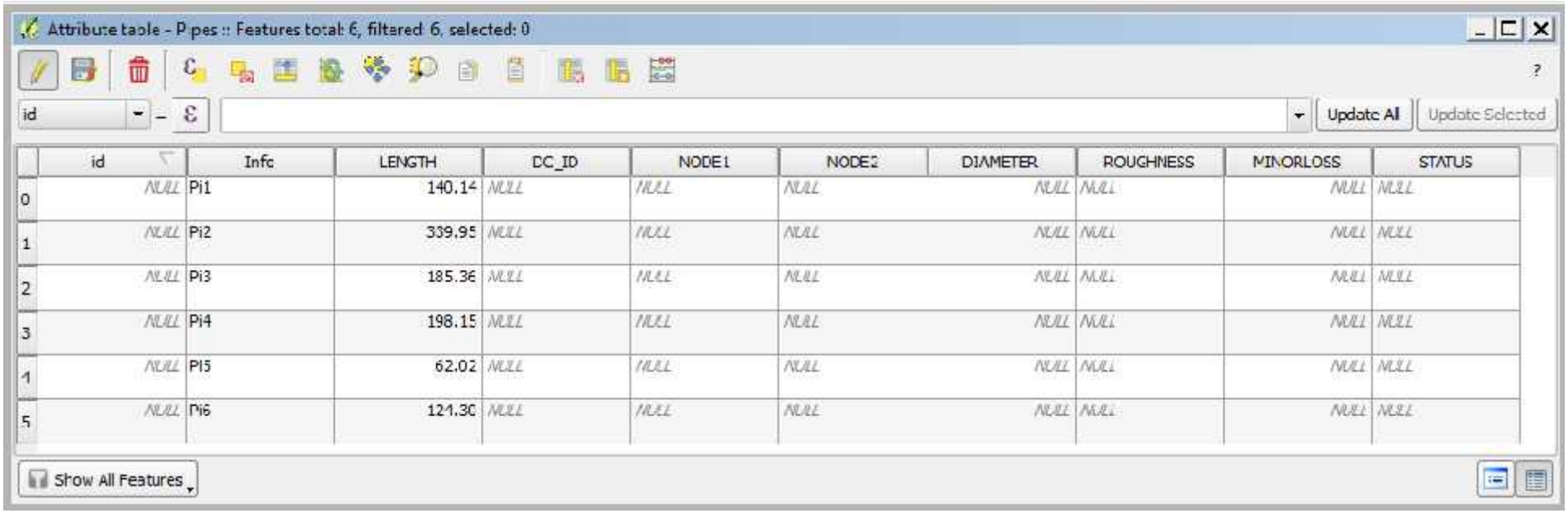
	id	Info	LENGTH	DC_ID	NODE1	NODE2	DIAMETER	ROUGHNESS	MINOR_CSS	STATUS
0	NULL	Pi1	140.14	NULL	NULL	NULL	NULL	NULL	NULL	NULL
1	NULL	Pi2	339.95	NULL	NULL	NULL	NULL	NULL	NULL	NULL
2	NULL	Pi3	185.36	NULL	NULL	NULL	NULL	NULL	NULL	NULL
3	NULL	Pi4	198.15	NULL	NULL	NULL	NULL	NULL	NULL	NULL
4	NULL	Pi5	62.02	NULL	NULL	NULL	NULL	NULL	NULL	NULL
5	NULL	Pi6	124.30	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Use of Epanet within qGis (plug-in GHydraulics)

Note:

For automatic length column (in case you do not have it):

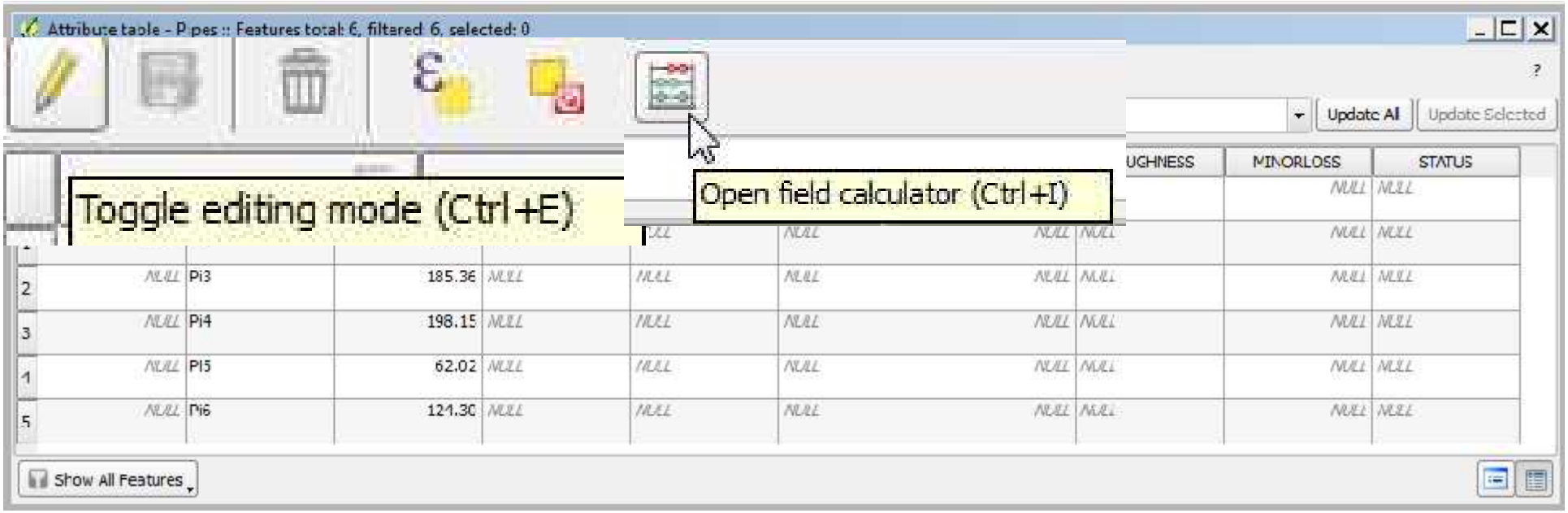
Open attribute table of Pipes



	id	Info	LENGTH	DC_ID	NODE1	NODE2	DIAMETER	ROUGHNESS	MINORLOSS	STATUS
0	NULL	Pi1	140.14	NULL	NULL	NULL	NULL	NULL	NULL	NULL
1	NULL	Pi2	339.95	NULL	NULL	NULL	NULL	NULL	NULL	NULL
2	NULL	Pi3	185.36	NULL	NULL	NULL	NULL	NULL	NULL	NULL
3	NULL	Pi4	198.15	NULL	NULL	NULL	NULL	NULL	NULL	NULL
4	NULL	PI5	62.02	NULL	NULL	NULL	NULL	NULL	NULL	NULL
5	NULL	Pi6	121.30	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Use of Epanet within qGis (plug-in GHydraulics)

Toggle editing mode and click field calculator



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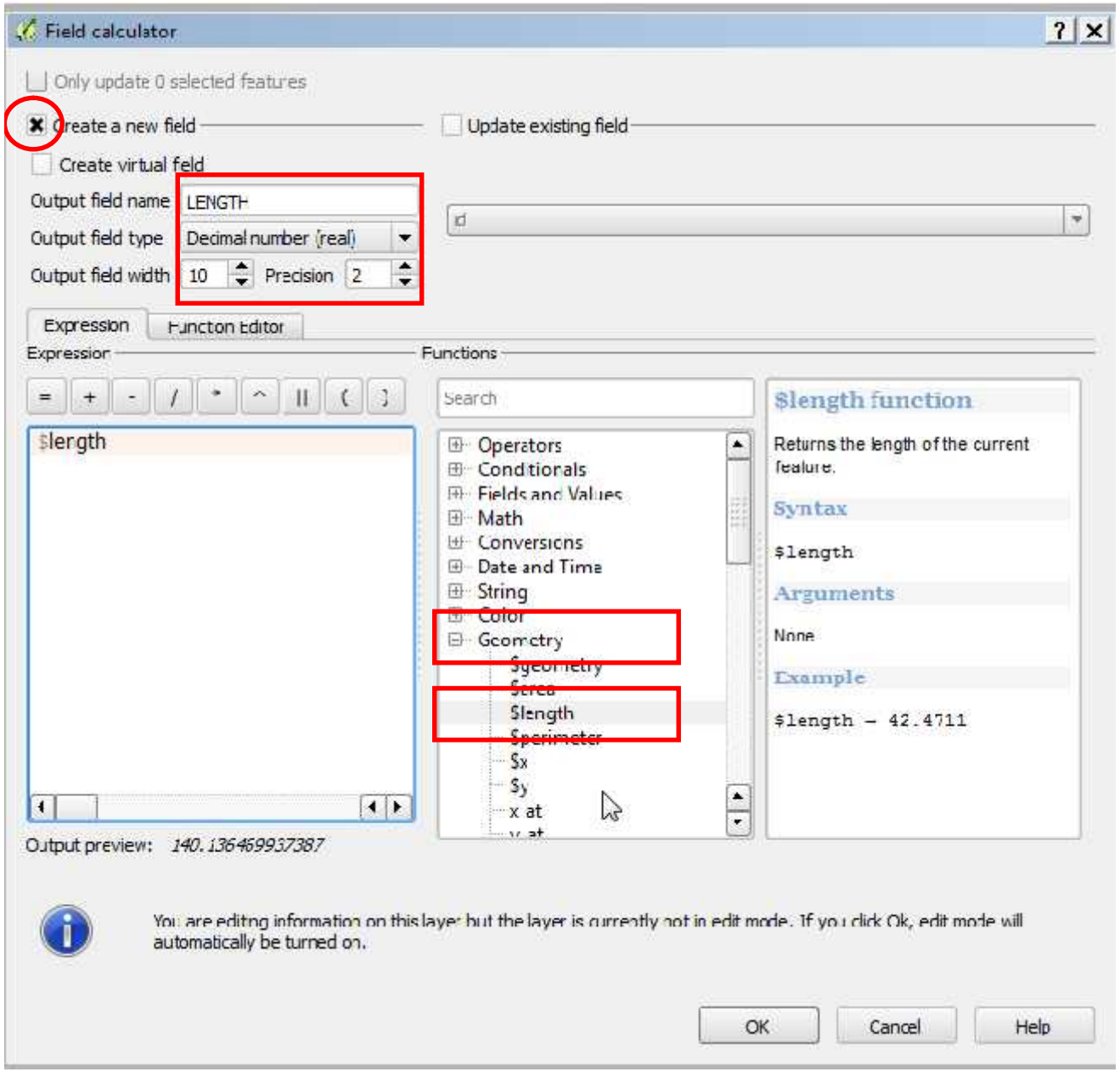
Use of Epanet within qGis (plug-in GHydraulics)



Write "LENGTH" , real 10 precision 2 and click twice on Geometry -> $Length -> OK

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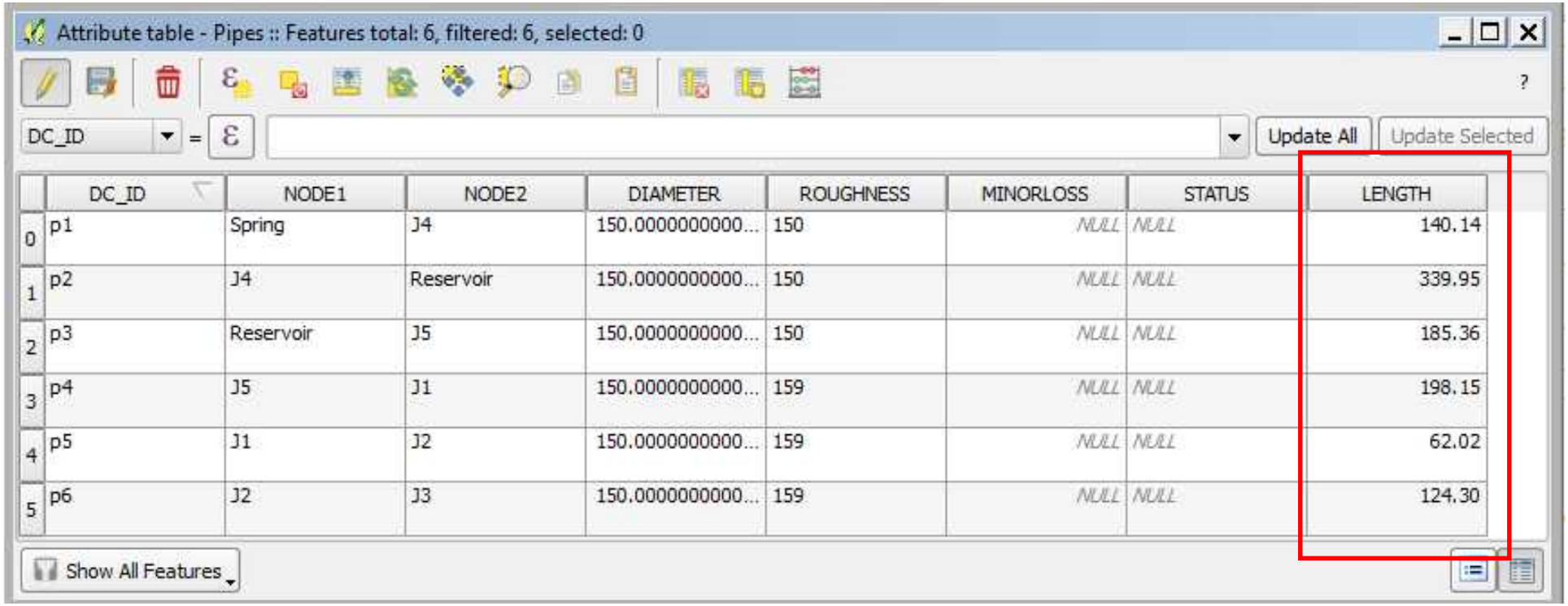
Use of Epanet within qGis (plug-in GHydraulics)

You should get the column "LENGTH" with the automatic length inserted



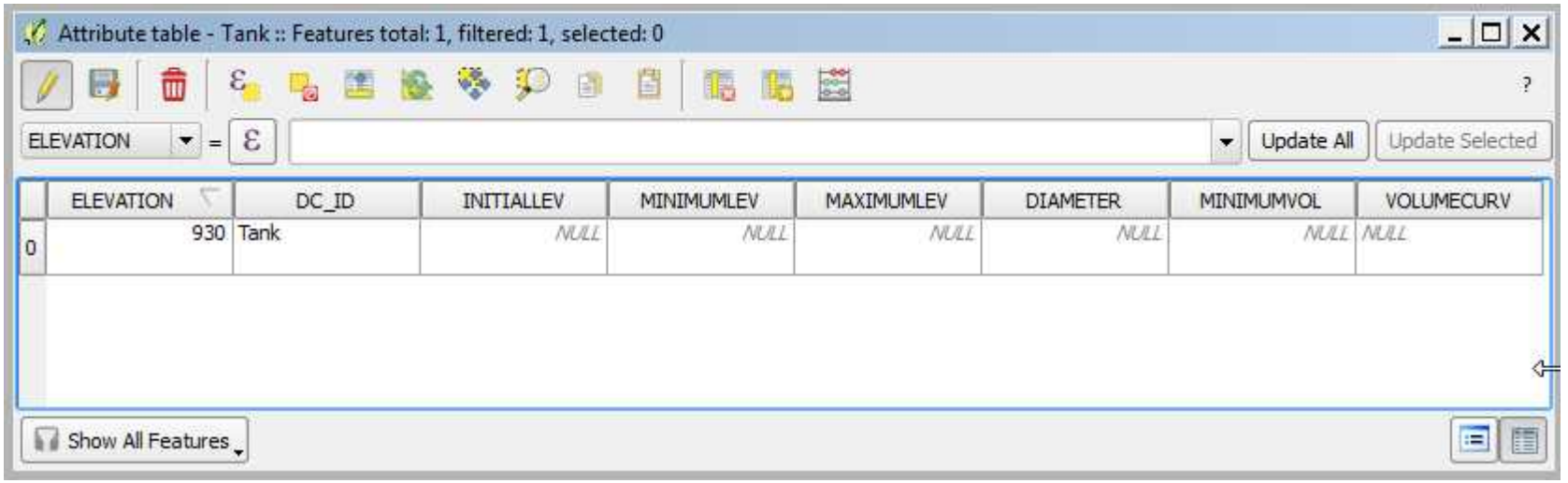
	DC_ID	NODE1	NODE2	DIAMETER	ROUGHNESS	MINORLOSS	STATUS	LENGTH
0	p1	Spring	J4	150.0000000000...	150	NULL	NULL	140.14
1	p2	J4	Reservoir	150.0000000000...	150	NULL	NULL	339.95
2	p3	Reservoir	J5	150.0000000000...	150	NULL	NULL	185.36
3	p4	J5	J1	150.0000000000...	159	NULL	NULL	198.15
4	p5	J1	J2	150.0000000000...	159	NULL	NULL	62.02
5	p6	J2	J3	150.0000000000...	159	NULL	NULL	124.30

Use of Epanet within qGis (plug-in GHydraulics)

Step7

Fill the missing parameter into the attributes and delete unnecessary columns

Tank



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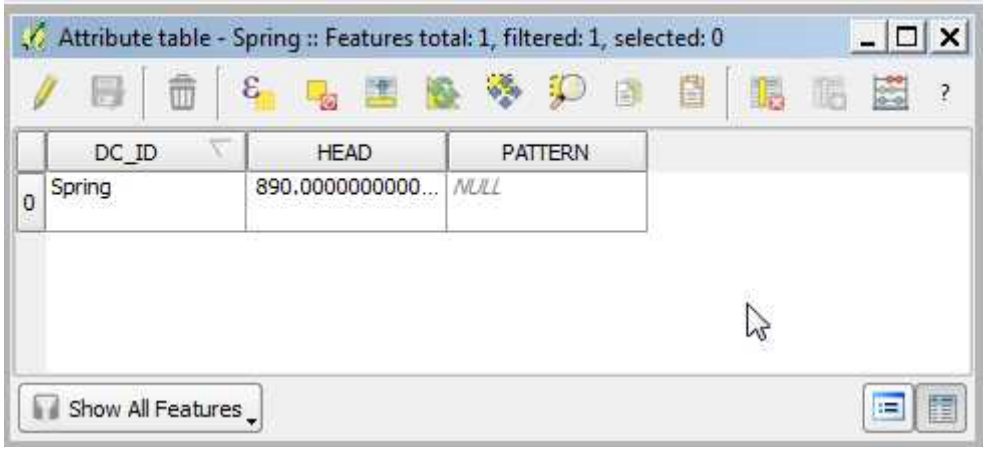
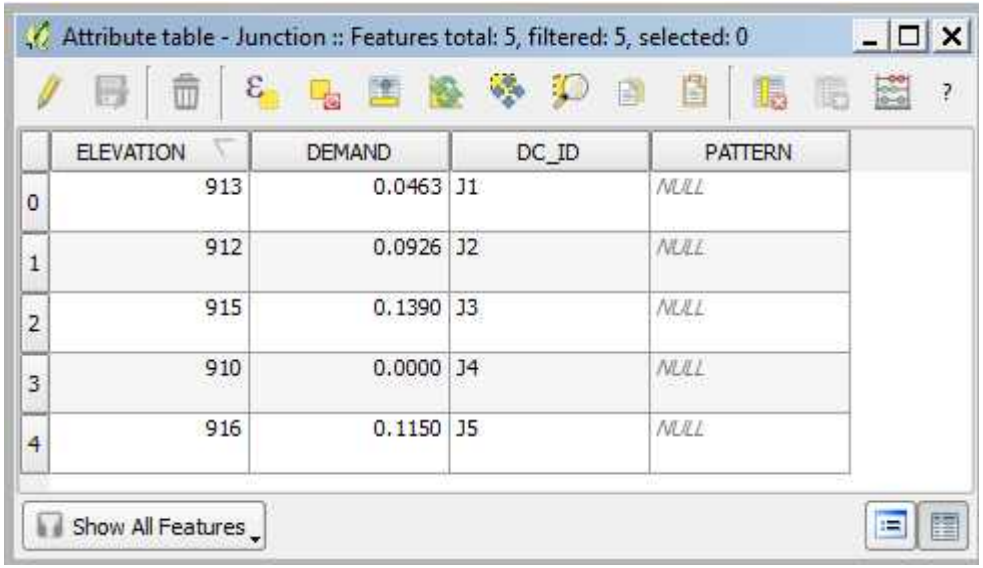
Use of Epanet within qGis (plug-in GHydraulics)

Spring



Junctions



Use of Epanet within qGis (plug-in GHydraulics)

Pipes

Attribute table - Pipes :: Features total: 6, filtered: 6, selected: 0

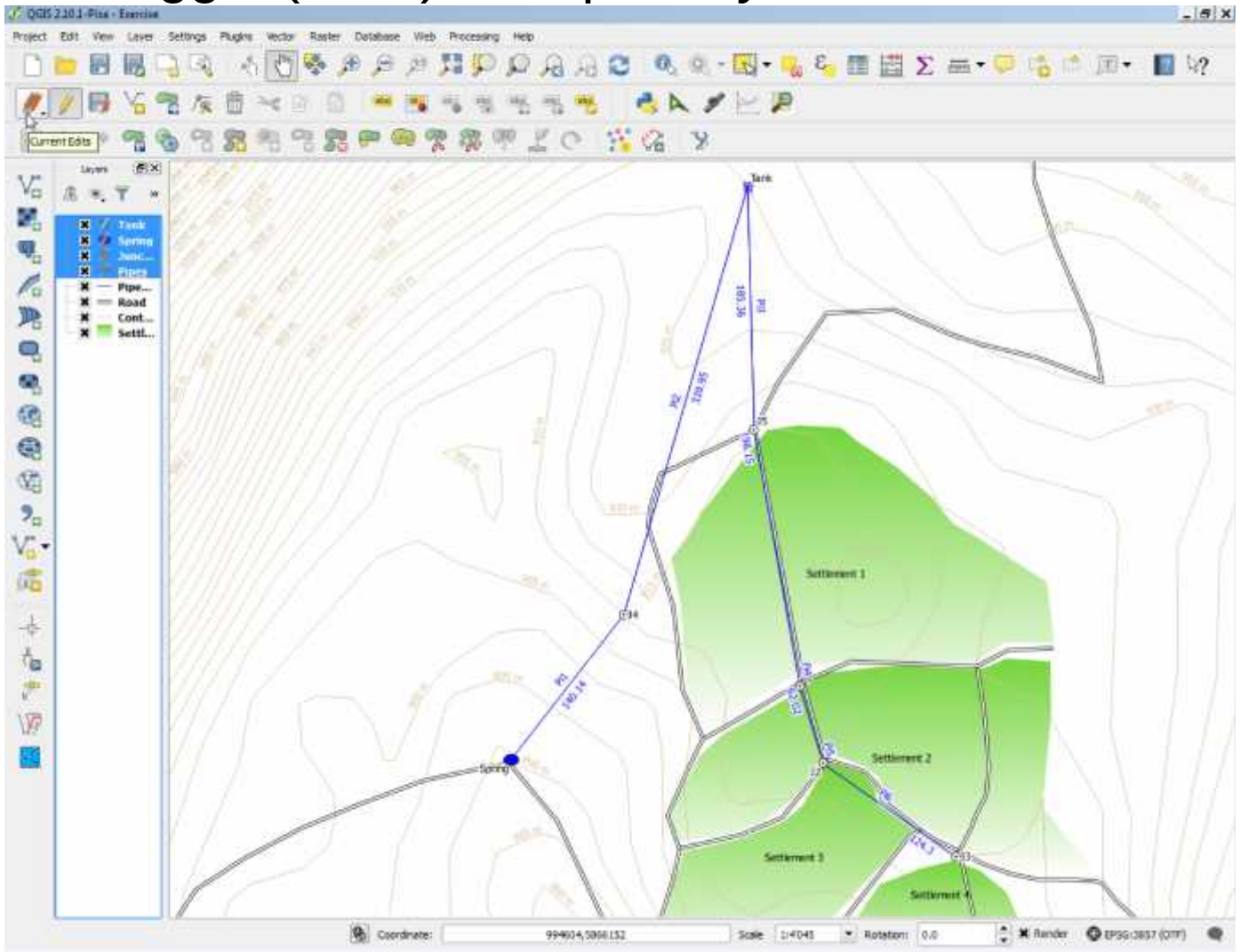
	LENGTH	DC_ID	NODE1	NODE2	DIAMETER	ROUGHNESS	MINORLOSS	STATUS
0	140.14	Pi1	Spring	J4	NULL	NULL	NULL	NULL
1	339.95	Pi2	J4	Tank	NULL	NULL	NULL	NULL
2	185.36	Pi3	Tank	J5	NULL	NULL	NULL	NULL
3	198.15	Pi4	J5	J1	NULL	NULL	NULL	NULL
4	62.02	Pi5	J1	J2	NULL	NULL	NULL	NULL
5	124.30	Pi6	J2	J3	NULL	NULL	NULL	NULL

Show All Features

Use of Epanet within qGis (plug-in GHydraulics)

Step7

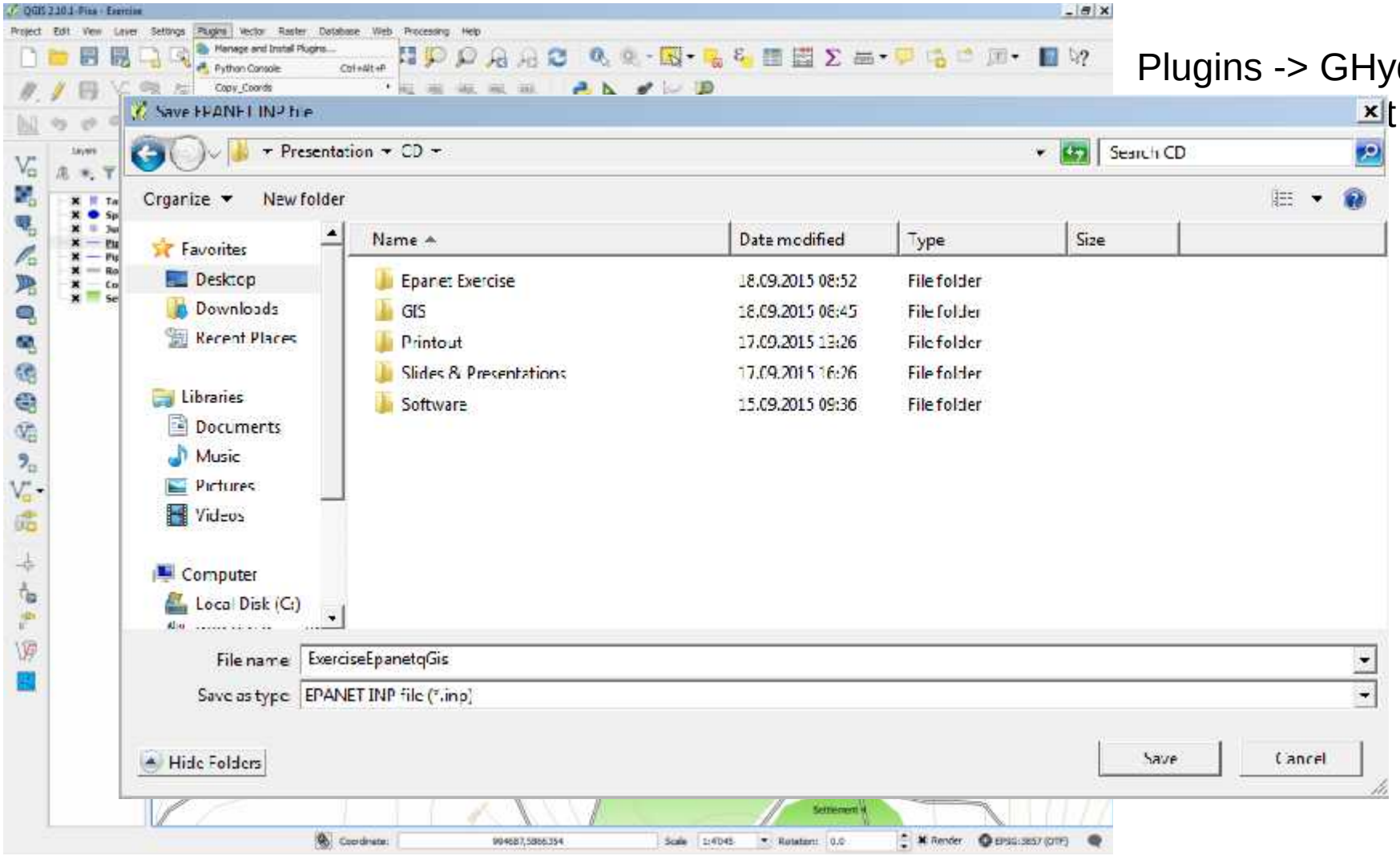
Un toggle (save) the open layers



Use of Epanet within qGis (plug-in GHydraulics)

Step8

Write Epanet file (to be opened later directly with Epanet)

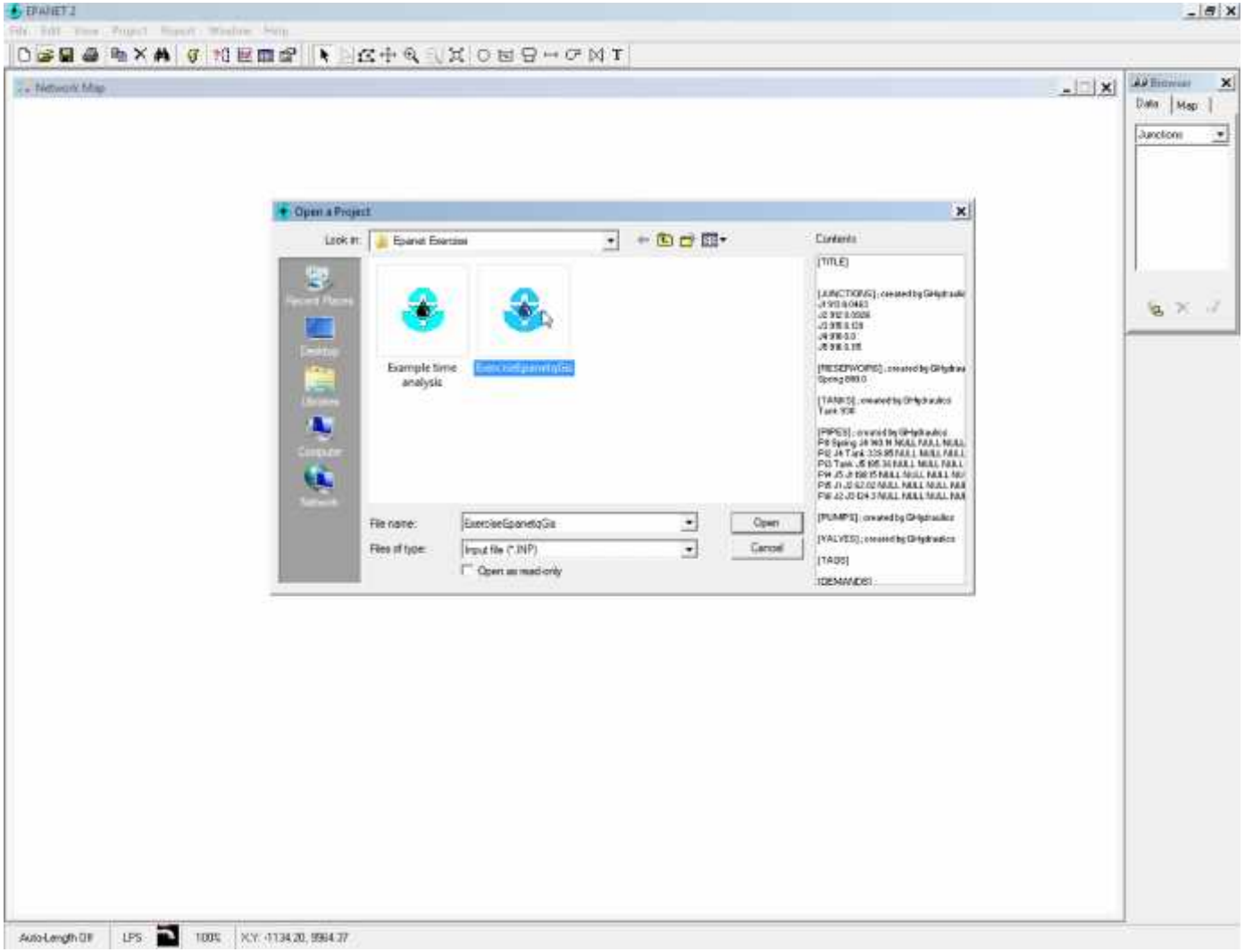


Plugins -> GHydraulics
t inp file

Use of Epanet within qGis (plug-in GHydraulics)

Step10

Open the saved inp file with Epanet (CD Epanet Exercise folder -> ExerciseEpanetqGis)



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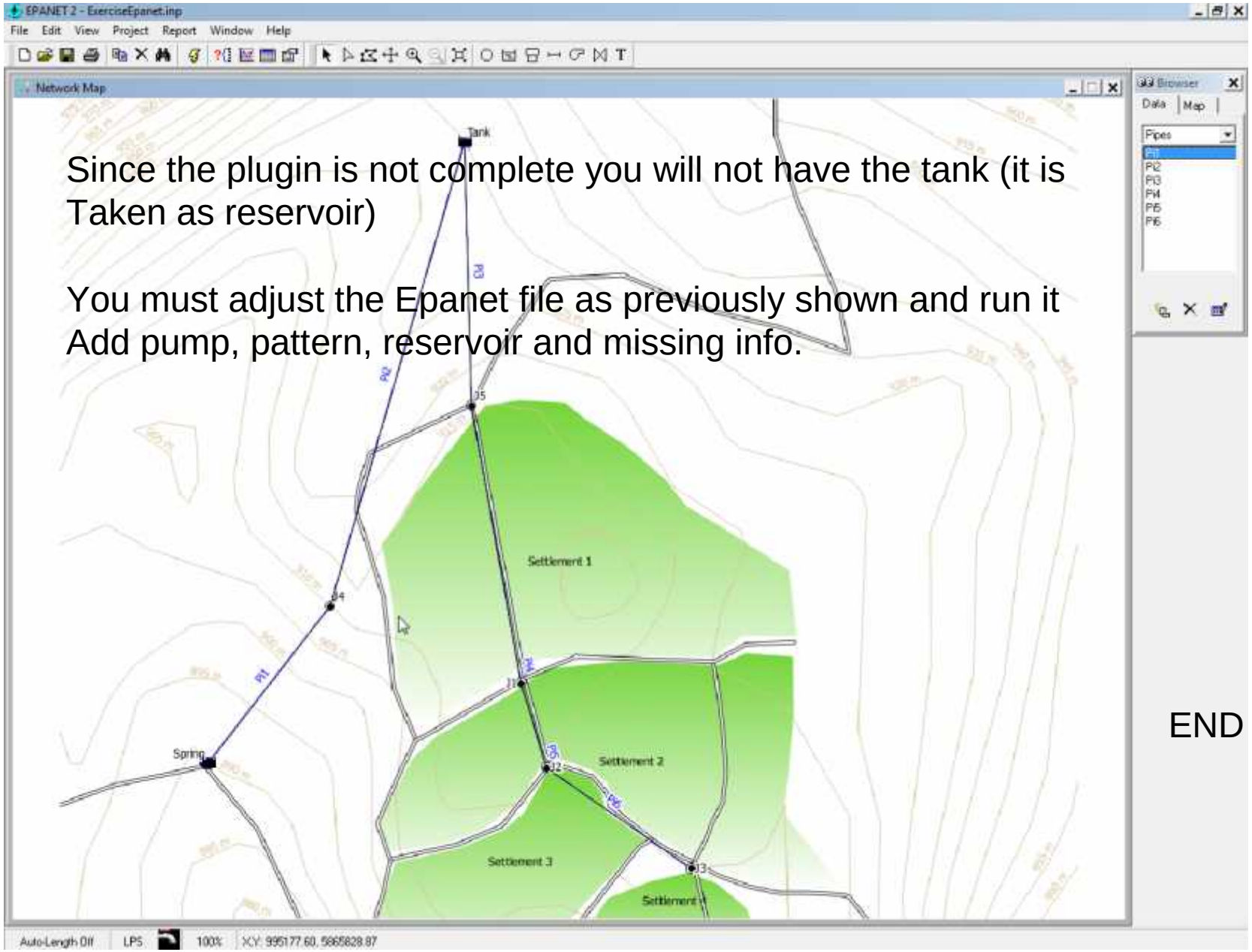
Use of Epanet within qGis (plug-in GHydraulics)



Since the plugin is not complete you will not have the tank (it is Taken as reservoir)

You must adjust the Epanet file as previously shown and run it
Add pump, pattern, reservoir and missing info.

END

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Tools around Epanet

Objective:

Overview of other tools around Epanet that might be interesting.

NOTE:

Most of those tools are self explanatory and very easy. Just play with them!

I did not test all of them!

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Tools around Epanet

Zonum Solutions at http://www.zonums.com/epanet_cat.html

- **Epanet Z:** Display Yahoo Maps, Google Maps and VE imagery as a background.
- **EpaElevation**: Find missing elevation of points online.
- **Epa2Gis:** Transport Epanet projects to a GIS environment using thematic layers.
- **Shp2Epa**: Create Epanet inp files from ESRI shapefiles. Utilize GIS data as input for Epanet projects.
- **Net2Epa**: Create Epanet INP files online using Google Maps. Digitize over a Satellite, Map or Hybrid map to create Epanet Network Maps.
- **Gpx2Epa:** Create Epanet INP files online from data collected with a GPS unit.
- **Epa2kmz**: Visualize and share Epanet projects on Google Earth.
- **Excel2Epa**: Create INP Network files for Epanet from data contained on an Excel sheet.
- **Kml2Epanet**: Utilize Google Earth Imagery to create the network map, then load the project into Epanet. Kml2Epanet converts kml files to inp.

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Tools around Epanet

Qgis plugin qGisEpanet https://github.com/Oslandia/qgis-epanet

Extends processing framework to models the hydraulic and water quality behavior of water distribution piping systems.
This plugin lets you model hydraulic network for water and run simulations to get water pressure informations and more.

See a demo screencast here :
https://vimeo.com/87754967

This plugin looks very professional and complete.
It is free but do not have tutorial unless you pay for a training.

In case you have a tutorial or info aout it, pls share with the WASH unit.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

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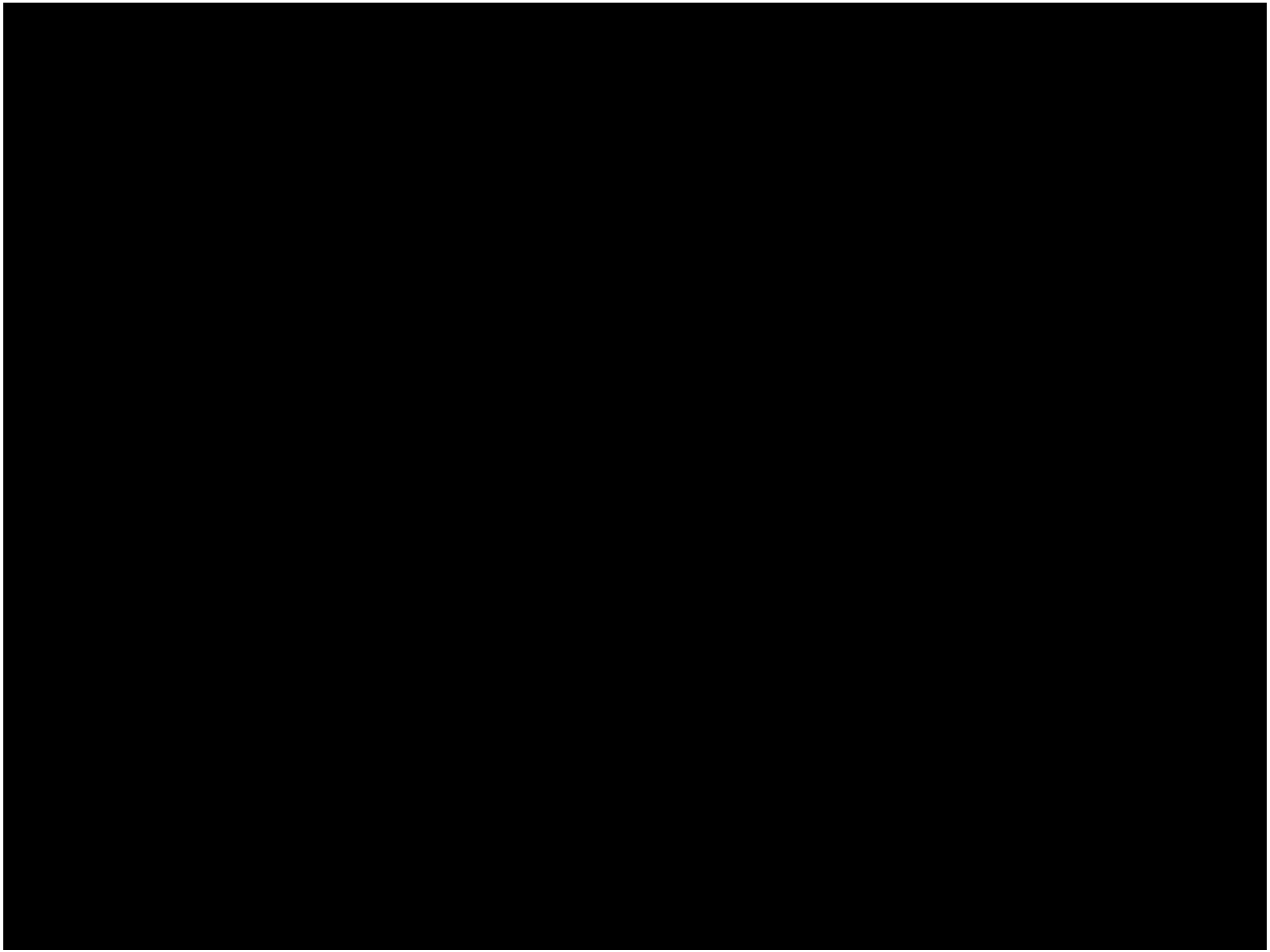
Tools around Epanet

Do you want to see the video of Epanet plugin?

1min 45 sec



Thanks

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Elevations issues

Objective:

Find the most precise elevation with available tools in the field/office

- GPS
- Topographic maps / cadaster if available
- Online maps Google Earth
- Online tools
- Map analysis (Global Digital Elevation Model Aster GDem)

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Elevations issues

1 Elevation from GPS:

GPS give very imprecise elevations. Do not trust GPS elevation

(+/-23meters with a DOP of 1 for 95% confidence).

i.e. Tank 922m

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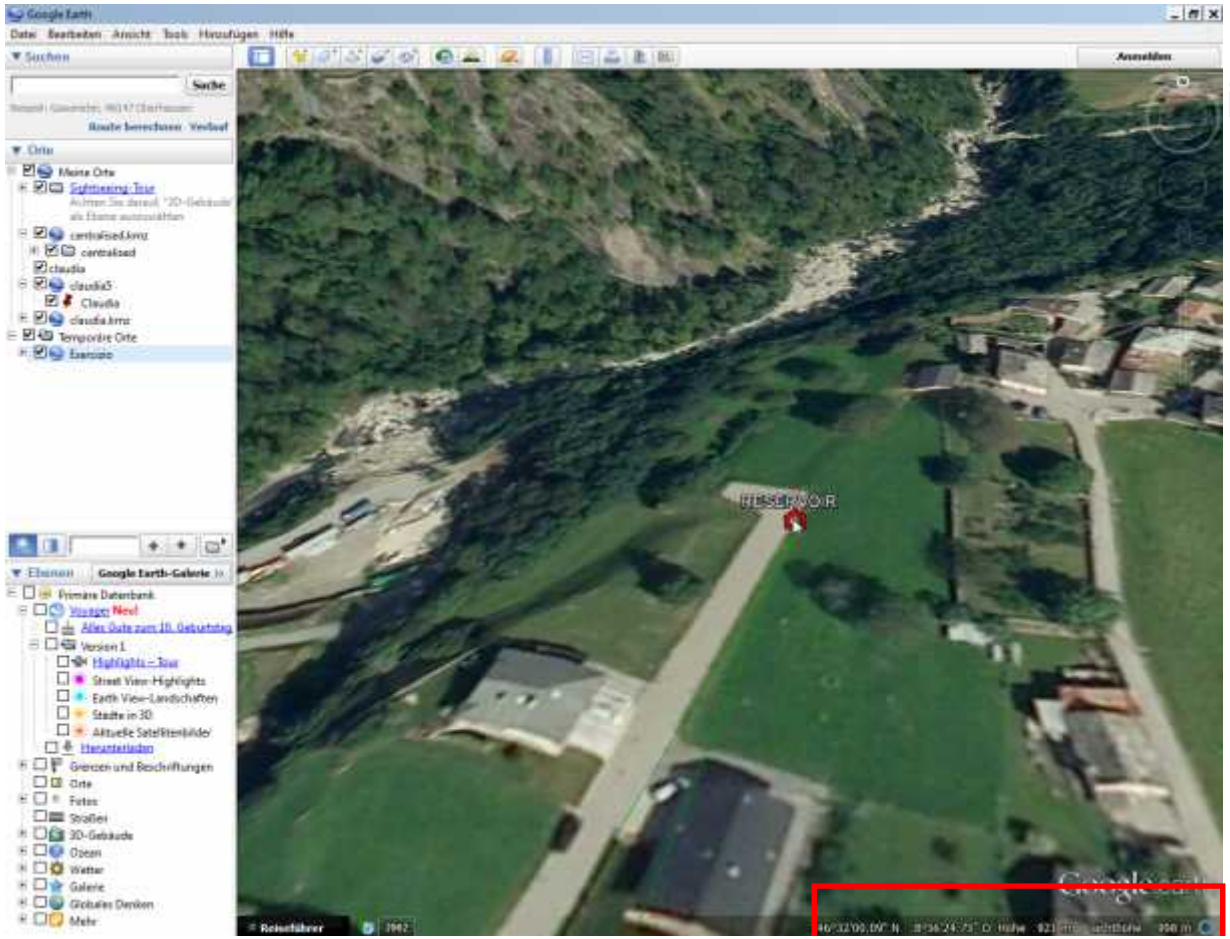
Elevations issues

2 Elevation from Google Earth:

Select your point in Google Earth and look right down the elevation

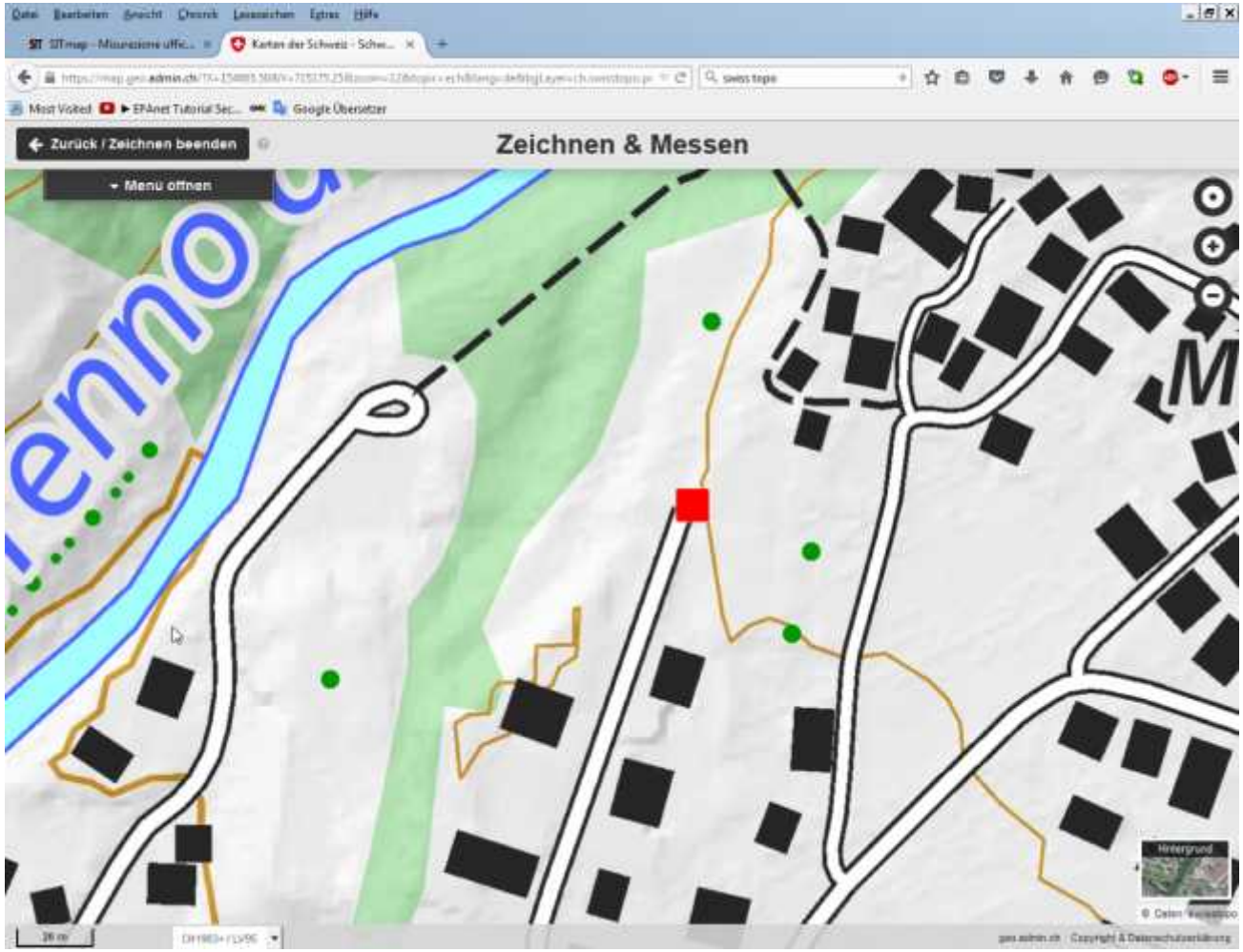


i.e. Tank 921 m

Elevations issues

3 Elevation from topographic maps:

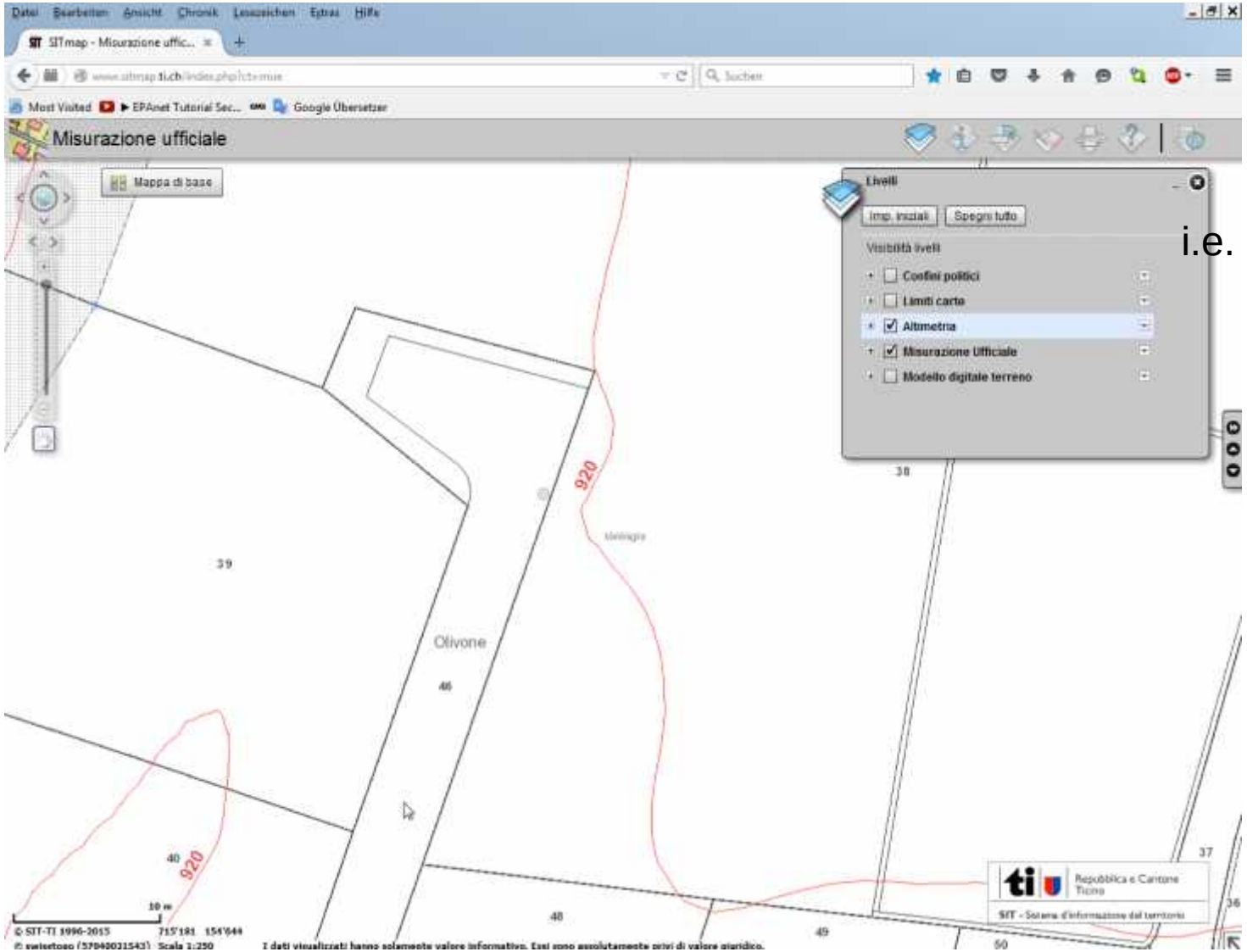
Use topo maps if available (oft online)



i.e. Tank 919 m

Elevations issues

4 Elevation from cadastre if available:



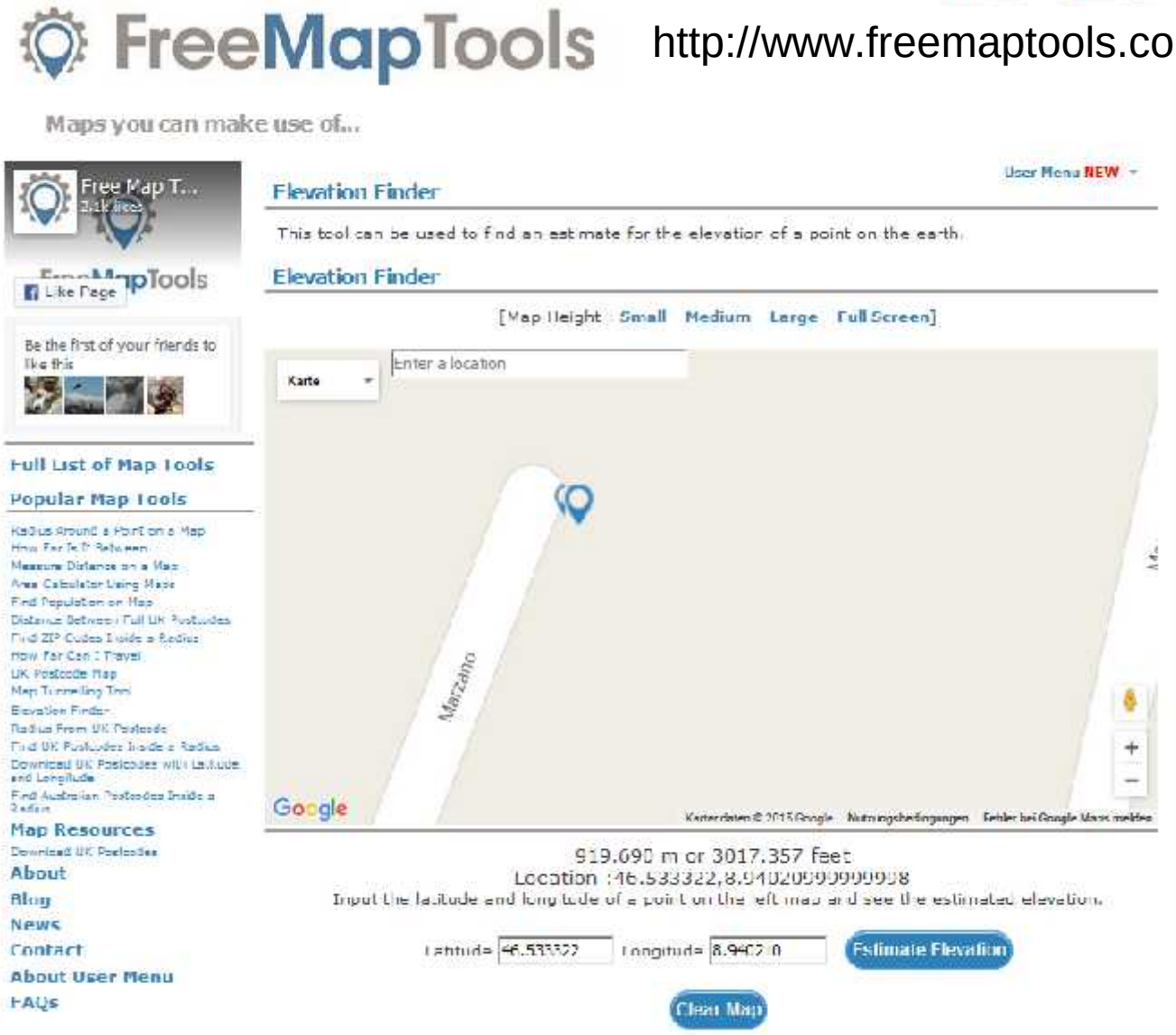
i.e. Reservoir 919.8 m

Swiss Agency for Development and Cooperation SDC

Elevations issues

5 Elevation from online tools:

FreeMapTools http://www.freemaptools.com/elevation-finder.htm



i.e. Tank 919.69 m

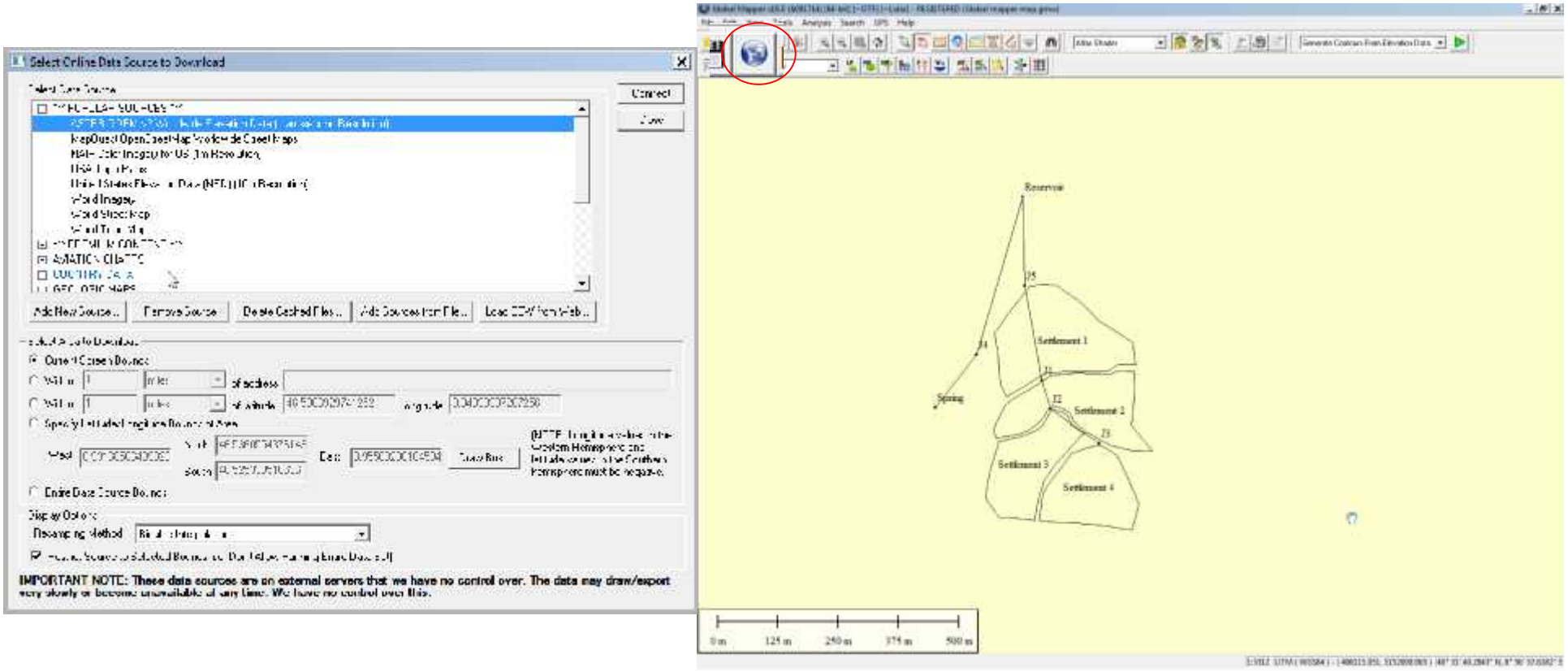
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

Elevations issues

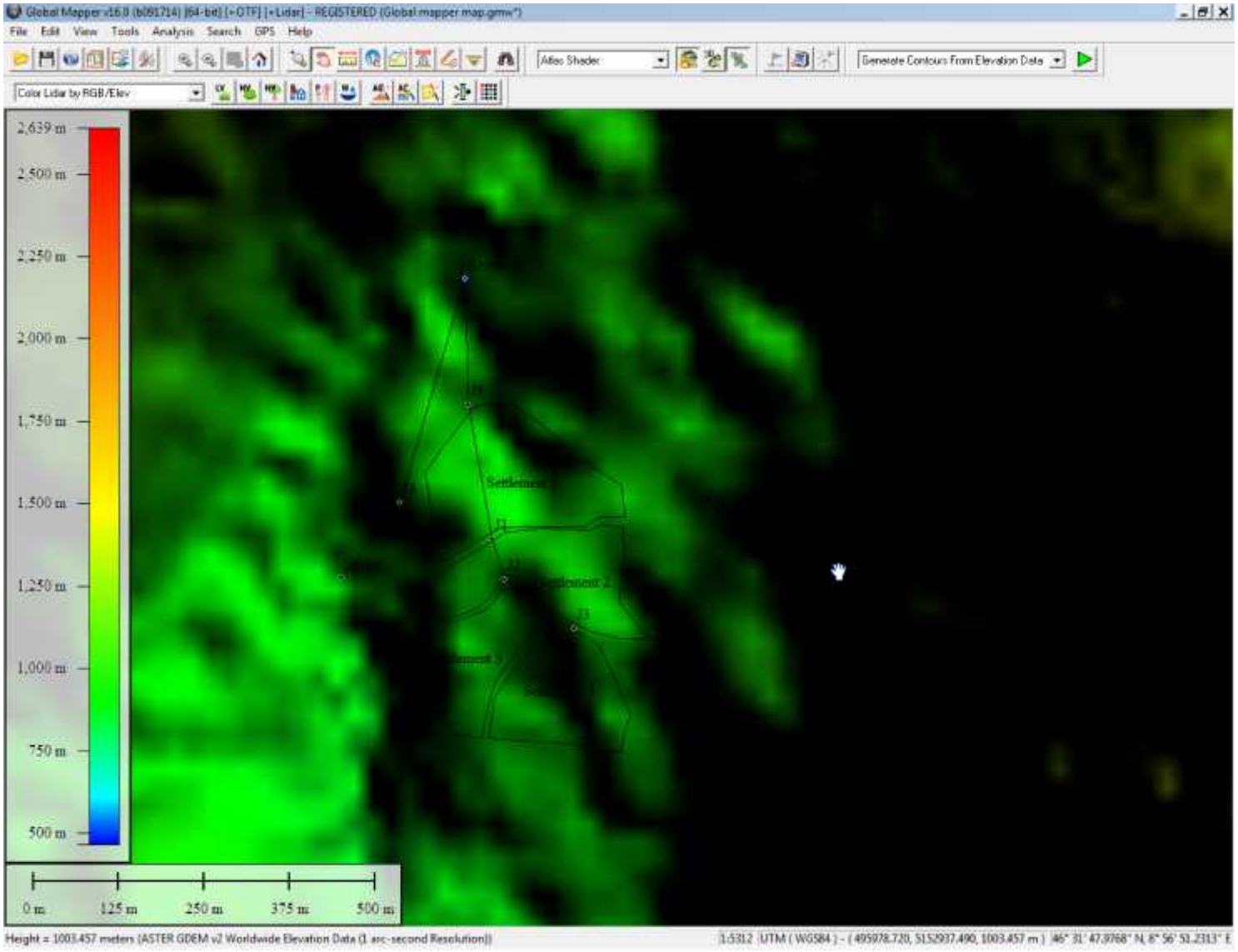
6 Global Digital Elevation Model Aster GDem

- Open Global Mapper
- Open the shape files of the junctions/reservoir/tanks/settlements
- Download online data (Aster GDEM) need internet connection without proxy, if proxy (UN, Ambassy) go to http://gdem.ersdac.jspacesystems.or.jp/ on in a internet café



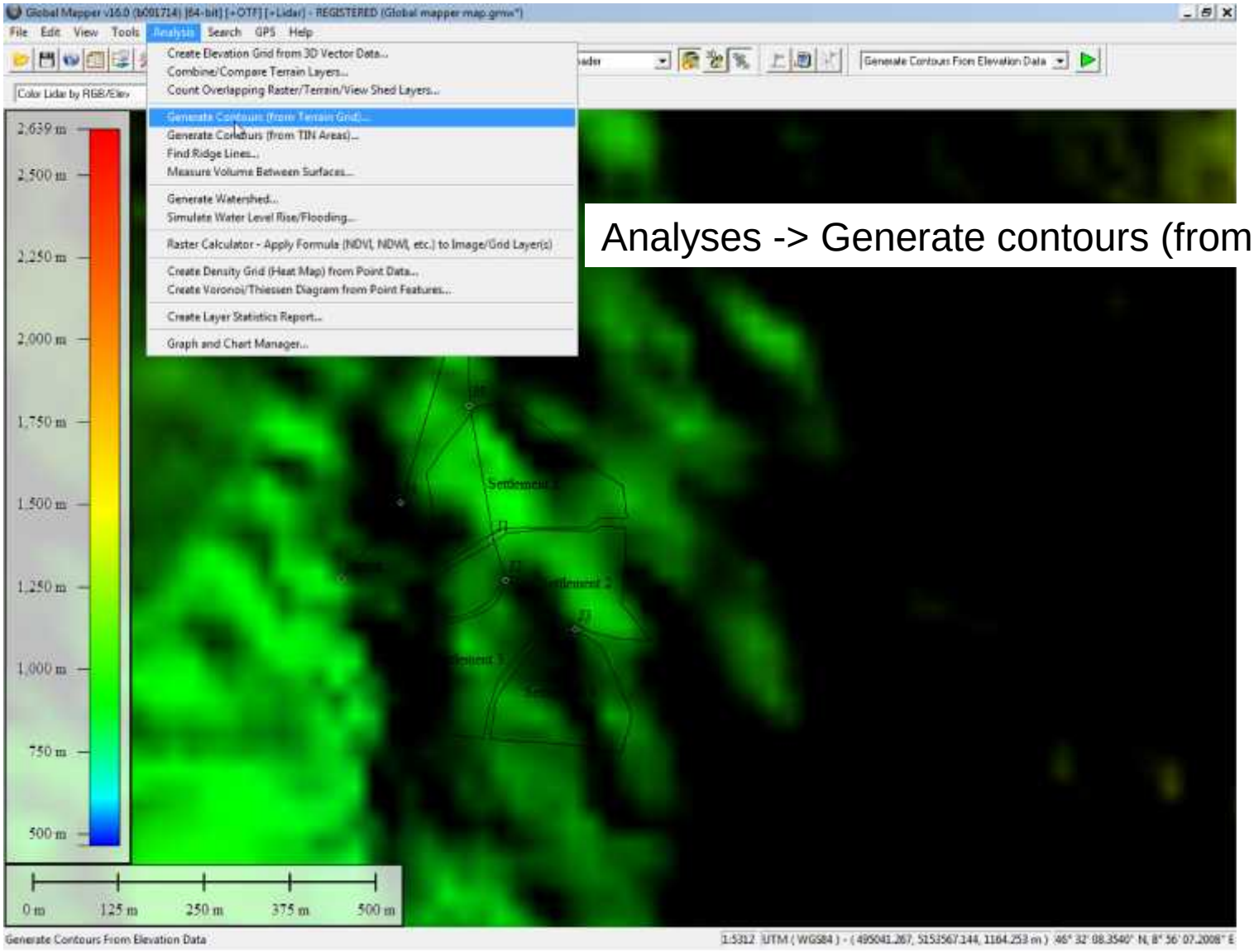
Elevations issues

6 Global Digital Elevation Model Aster GDem



Elevations issues

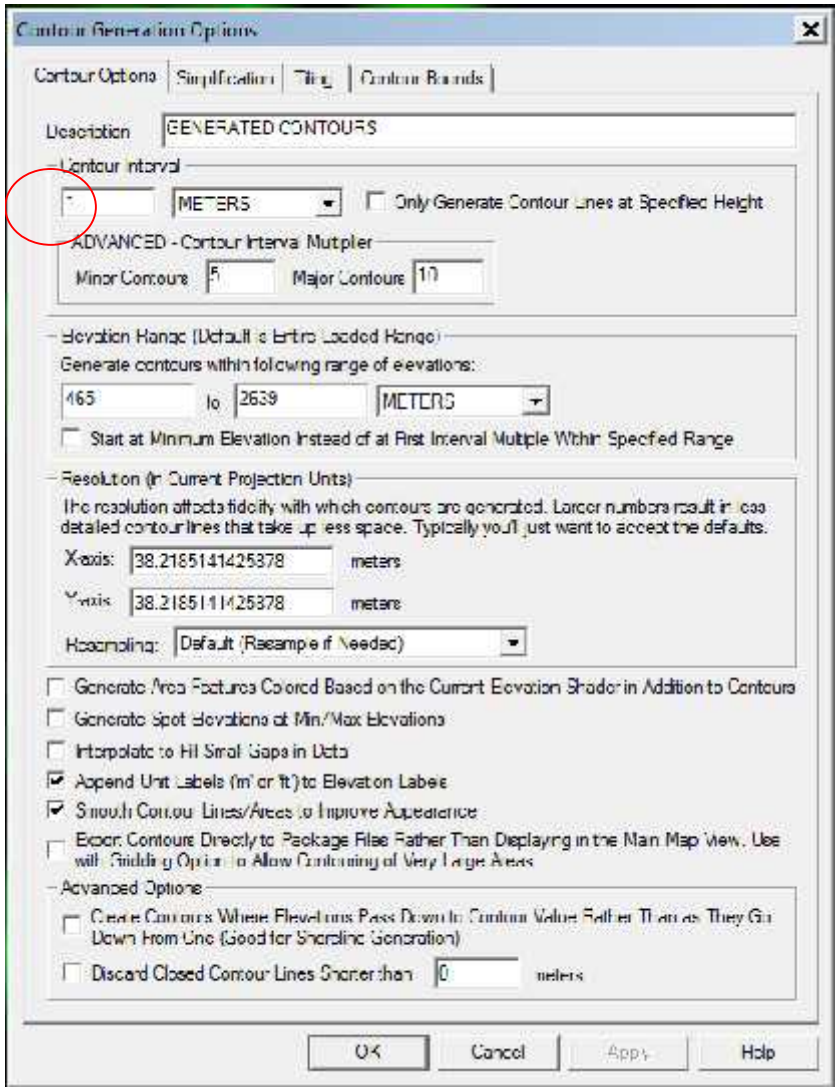
6 Global Digital Elevation Model Aster GDem



Analyses -> Generate contours (from Terrain Grid)

Elevations issues

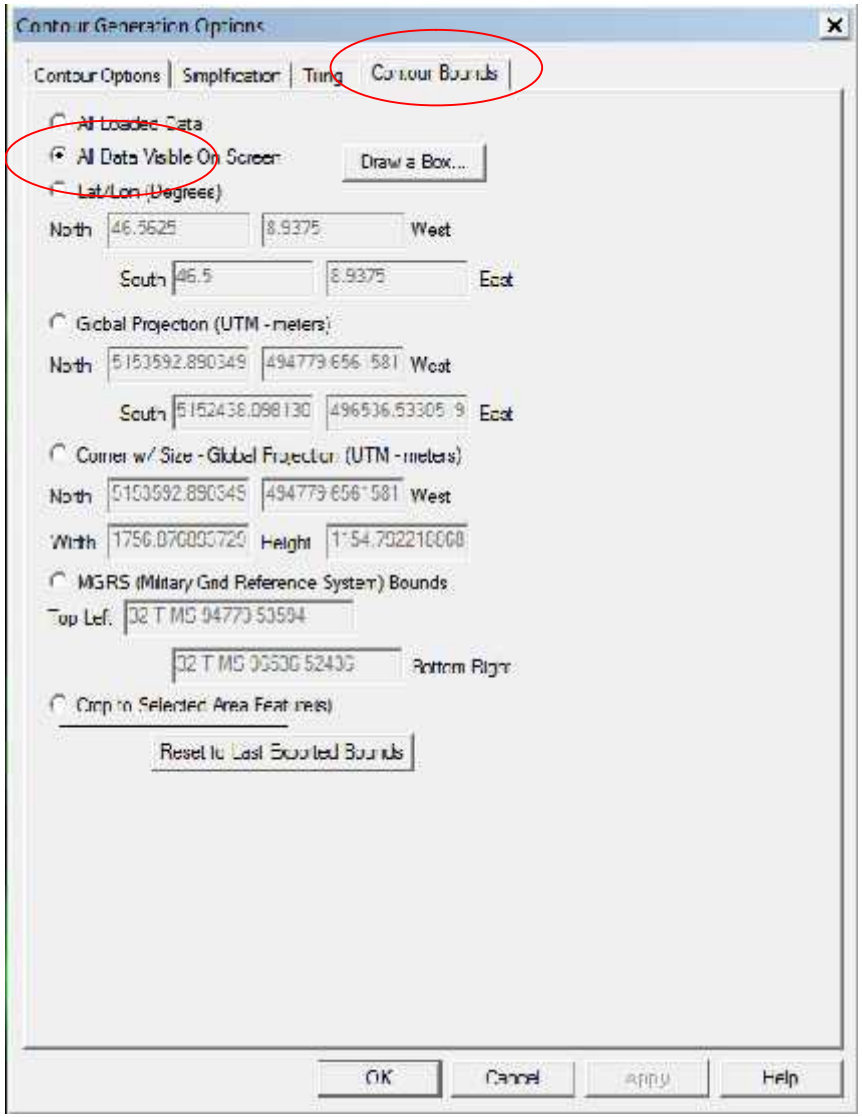
6 Global Digital Elevation Model Aster GDem



Contour interval 1m

Elevations issues

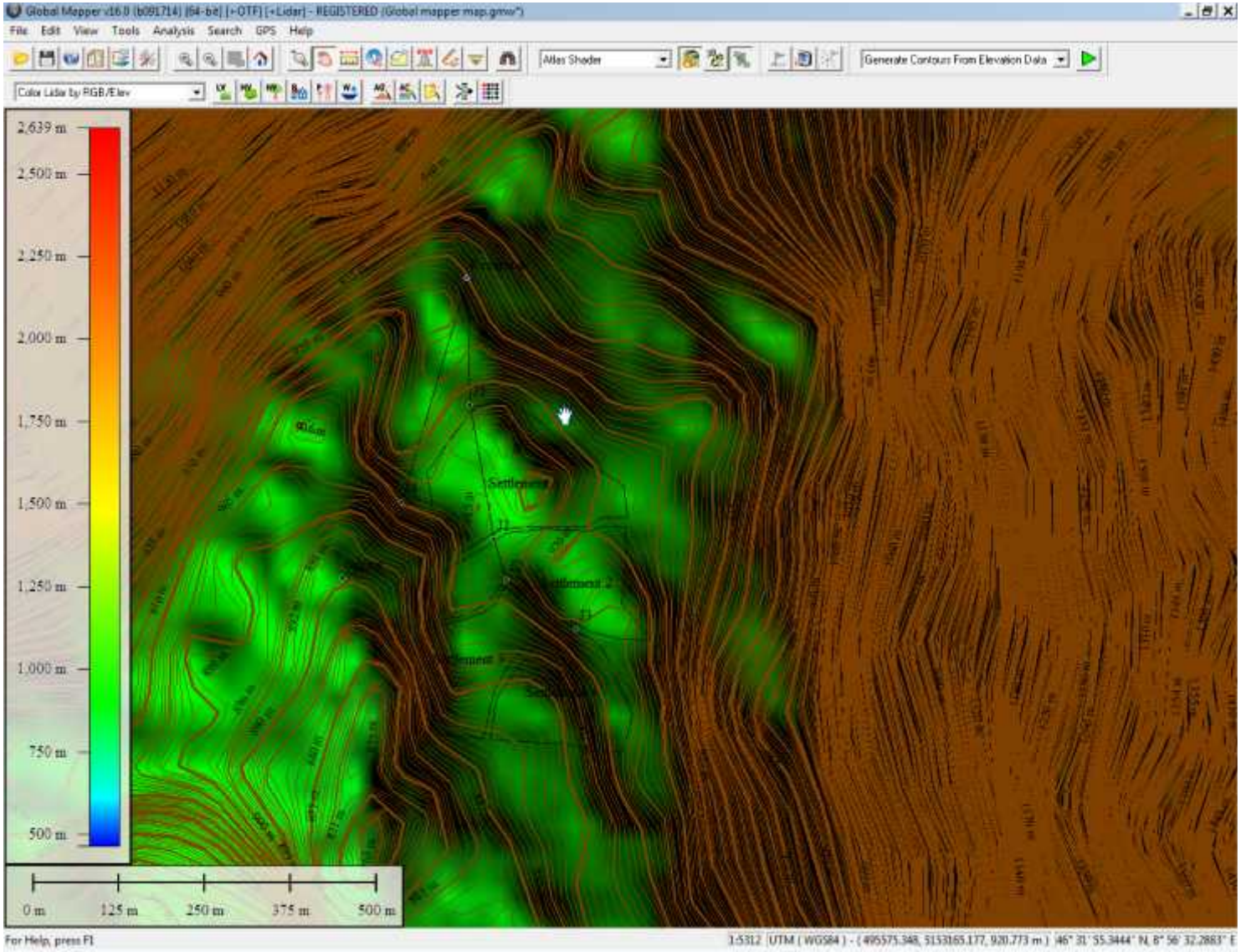
6 Global Digital Elevation Model Aster GDem



Contour bounds
All visible data on the screen

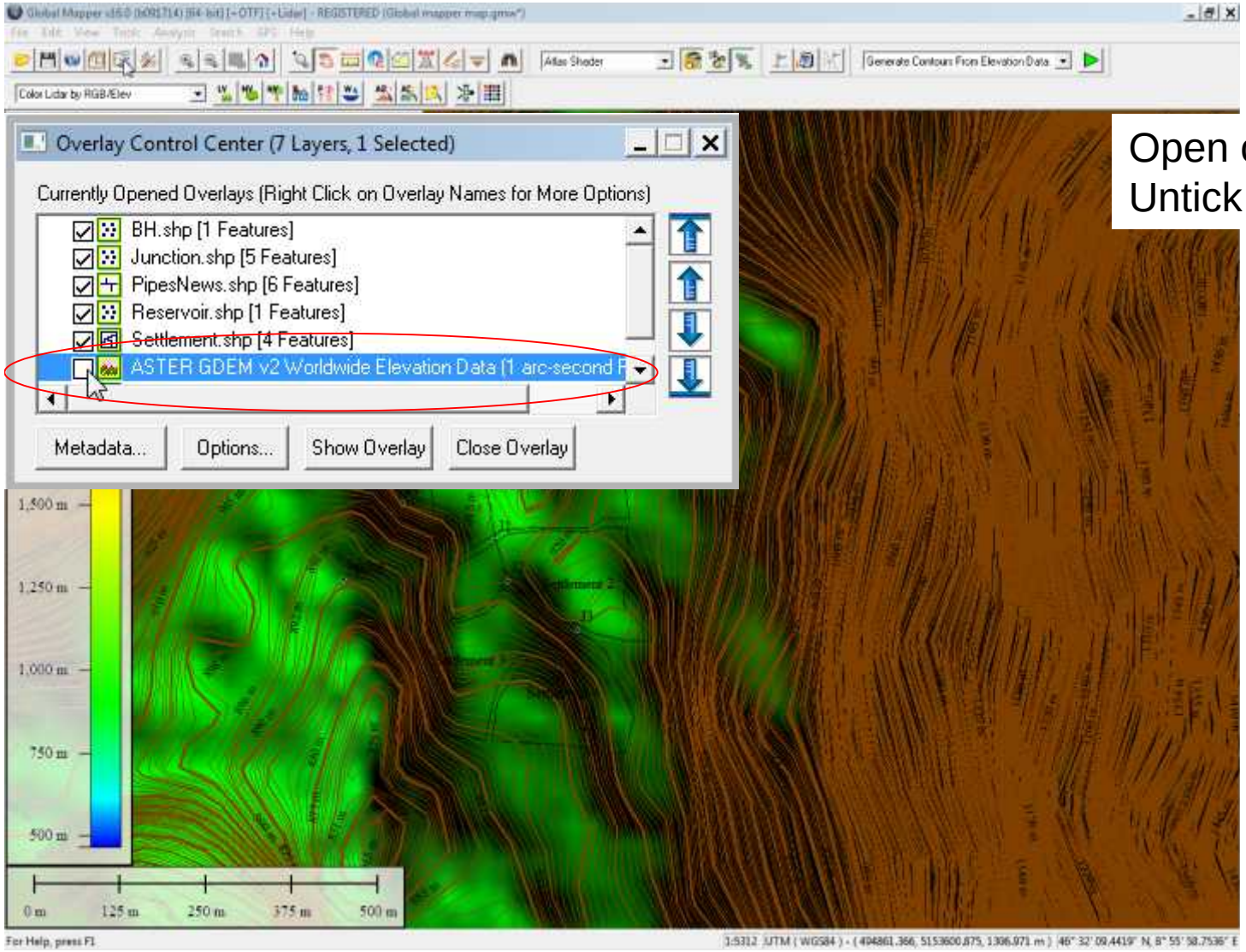
Elevations issues

6 Global Digital Elevation Model Aster GDem



Elevations issues

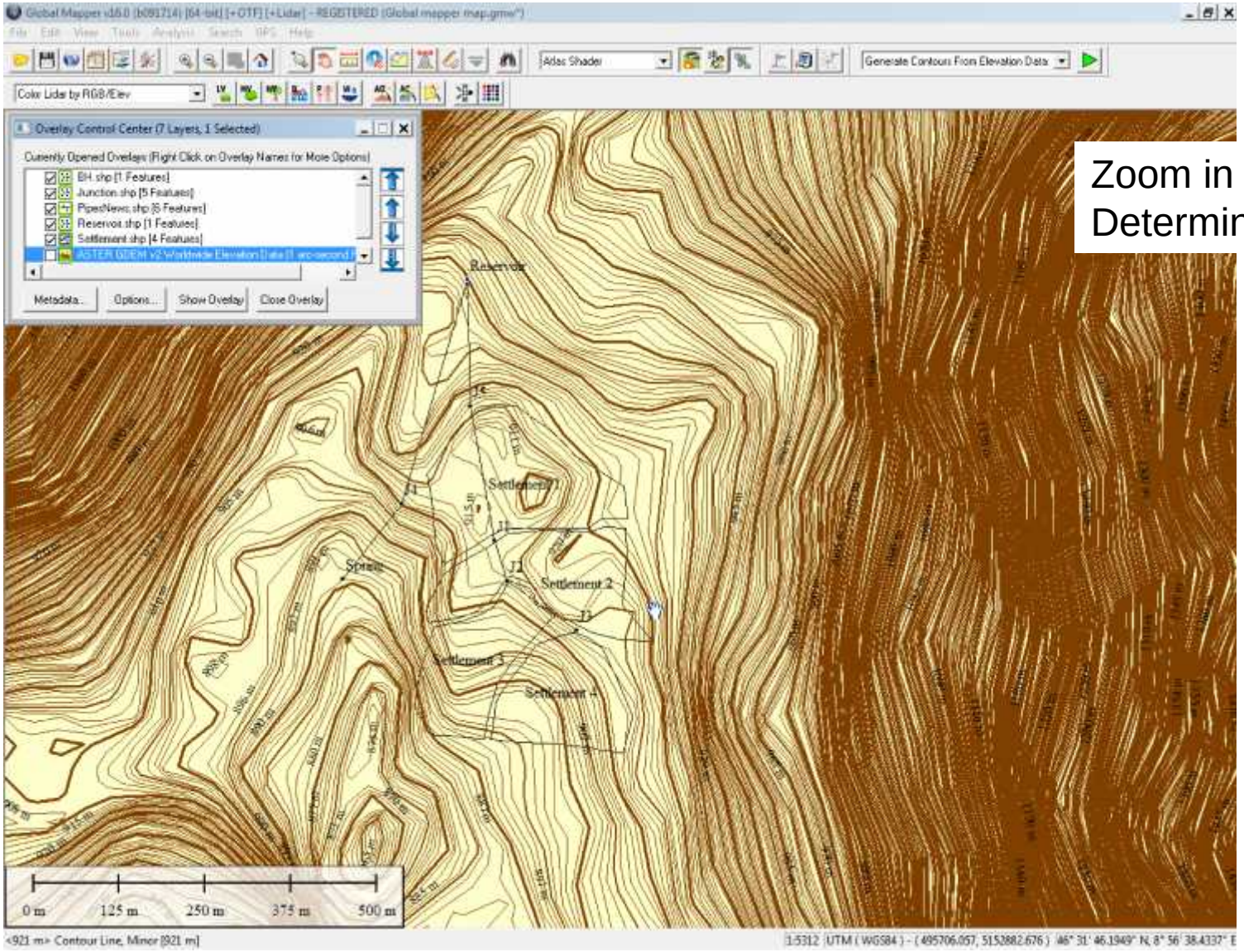
6 Global Digital Elevation Model Aster GDem



Open control Center
Untick the AsterGdem layer

Elevations issues

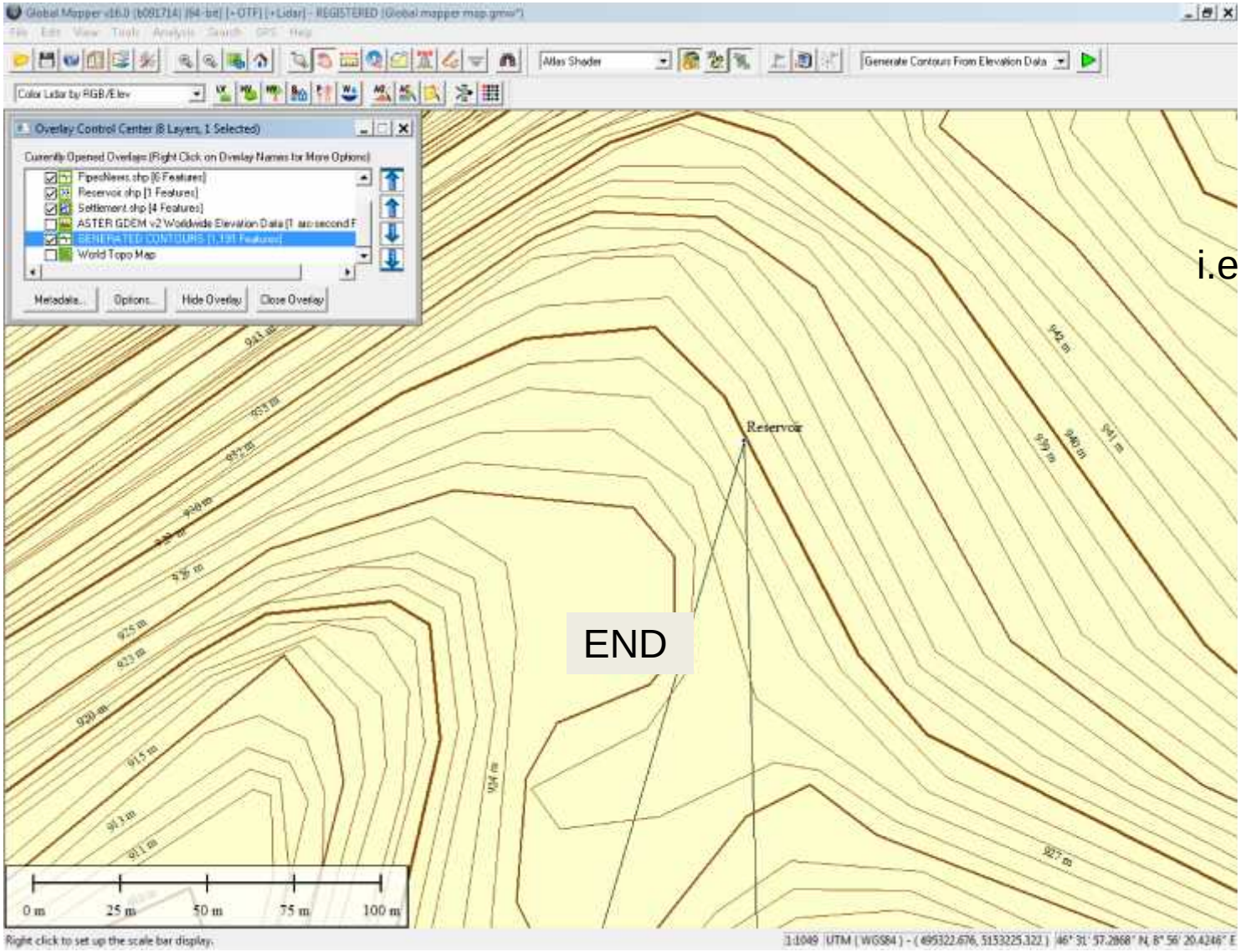
6 Global Digital Elevation Model Aster GDem



Zoom in to the point and
Determine the elevation

Elevations issues

6 Global Digital Elevation Model Aster GDem



i.e. Reservoir 929.8 m

END