Design of wastewater Collection system for Ajja village

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Introduction

- the traditional to dispose of waste water is cesspits way .
- the solution is to design sewage collection system.

Objectives

1- Estimate the amount of wastewater generated in the village to solve the sanitation problem.

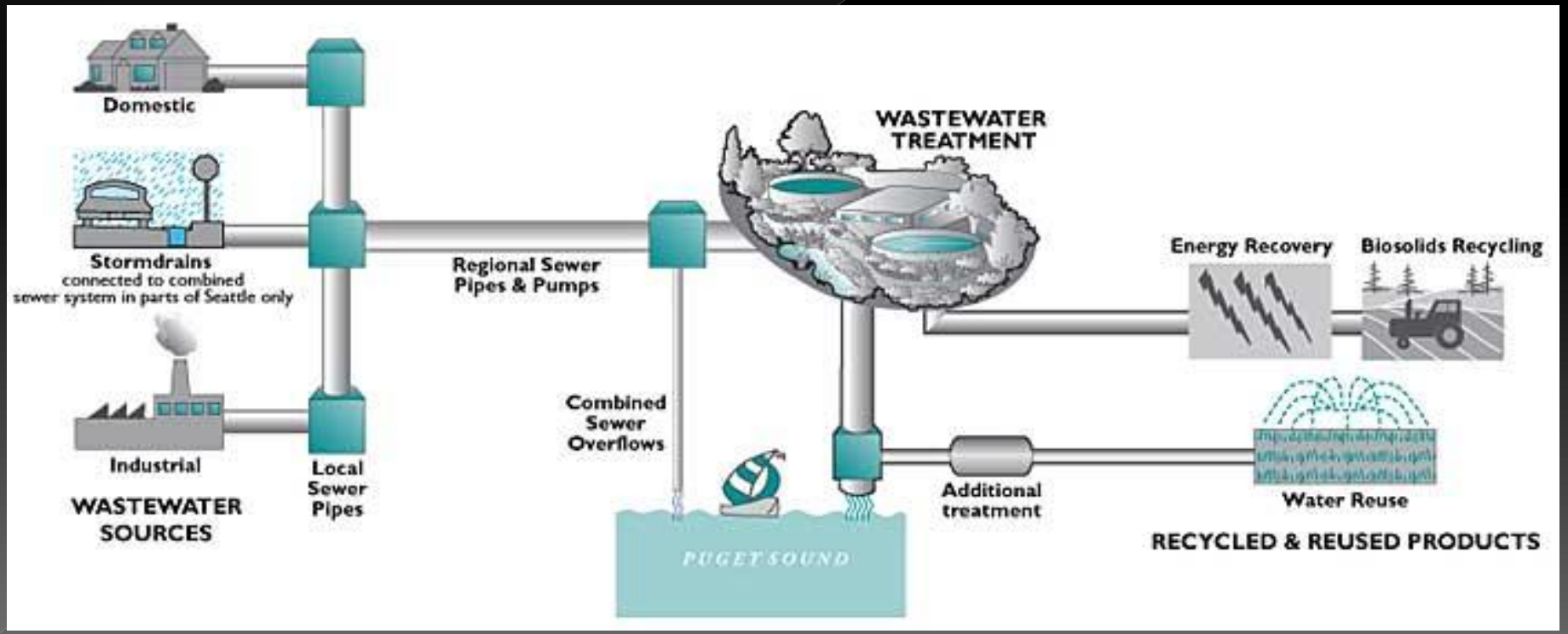
2- Design a wastewater collection system to serve Ajja village.

Study Area

- Ajja village is located 19 km south from Jenin city.
- It has a population of 6700 person
- The village is a hilly area, It is at elevation of 380 meters above mean sea level.
- Climate in Ajja is governed by its position on the eastern Mediterranean: rainy in winter, and hot in summer.

Wastewater Collection Elements

Sewer system is a network of pipelines and ancillary works which conveys wastewater and/or surface water from drains to a treatment works or other place of disposal.



Gravity wastewater system comprise mainly of:

1. Sewers pipes

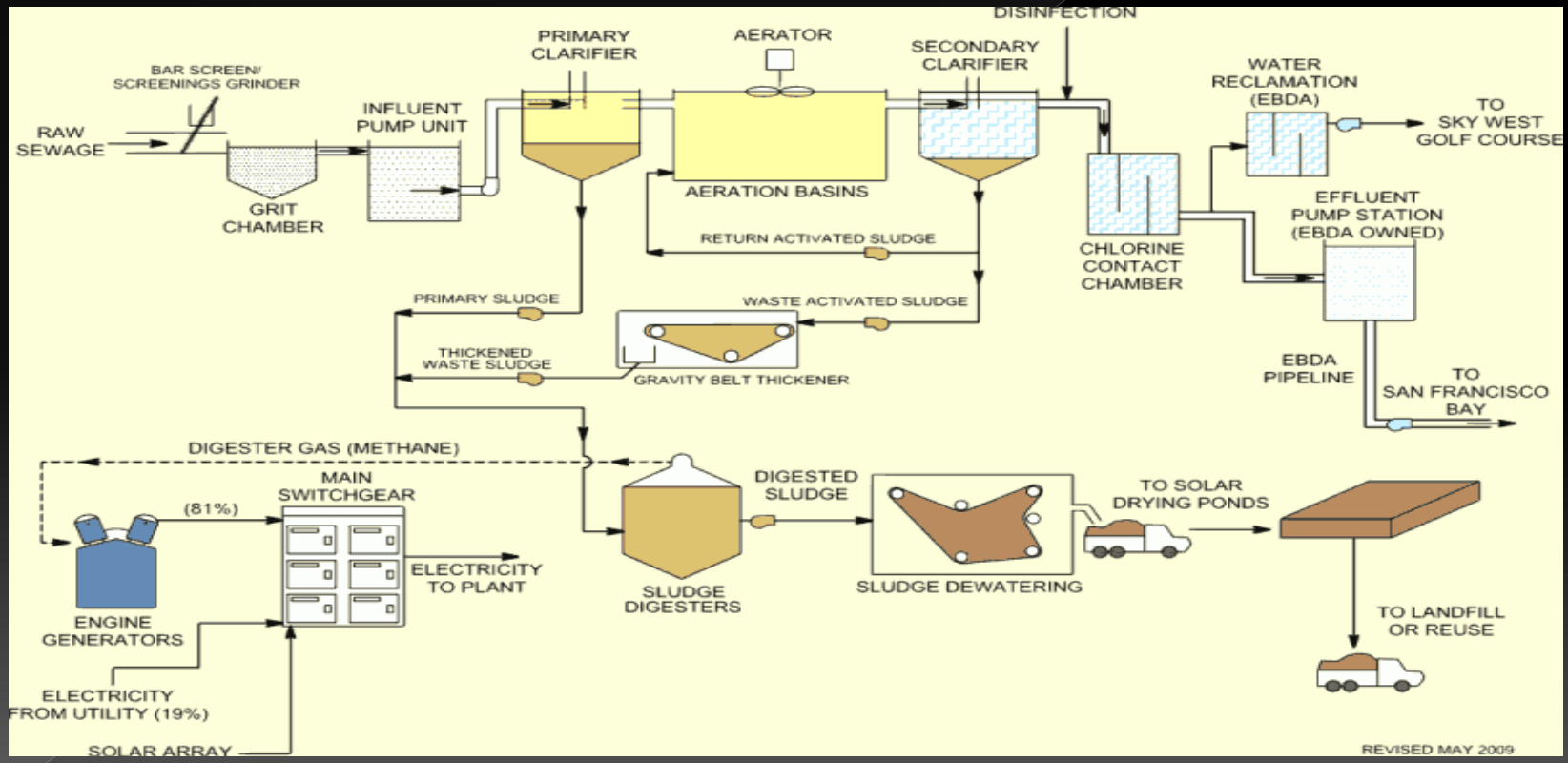
And there are two mainly common type of pipes uses in sewer system:

- **Concrete pipe**

- **PVC pipe**

2. Manholes

3. Wastewater Treatment Plant.



Water Supply & consumption

- The main water Supply is the municipality water.

- The average water consumption is about 150 leter per capita per day.

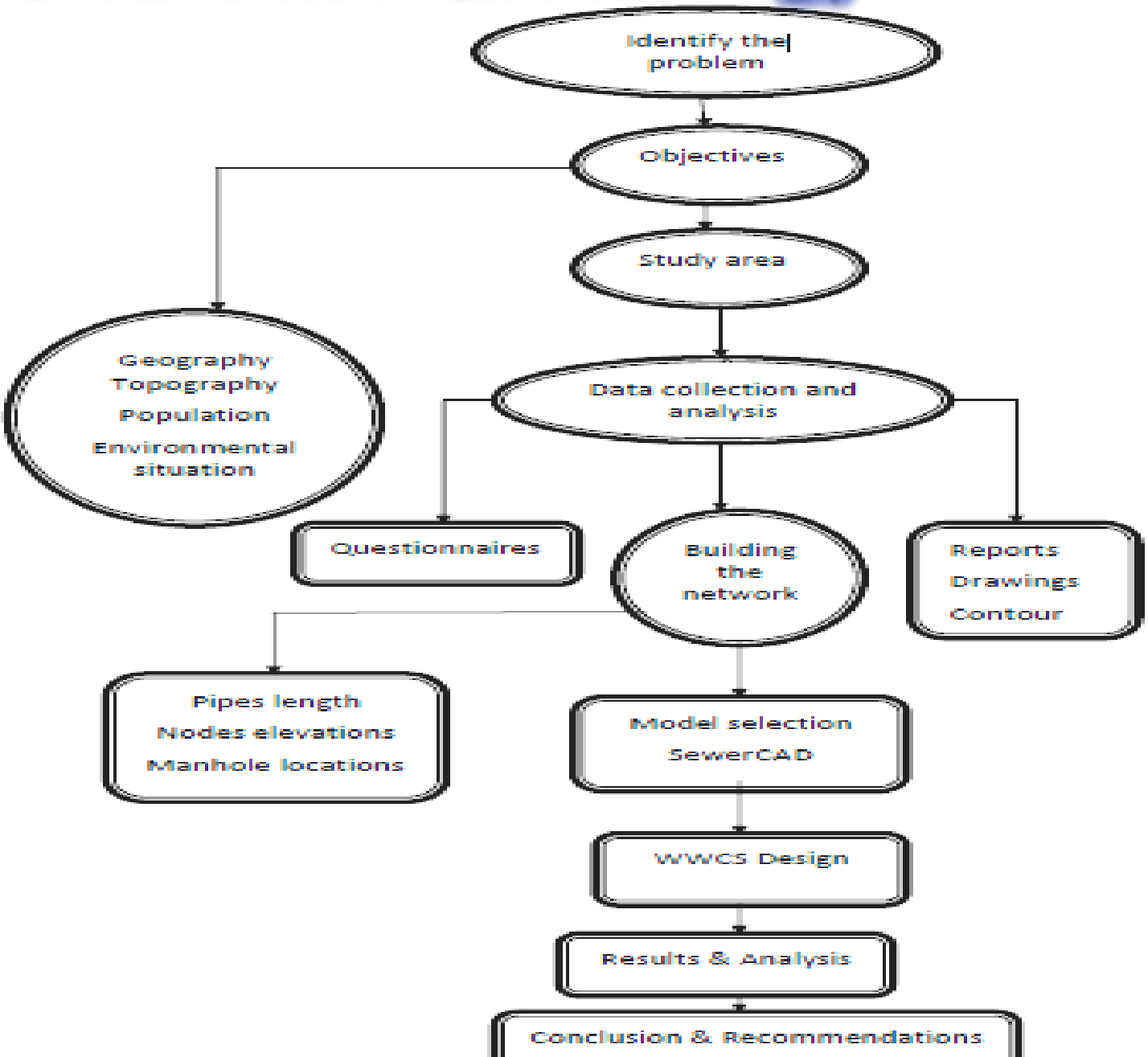
Methodology

The methodology to be applied in this study is depicted by:

- Collect the necessary information and data about Ajja:

  Geographic maps, consumption of water.
- Applying questionnaire about water consumption and wastewater disposal, and perform it for the village population.
- layout the wastewater collection system by AutoCAD software, and convert from AutoCAD to be use in SewerCAD software.
- We used SewerCAD in the design.

Flow chart methodology

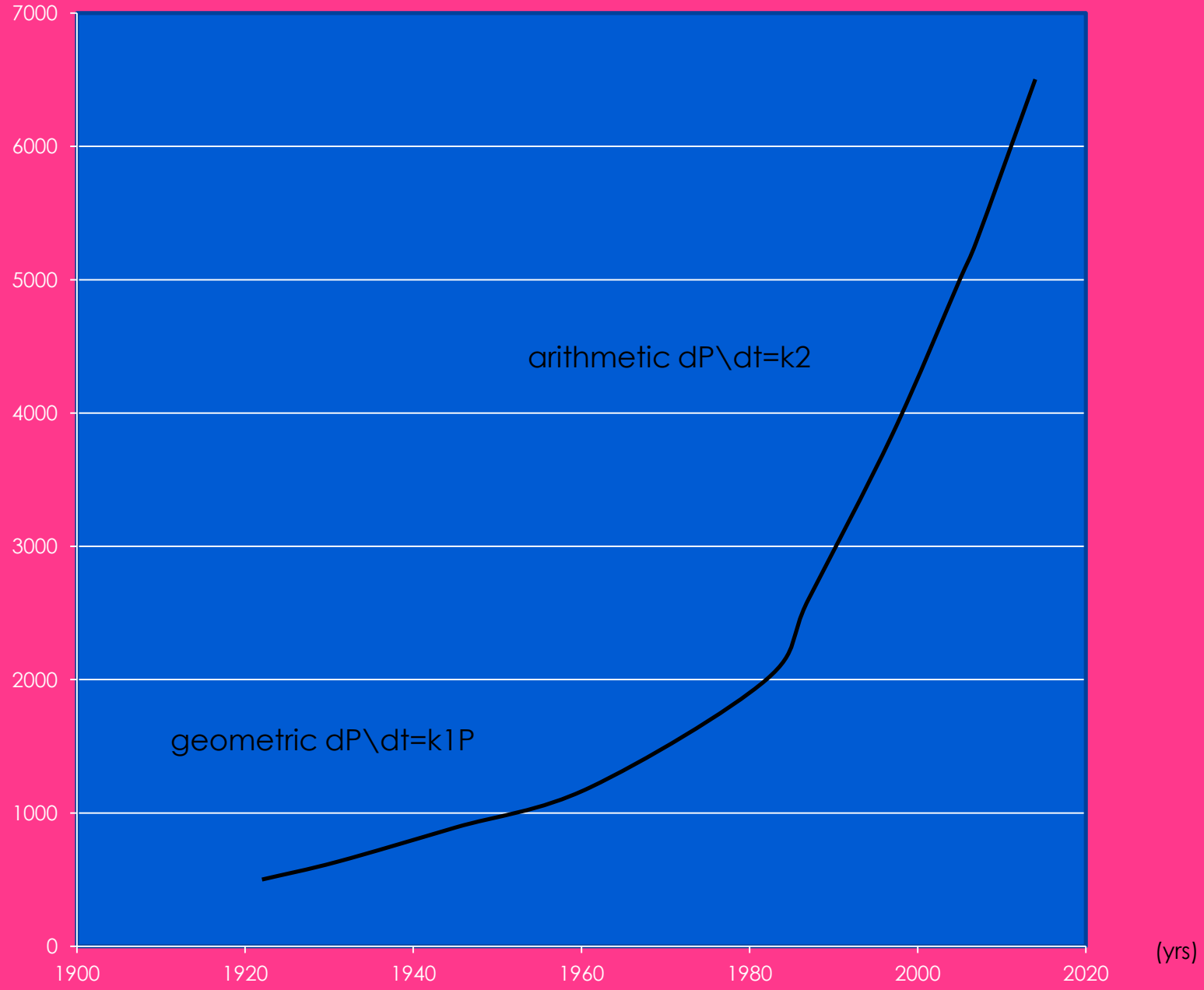


Design and Data analysis

- Contour map for the village and analyze it .
- Details plan of the village, including houses, main streets.
- The population data from the PCBS.
- The water consumption from the village council.
- The collected data through the questionnaire .

Population analysis

year	Population-capita
1922	500
1931	634
1945	890
1961	1190
1982	2000
1987	2600
1997	3840
2005	4998
2007	5287
2014	6503


7000
6000
5000
4000
3000
2000
1000
0
1900
1920
1940
1960
1980
2000
2020
(yrs)
arithmetic dP\dt=k2
geometric dP\dt=k1P

$Pn = Pi(1+i)n$

To find growth rate of population,

$6503=4998(1+i)9$

$i= 3\%$

The rate of population growth is around 3% in Palestine, and the design period is 35 years. So, n will be 36

$Pn = 6503(1+0.03)36$

Future population = 18847capita (in the year 2050)

Consumption analysis

Monthly water consumption in Ajja 2014	
Month	Amount
Jan-2014	10024
Feb-2014	10120
Mar-2014	10561
Apr-2014	9981
May-2014	9850
Jun-2014	12250
Jul-2014	**19101**
Aug-2014	15939
Sep-2014	13802
Oct-2014	8691
Nov-2014	9986
Dec-2014	8360
Total	130305

Current flow

Depending on the last table the water consumption is 97 letter per capita per day in Ajja village, in this design we did assume water consumption to be 150 as recommended value.

Residential flow =1261 cubic meter per day

Infiltration=156 cubic meter per day

Design flow =3277 cubic meter per day

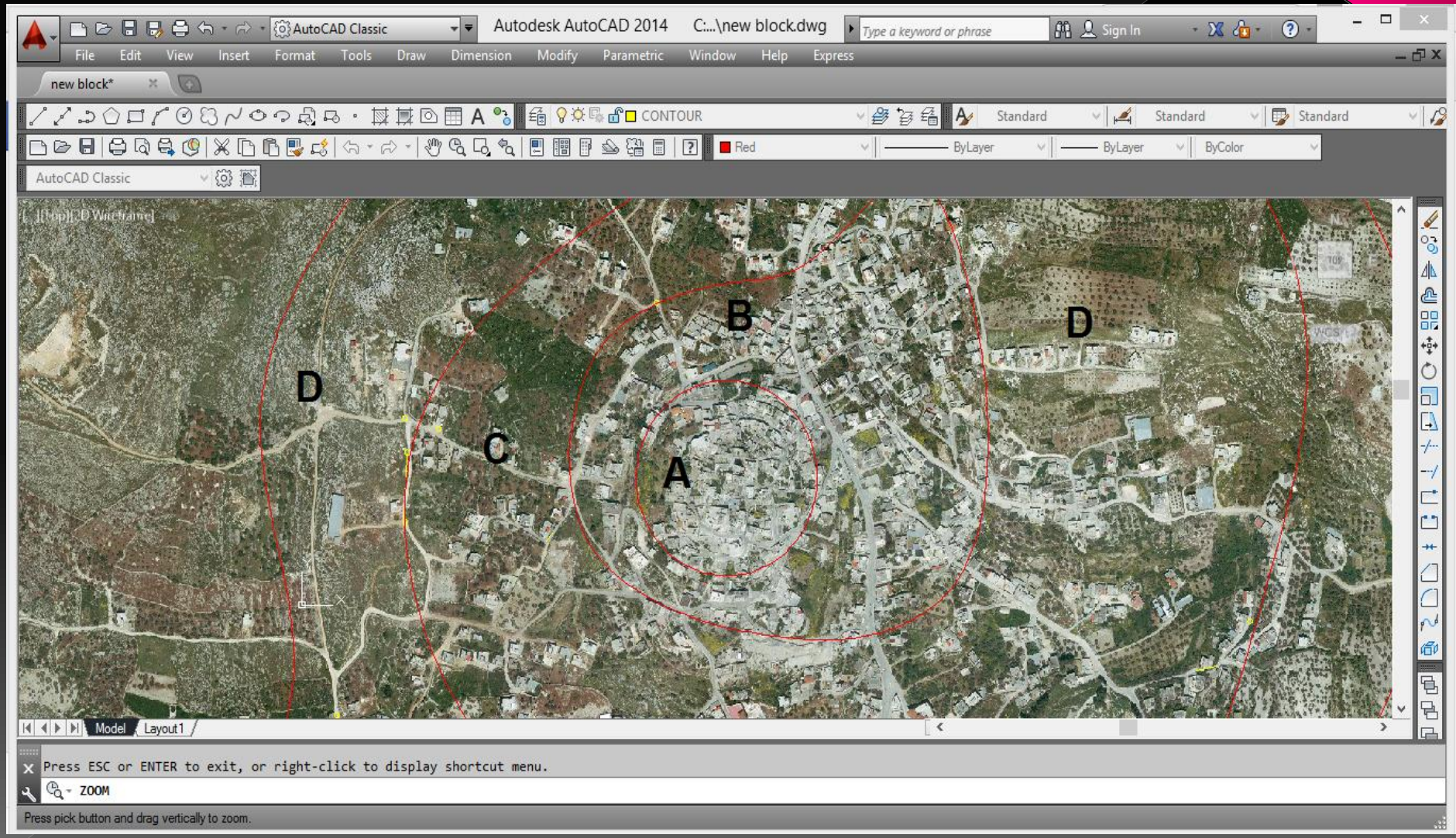
Future flow

Residential flow = 9046 cubic meter per day.

Infiltration = 452 cubic meter per day.

Design flow = 9498 cubic meter per day.

Sanitary load calculations



ZONE	Increment Future population	#Manholes	Capita per manhole
A	200	20	10
B	1000	58	17
C	3000	104	29
D	8150	194	42

SewerCAD Software

SewerCAD is a powerful design and analysis tool that allows you to layout a collection system, develop and compute sanitary loads, and simulate the hydraulic response of the entire system, including gravity collection piping and pressure force mains.

Model builder SewerCAD

We use model builder sewerCAD to import data such as, manhole sanitary load.

Design Constrains

- **Velocity**

Conduits are designed to provide minimum velocity equals to 0.6 m\s, and maximum velocity of flow is 3m/s.

- **Cover**

Cover depth range between minimum cover which is about 1 m and a maximum cover which is about 5 m.

- **Slope**

The design cover depth range from 1% up to 15% which is recommended for sewer system.

Criteria for Sewer System Design

- The network followed the natural slope of the ground surface.
- The pipes connected in sequence from smaller to larger.
- The depth of pipes must be suitable.
- The number of manholes must be sufficient and economic.
- Keep the minimum excavation.

Analyzing the System

The design for wastewater collection system is done by SewerCAD program, the outputs of the program are checked to make sure of some criteria such as slope, velocity and cover are met the standards.

Data input and Output for SewerCAD

Input Data

- Excel sheet file for manholes sanitary load.
- Network layout which contain conduit, manholes and outfall.

Output Data

- Conduit table: which contains a very important data to be able to design and to check the results with respect to design constrains.
- Profiles: which demonstrate the geometry of the manholes with the connection conduits.

Final layout

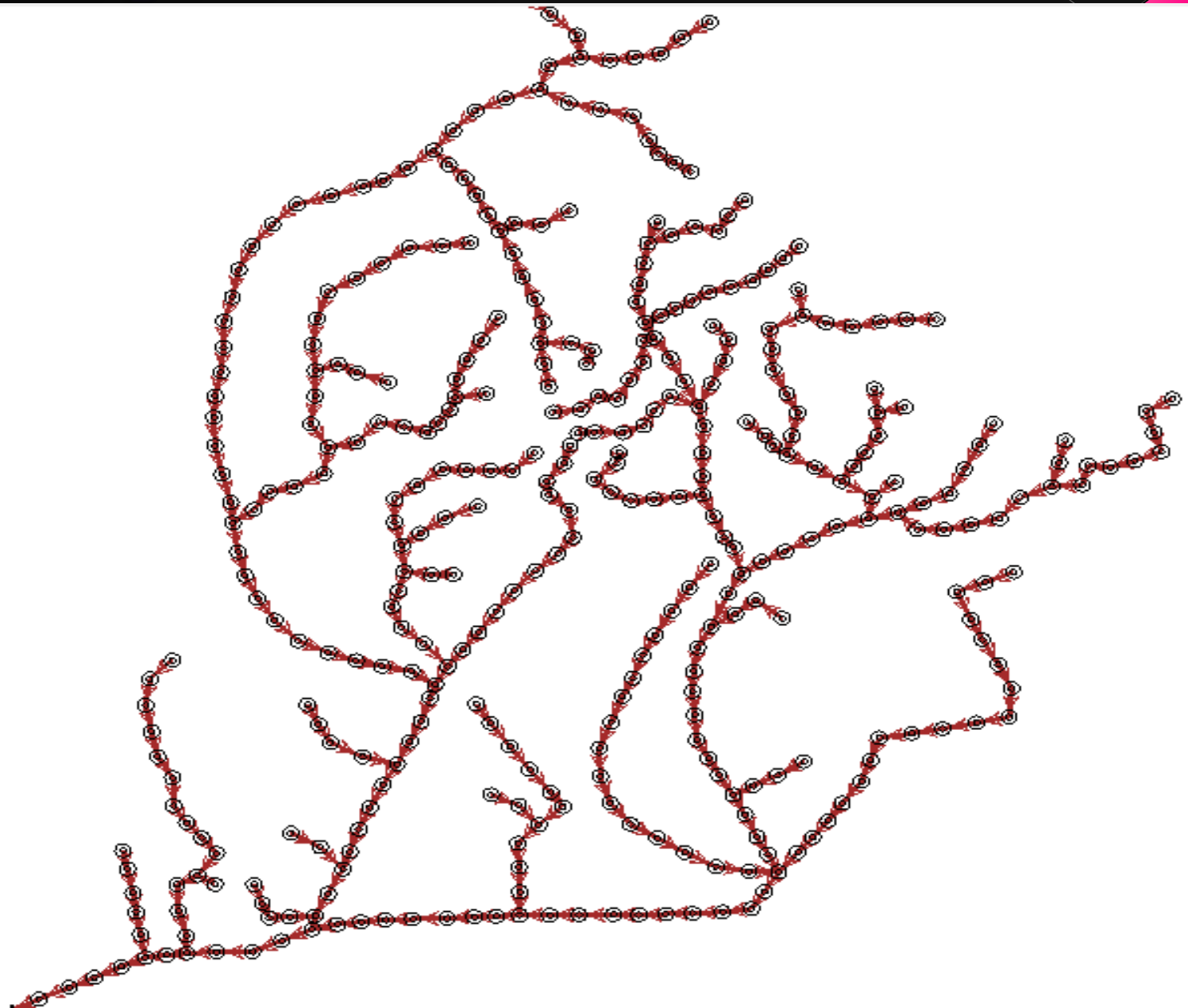


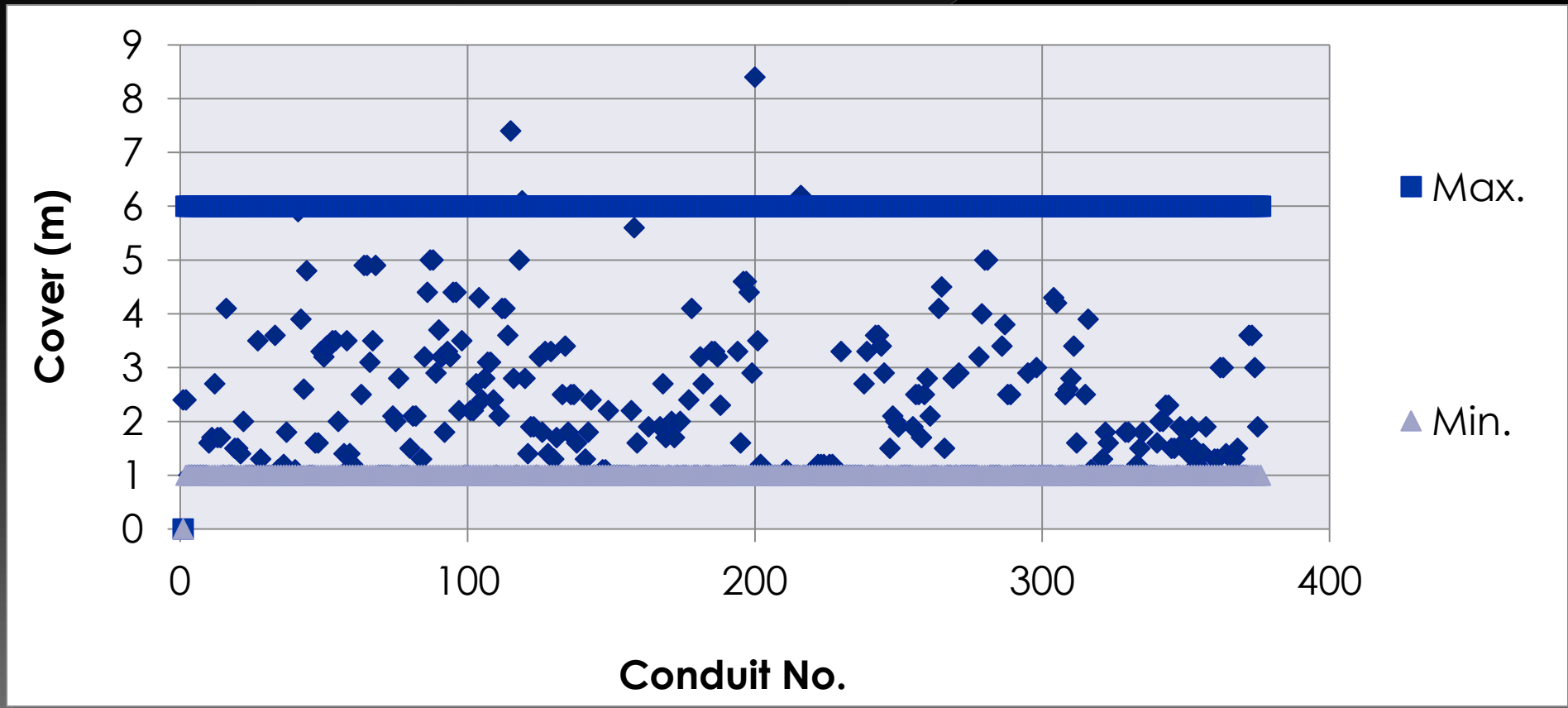
Table 4.1: Summarize results for the network

Results

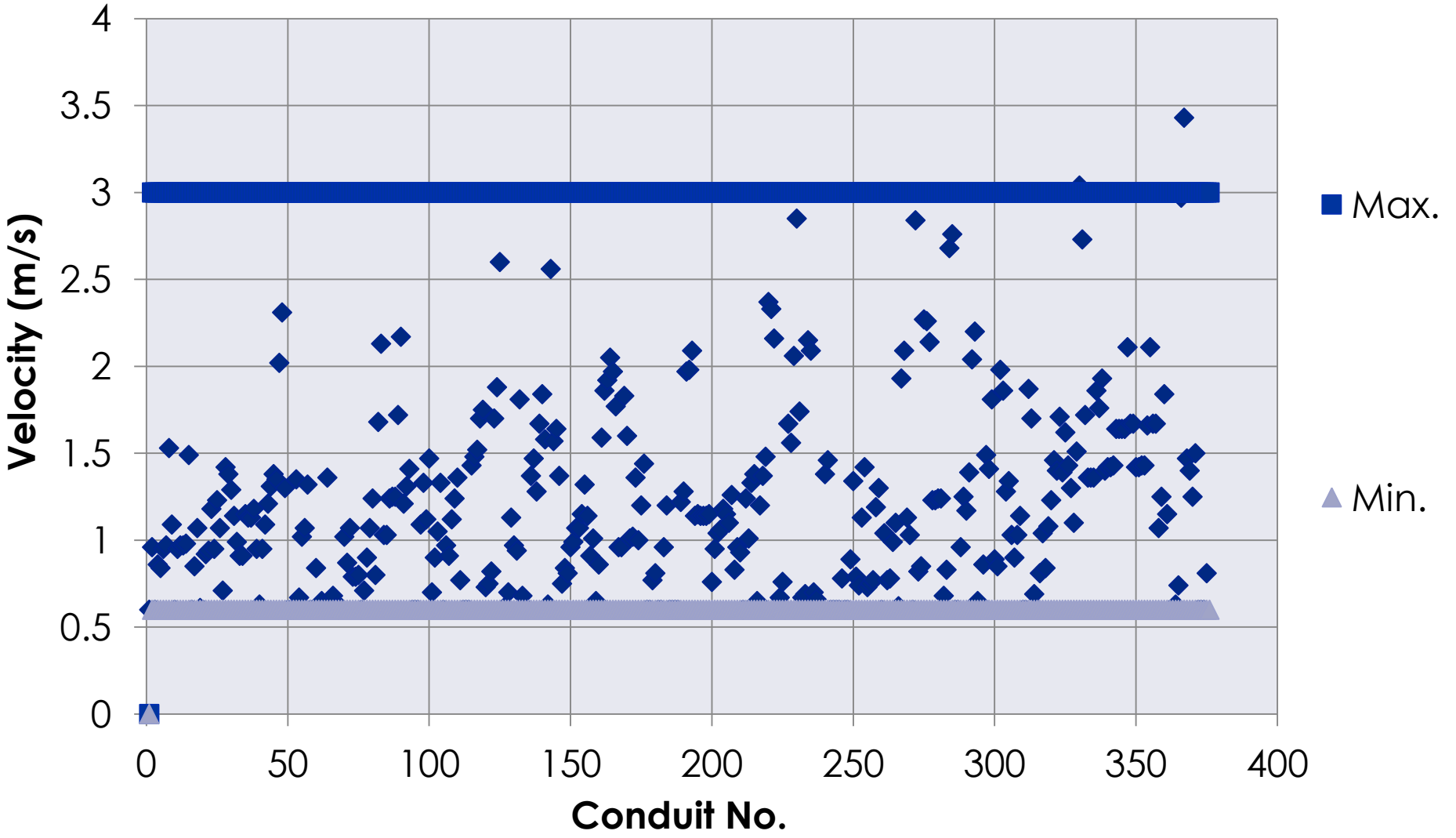
Number of manhole	377
number of conduit	376
Total Conduit length (m)	15,625
Number of 8 inches conduits	333
8 inches conduit length (m)	13815
Number of 12 inches conduits	32
12 inches conduit length (m)	1332
Number of 16 inches conduits	11
16 inches conduit length (m)	478
Maximum velocity (m/s)	3
Minimum velocity (m/s)	0.6
Maximum cover (m)	6
Minimum cover (m)	1

Cover depth

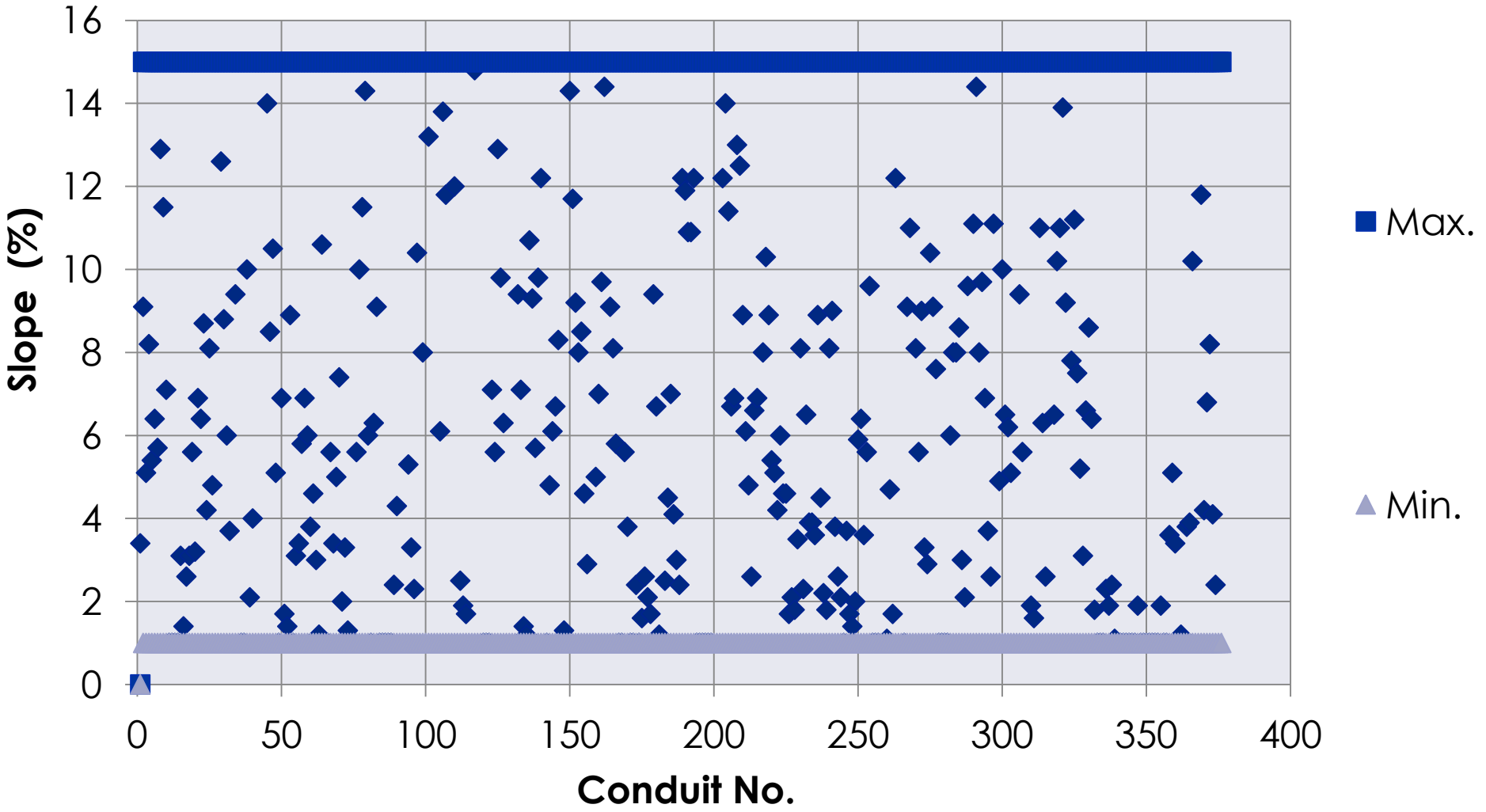
We represent cover depth for each conduit using scattered plots.



velocity


Velocity (m/s)
4
3.5
3
2.5
2
1.5
1
0.5
0
0
50
100
150
200
250
300
350
400
Conduit No.
Max.
Min.

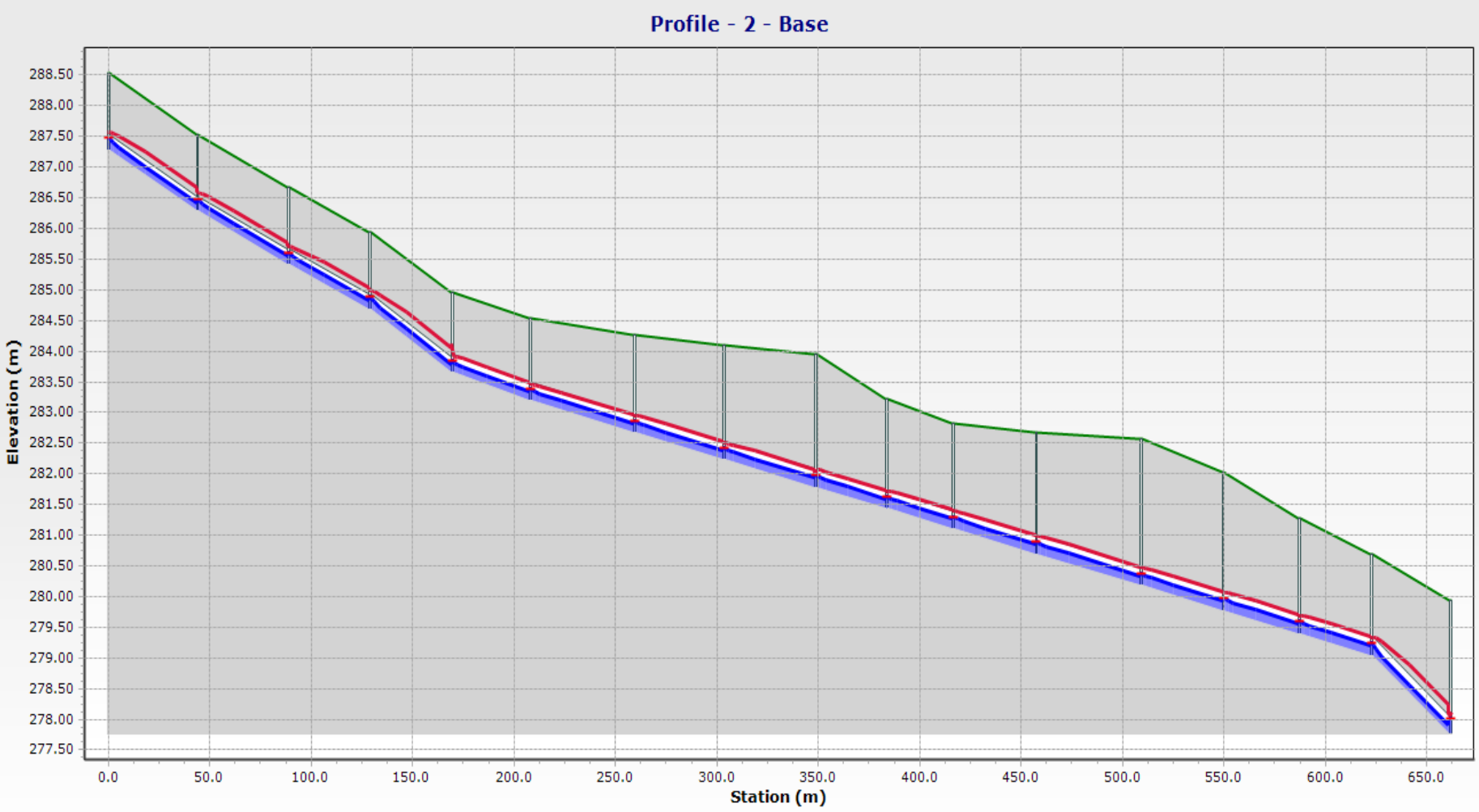
slope


16
14
12
10
8
6
4
2
0
Slope (%)
0
50
100
150
200
250
300
350
400
Conduit No.
Max.
Min.

Profile

Profile: Profile - 2

Time:



Recommendations

There is a need for wastewater collection system for Ajja village, so designing of wastewater collection system is important to overcome people problem, also it may design small wastewater treatment plant.

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THANK YOU