MPIRO AND LOSHO SPRING PROTECTION WASH PROJECTS

TOPOGRAPHICAL SURVEY DRAFT REPORT

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1. INTRODUCTION

1.1 Background

The maps available for the Study Area from Survey of Kenya are in 1:50,000 scale that were prepared in the 1970s. Although the some of the maps have been updated, the changes are limited and not appropriate for pipeline route design work especially for a gravity flow pipeline system.

The sub-consultant will be responsible for conducting a detailed topographical survey capable of design and setting out of a pipeline route for the water supply for Mpiro and Losho villages.

The product of the survey exercise will be a topographical map and pipeline route survey data which will be useful to the water engineers for the design of the water pipeline route. A pipeline route survey is carried out to collect data and information of the features and elevations along the main and minor pipeline routes. The data collected will be primary used for the design of the pipeline routes, pipe sizes, pipe types, fittings, gravity flows, air valve and gate valve points.

1.2 Main objectives

The main objectives of the study include;

- To carry out additional topographical survey to identify highest point within the area
- To plot the surveyed data and produce topographical maps that include the main profile.
- To identify the best route for location of the pipelines

1.3 Study phases

In order to successfully meet the objectives, the survey was divided into the following phases;

- Reconnaissance -Phase 1
- Survey Control establishment- Phase 2
- Topographical survey and Data collection- Phase 3
- Data processing, Plotting and Reporting-Phase 4

2. EQUIPMENT AND SOFTWARE

2.1 Equipment

The following equipment was used during the topographical survey

- Stonex S3II GNSS Receivers RTK equipment
- Garmin Handheld GPS
- 50m Tape Measure
- Metallic tripod and Assorted staff

2.2 Software

The following software was used during the topographical survey and data processing

- Field Genius software
- MapSource
- Microsoft Excel
- AutoCAD Civil 3D
- Global Mapper

3. SCOPE OF WORK

The survey has been conducted by local consultants with proficiency in water surveys. The scope of work specified in the Technical Specification part include;

1. Reconnaissance
2. Topographical survey of additional pipeline route for the 2 sites; Mpiro and Losho villages
3. Survey report to include survey control points, levels, profile and layouts

4. GROUND CONTROL SURVEY

4.1 Datum

The following datum was used for the survey

The datum parameters are;

Grid: UTM Zone 36 M (South)
Projection: Transverse Mercator
Ellipsoid: WGS84
Unit of Measurement: Meter
Central Meridian: 33 Degrees East of Greenwich
Latitude of Origin: Equator 0.0000
Scale Factor at origin: 0.9996
False Coordinate of Origin:
False Easting = 500,000 m
False Northing= 10,000,000 m
Datum: WGS84

4.2 Establishment of Survey Control Points

The established control points were used for extension of pipeline routes. The point had been successfully selected and installed on the ground away from canopy, electric lines, structures or obstacles. This is necessary to ensure the GPS satellites signals are not obstructed during the survey. The points are established and concreted using a metallic rod and mixed concrete. The point name is inscribed on the face of the benchmark.

4.3 Survey Control Points/Benchmarks

Site Benchmarks are as shown in the Table below. Benchmarks are given in UTM coordinates with a WGS84 datum Zone 36M.

Table 1: Site Benchmark Information

Benchmarks	Northing	Easting	Elevation	Description	Remarks
1	9821199.110	779360.281	1940.837	BML1	Losho Primary School - benchmark at the classroom
2	9825159.649	792647.755	2033.374	BMM1	Mpiro Primary School – benchmark next to classroom

5. GPS DATA COLLECTION

The data was collected using GNSS Equipment that utilizes satellites for navigation. During the survey Stonex S3 II RTK equipment was used with a horizontal accuracy of 0.015 m and vertical accuracy of 0.030m. The equipment utilizes a 2Watt UHF radio that has a range of 10km for a clear site.

The Mpiro site has an existing spring catchment that has been rehabilitated spring eye with a concrete retaining crest wall. The site had low canopy and sufficient water from various surface points. The current Mpiro primary school relies on gutters and fetching of water from the springs. The surveyed route was from the springs to a proposed water kiosk/tanks site.

The Losho site an existing spring catchment that has been rehabilitated with two spring eyes 30m apart. The spring eye 1 is an indication of the resilience of the community in trying to capture sufficient water via gravity to the school. The school has an ever-flowing tap that is connected to spring eye 1. The spring eye 2 takes water to the Losho dispensary. The Losho site had existing canopy within the spring eyes that should not be disturbed.

The survey of the pipeline route was done on 11th to 16th November 2024.

5.1 Mpiro Spring Protection

Mpiro water supply project is a proposed water supply system that will supply water to Mpiro primary school and a water kiosk for the community. The water supply intends to get water from a single springs eye which had been previously rehabilitated. The proposal is for the water to flow to a sump, from the sump due to the levels at the spring location the water will be pumped to elevated tanks at the location of water kiosk. Once at the kiosk the water will be distributed to the primary school to serve the handwash station and the VIP toilets.

A comprehensive hydrological survey of the springs has to be undertaken to determine the yield. The spring flows will need to be measured during the dry season.

The sub-consultant was responsible for conducting a detailed topographical survey of the spring eyes. The data collected will be used for design of spring protection works and setting out of pipeline route to the school and water kiosks.

5.1.1 Spring eye

The spring eye is located in geographic coordinate 1° 34' 35.3" S and 35° 37' 59.3" E. The elevation at spring 1 is 2035.9 m ASL. It's located beyond an existing flowing river on the southern side of Mpiro Primary School. It has been a source of water for the school during all seasons. The spring can be classified as an underground type of spring due the its natural water source. The water for the rehabilitated springs comes from underground and flows towards a swampy area that supports the flora and fauna within the area. The depth at the spring eye is approx. 1m, it's a permanent spring. It's waters flow via gravity parallel to the river.

The major design components that should be considered for the spring are

- The spring area rehabilitation of the existing weir
- Outlet through pipes to the pipeline route
- Construction of an infiltration gallery and silt trap
- Construction of a collection sump and a pump house

The spring eye requires adequate protection to prevent from human and animal pollution. Considering the nature of the spring the following design procedures are recommended;

i. Clearing the area with reeds after the spring
ii. A collection chamber made of masonry stones to be used as first collection point
iii. Training wall for the underground spring channel to avoid mixing with stream flood waters.
iv.

5.2 Mpiro Pipeline Route

Mpiro primary school is located on geographic coordinate 1° 34' 49.0" S 35° 37' 59.3" E. The school has insufficient water sources heavily relying on fetching water using jerry cans from the existing springs and river. The school is located at an elevation of 2033 m ASL which is approx. 2 metres below the proposed sump.

5.2.1 Rising Main: Spring eye sump to Tanks

The sump is the proposed collection point for all the waters from the springs. The water will be pumped to the tank location site at the school before distribution further to the VIP latrines and adjacent villages. The distribution network is dependent on the yield.

The distance between the rehabilitated spring eye to the infiltration chamber to the proposed sump location is approx. 30 metres. The elevation at the spring eye invert and that at the proposed sump location is approx. 0.8m below that of the spring eye at 2035.1m ASL.

The pipeline route starts at the proposed sump location and runs for a distance of 580m to the proposed elevated tanks. The proposed sump is located on geographic coordinates 1° 34' 36.5" S and 35° 37' 59.3" E. The pipeline route flows along the proposed route which is an existing pathway to the river embankment at KM0+300 which will require construction of anchor blocks. The elevation at the river crossing is the lowest with the invert at 2028.8m ASL.

The elevation at the proposed tank site which is also the location of the community water kiosk is 2034.9m ASL. The elevations at the sump and at the proposed tank site are the similar, this makes it impossible for sufficient water flow via gravity. This requires a storage tank at the sump location from where water can be pumped to the proposed tank/water kiosk site.

The line can also be plotted as a graph as shown in the figure.

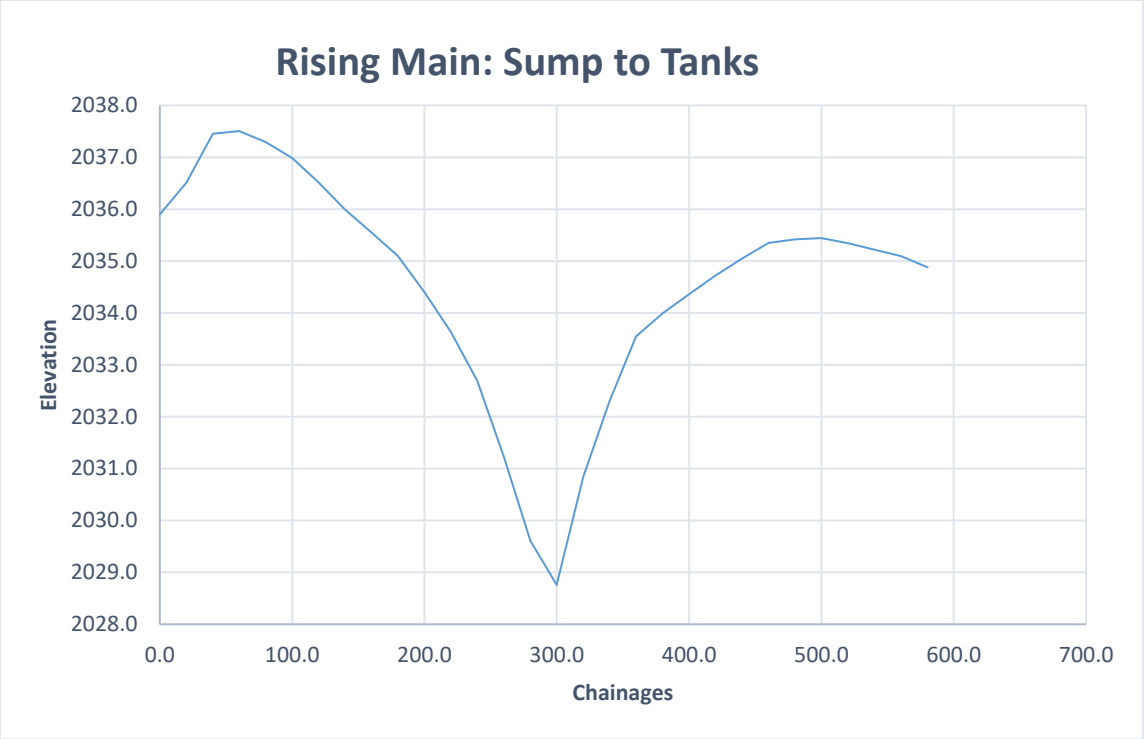

Figure 1: Spring eyes sump to tanks/water kiosk

5.2.2 Tanks to VIP Latrines

The pipeline route from the proposed tank location to the VIP Boys & Girls is approx. 134.8 metres in length and is within Mpiro Primary school compound. The elevation at the VIP Boys and Girls toilets is proposed sump is 2033.5 m ASL while the elevation at the kiosk is 2034.9 m ASL. The vertical difference between the proposed tank site and proposed VIP latrines is 1.4 metres.

Additional lines that provide water to the VIP teachers and handwash should be provided. The distances to the VIP Teachers and handwash from the VIP Girls are quite small with the line to teachers VIP latrines being 115 metres at 2033.8m ASL, the handwash being 53 metres from the VIP Teachers at 2033.1m ASL.

The graphical representation of the line is as below

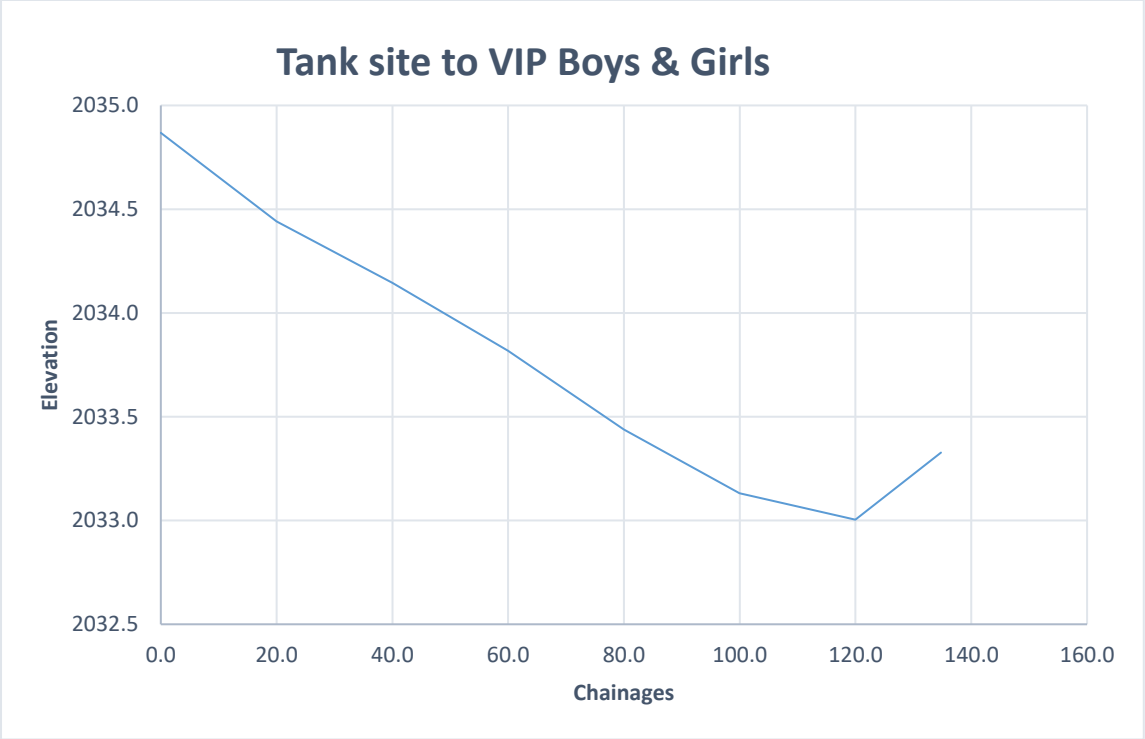

Figure 2: Tanks to VIP Boys & Girls

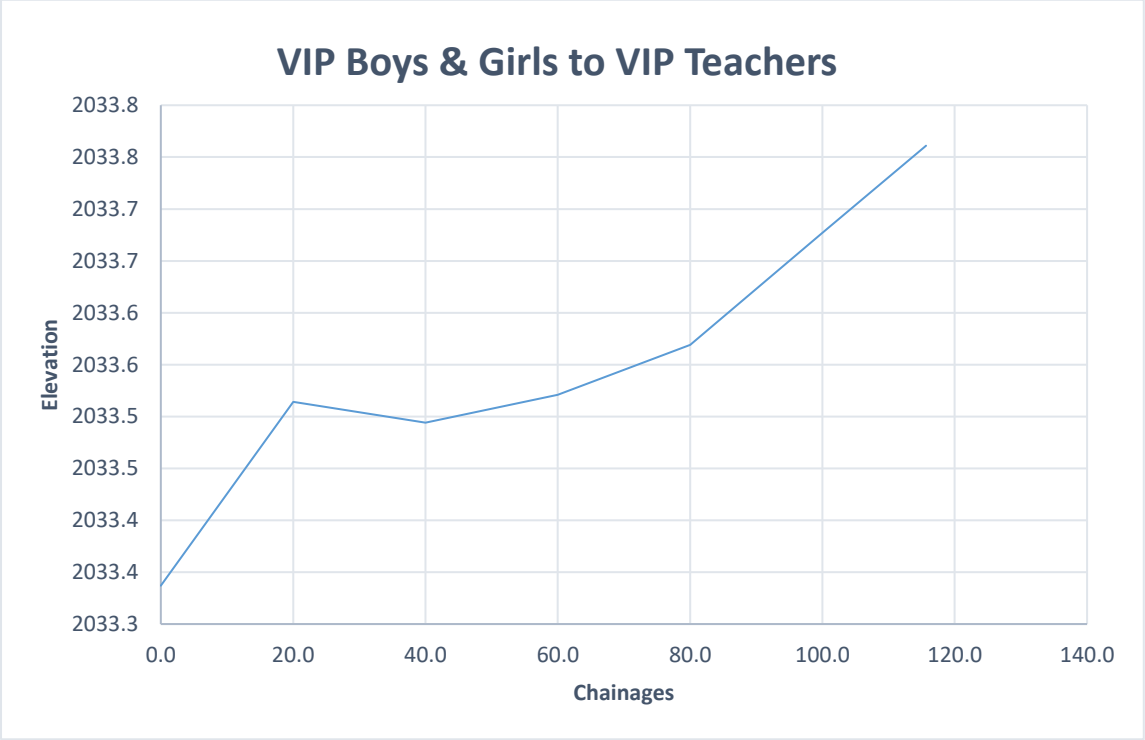

Figure 3: VIP Boys & Girls to VIP Teachers

5.2.3 Gate Junction to Water Kiosk 3

The pipeline route from the Gate Junction follows the path along the fence line, the underground tank and the tank towers. The 0.9m gate junction provides for the separation of the waters that go to the water tower and the ones that go to water kiosk 3. The total distance from the gate junction to water kiosk 3 is 660 metres with an elevation increase of 5.0 metres. However, with the elevated water tower 6 metres above the ground elevation of

2035 metres, the water can flow via gravity to water kiosk 3. The distance from the water tower to water kiosk 3 is approx. 760 metres. The pipeline crosses a stream at KM0+220 where the pipe will need to be GI with anchor blocks. The graphical representation of the line is as shown below.

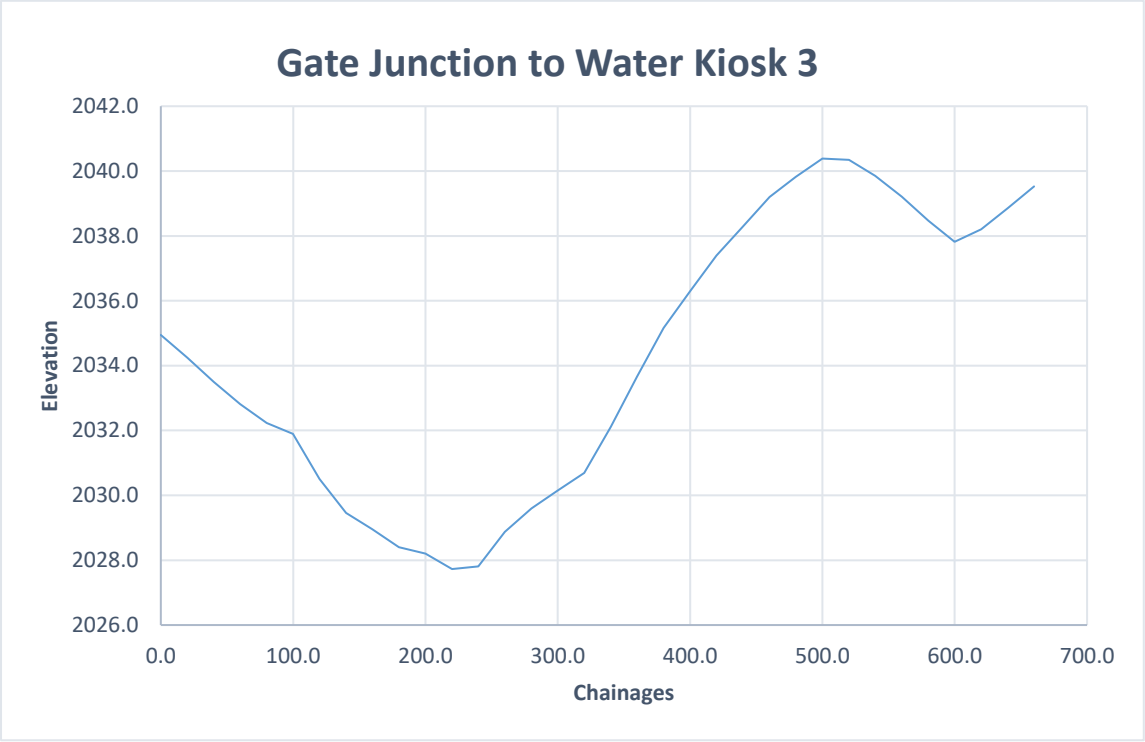

Figure 4: Gate Junction to Water Kiosk 3

5.2.4 Water Kiosk 1 to Juakali Water Kiosk

The pipeline route from water kiosk 1 to the proposed juakali water kiosk is approx. 1219 metres. The pipeline route has already been excavated and it starts at water kiosk 1 within the school compound towards the main road, it crosses the road at KM0+280 towards the road to Juakali. Its dug along the fenceline and has a 1.4% slope up to the Juakali water kiosk. The elevation difference between WK1 and Juakali WK is a decline of approx. 17 metres. The elevation difference is sufficient for water to flow via gravity. The line can be represented as below

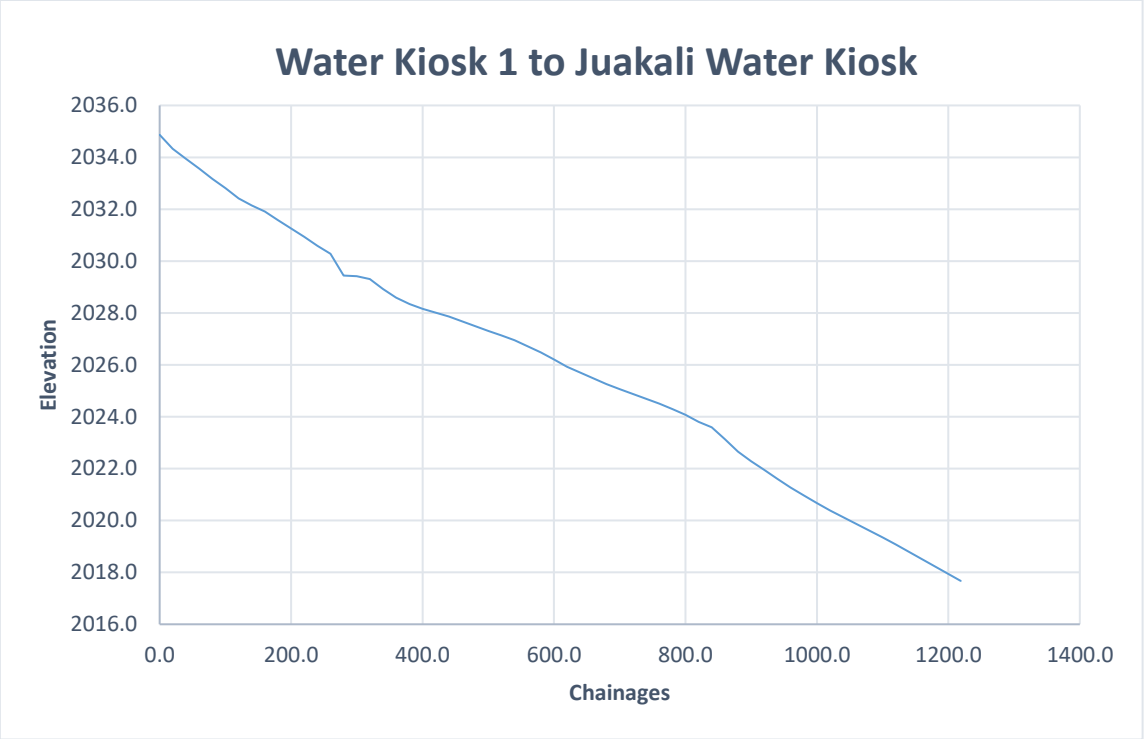

Figure 5: Water Kiosk 1 to Juakali Water Kiosk

5.2.5 Juakali Water Kiosk to Water Kiosk 4

The total length of the pipeline route from the proposed Juakali Water Kiosk to the proposed Water Kiosk 4 is approx. 2120 metres. The pipeline route crosses a lagga at KM0+440, the area with require use of anchor blocks and GI pipes for the section. The vertical difference between the Juakali WK and WK4 is approx. 3 metres. The route is undulating with two low sections within the route at KM0+440 whose elevation is 2008m and KM1+360 whose elevation is 2014.8 m. The total vertical difference from WK1 is approx. 20 metres. The line can be represented from Juakali WK as shown below

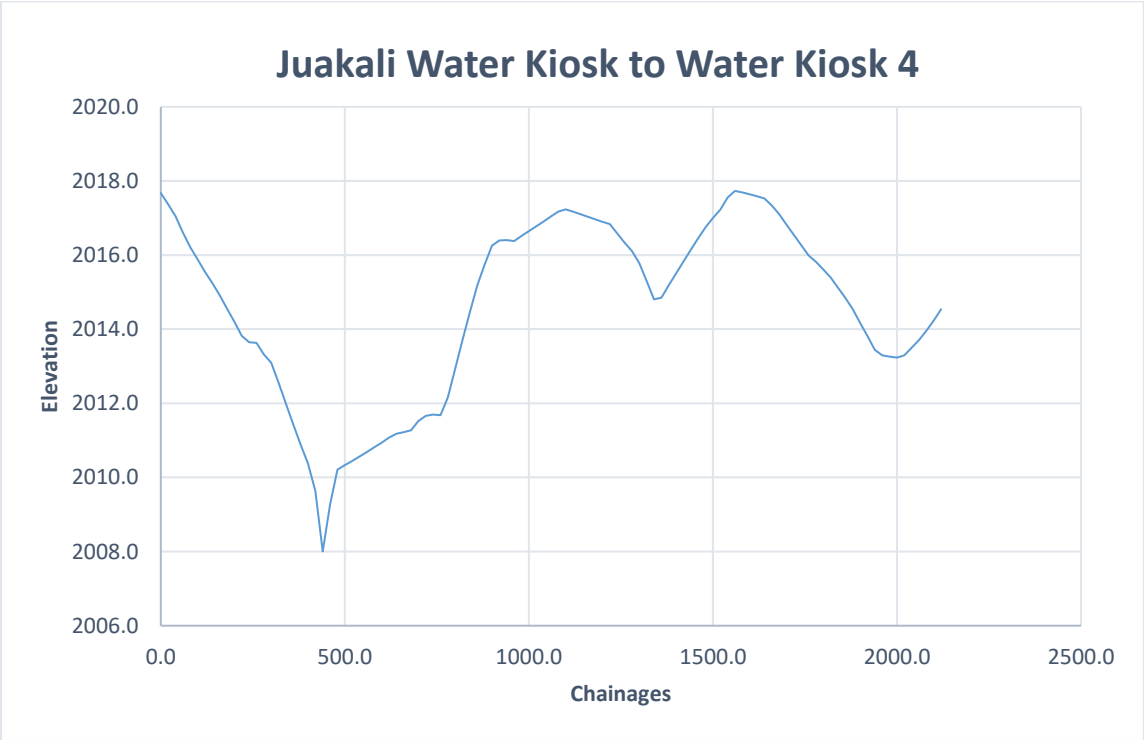

Figure 6: Juakali Water Kiosk to Water Kiosk 4

5.2.6 Water Kiosk 1 to Water Kiosk 5

The line starts at the already constructed water kiosk 1 towards the road onto the proposed water kiosk 5. The total distance from WK1 to WK5 is approx. 1357 metres. The line has been excavated and crosses the road at KM0+040-KM0+065. The elevation difference between Water Kiosk 1 and Water Kiosk 5 is approx. 8 metres increase. An additional raised tank along the route would assist for water to flow via gravity. The existing tank tower can get the water to KM0+700, however it would be difficult beyond that distance for water to sufficiently flow via gravity. The line is represented as shown below

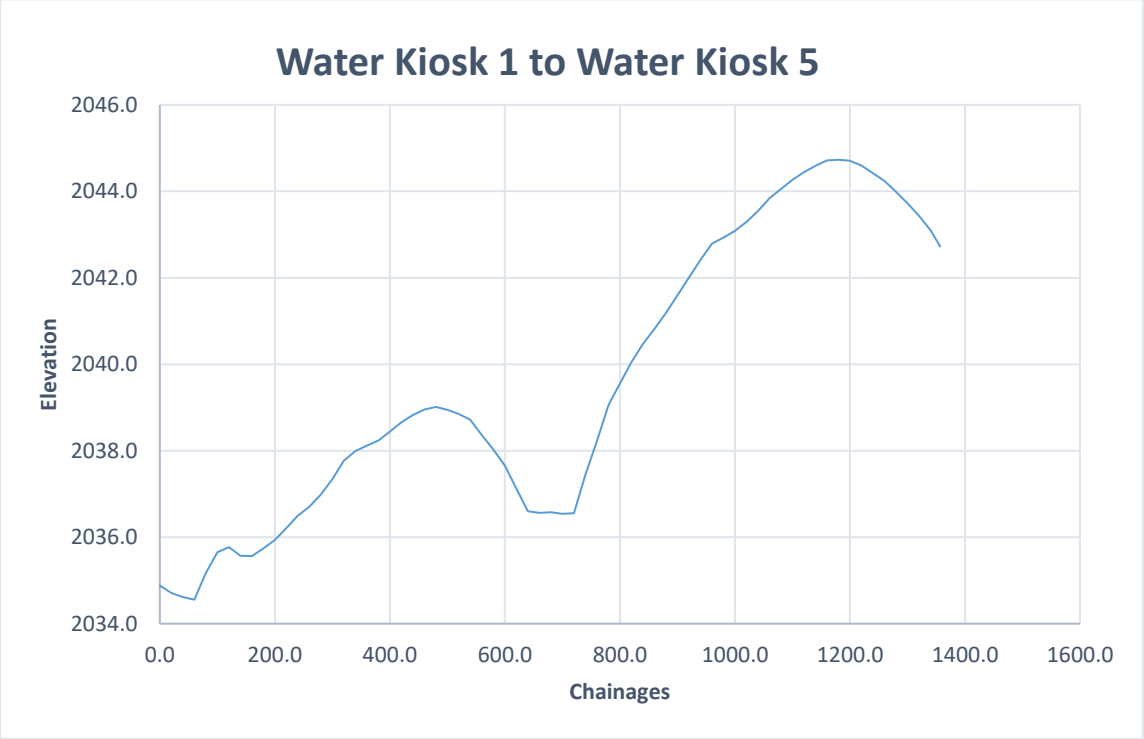

Figure 7: Water Kiosk 1 to Water Kiosk 5

5.2.7 T-Junction 1 to Water Kiosk 6

The line branches off KM0+480 of the line from water kiosk 1 to water Kiosk 5 where there is need for a T-junction. The pipeline route is approx.. 2466 metres, and is a steep incline of 2.54%. The elevation difference between the junction and the proposed water kiosk 6 is an increase of 63 metres. The water on this route would need to be pumped for it to get to WK6. The pipeline route follows the existing road. For water to flow via gravity a raised tank along the route to where water can be pumped to would aid. From the raised tank, the water can flow to water kiosk 5. The line can be represented as shown below

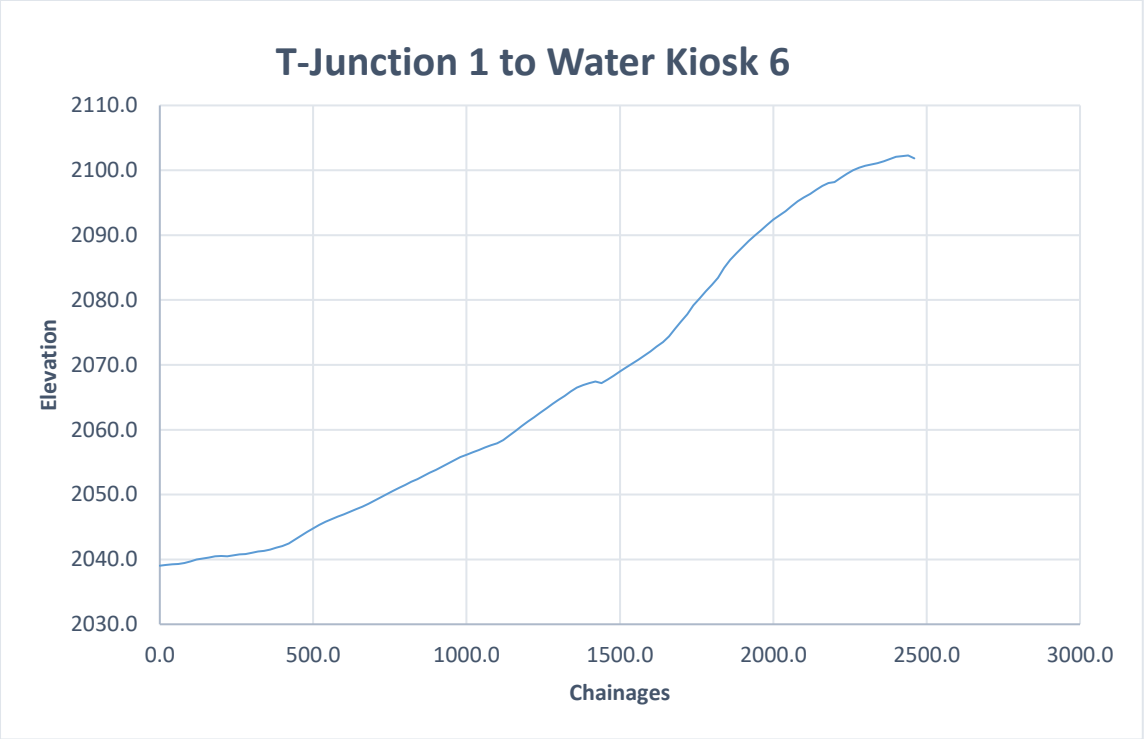

Figure 8: T-junction 1 to water kiosk 6

5.3 Losho Spring Protection

Losho water supply project is a proposed water supply system that will supply water to Losho primary school, Losho dispensary and to proposed three water kiosks for the community. The water supply intends to get water from a two springs eye which had been previously rehabilitated. The location of the spring eyes is advantageous as it is uphill of the location of the school, dispensary and the centre. The proposal is for water to flow into and infiltration chamber/silt trap and then piped to flow via gravity to the desired locations.

A comprehensive hydrological survey of the springs has to be undertaken to determine the yield. The spring flows will need to be measured during the dry season.

The sub-consultant was responsible for conducting a detailed topographical survey of the spring eyes. The data collected will be used for design of spring protection works and setting out of pipeline route to the school and water kiosks.

5.3.1 Spring eye 1

Spring eye 1 is located in geographic coordinate 1° 36' 55.6" S and 35° 30' 47.0" E. The elevation at spring 1 is 1947.9 m ASL. It's located towards an existing heavy canopy hilly area towards the northern side of Losho Primary School. The spring has been a source of water for the school during all seasons with an existing tap within the school that can be labelled as the ever-flowing tap. The spring can be classified as an underground type of spring due the its natural water source. The water for the rehabilitated springs comes from underground and flows towards a swampy area that supports the flora and fauna within the area. The depth at the spring eye is approx. 1m, it's a permanent spring. It's waters flow via gravity to the school.

The major design components that should be considered for the spring are

- The spring area rehabilitation of the existing weir and spring box
- Outlet through pipes to the pipeline route

- Construction of an infiltration gallery and silt trap that is self-cleaning

The spring eye requires adequate protection to prevent from human and animal pollution. Considering the nature of the spring the following design procedures are recommended;

i. Clearing the area with reeds after the spring
ii. A silt trap/infiltration gallery made of masonry stones to be used as first collection point
iii. Training wall for the underground spring channel to avoid blockage problems

Plate 1: Spring eye 1

5.3.2 Spring eye 2

Spring eye 2 is located in geographic coordinate 1° 36' 54.0" S and 35° 30' 48.4" E. The elevation at spring 1 is 1947.4 m ASL. It's located towards an existing heavy canopy hilly area towards the northern side of Losho dispensary and its approx. 66m N-E of Spring eye 1. The spring has been a source of water for the dispensary during all seasons and feeds its water to an existing concrete tank. The spring can be classified as an underground type of spring due the its natural water source. The water for the rehabilitated springs comes from underground and flows towards a swampy area that supports the flora and fauna within the area. The depth at the spring eye is approx. 1m, it's a permanent spring. It's waters flow via gravity to the dispensary. An attempt was made to pipe the water towards the centre but due to the inadequate protection works at the spring eye, the pipes experienced blockage and are no longer in use

The major design components that should be considered for the spring are

- The spring area rehabilitation of the existing spring box
- Outlet through pipes to the pipeline route
- Construction of an infiltration gallery and silt trap that is self-cleaning

The spring eye requires adequate protection to prevent from human and animal pollution. Considering the nature of the spring the following design procedures are recommended;

iv. Clearing the area with reeds after the spring
v. A silt trap/infiltration gallery made of masonry stones to be used as first collection point
vi. Training wall for the underground spring channel to avoid blockage problems

5.4 Losho Pipeline Route

Losho primary school is located on geographic coordinate 1° 36' 59.8" S and 35° 30' 38.4" E. The school has an existing water source with a piped water from Spring eye 1 towards a tap within the school compound. The tap offers water throughout all the seasons. The school adopts to the gentle slopes of the area with the elevation ranging from 1947.9m ASL at the Teachers quarter and 1931.5 at the fence corner beyond VIP Girls toilets.

The spring eyes will feed its water to a silt trap and an infiltration gallery. From spring eye 1 to the silt trap is approx. 38.5m while from spring eye 2 the horizontal distance is 42.9m.

5.4.1 Silt trap to Losho dispensary

Losho dispensary is located on geographic coordinate 1° 36' 49.0" S and 35° 30' 48.0" E and at an elevation of 1939.4m ASL. The dispensary has water available from spring eye 2 that goes to the concrete tank. The proposal is to change the route to have the water flow first to the silt trap and reroute it back to the dispensary.

The horizontal distance from the silt trap to the dispensary is 194.1 metres while the vertical difference is 5.5m. The water can flow via gravity to the dispensary.

Additionally, there is a proposal to put up **water kiosk** within the dispensary compound around the gate area, the location is approx. 160 metres from the dispensary.

The graphical representation of the line is as below

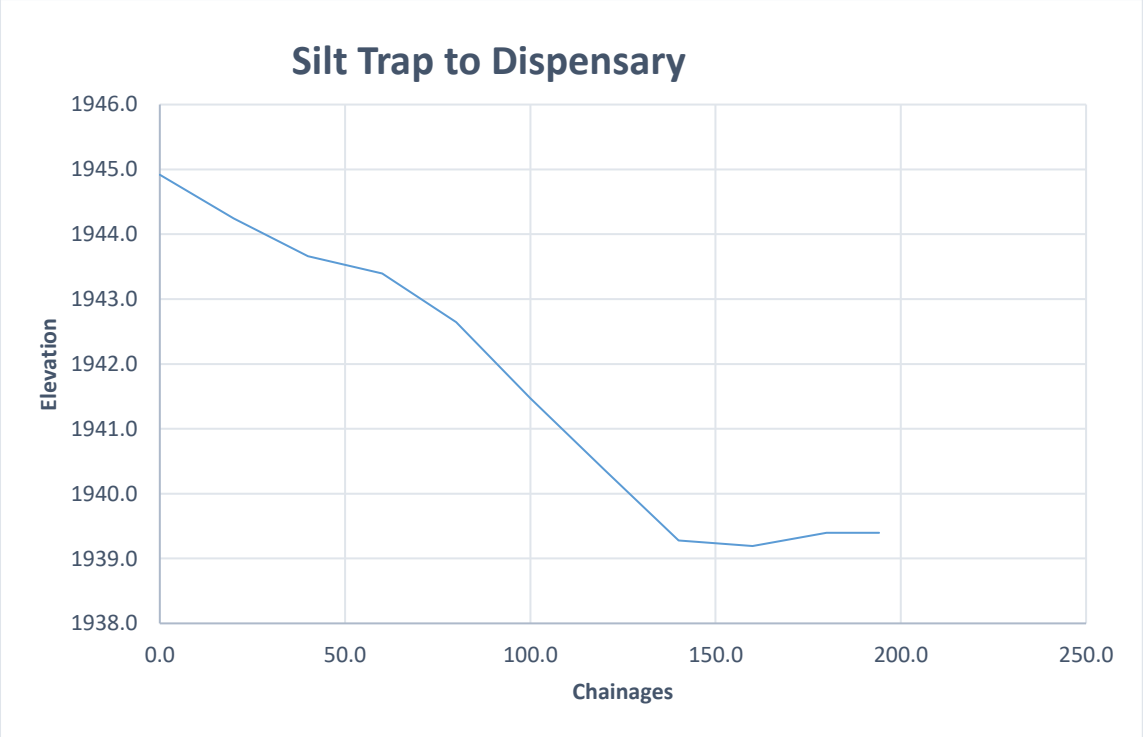

Figure 9: Silt trap to Dispensary

5.4.2 Dispensary to Losho Centre Water Kiosk 2

The pipeline route to Losho centre is the longest at 1753 metres. It follows the existing road as indicated on the mutation maps up to Losho Centre where the community representatives selected a water kiosk location.

The geographic coordinate of Losho Centre water kiosk 3 is 1° 36' 02.3" S and 35° 30' 39.9" E at an elevation of 1901.3m ASL. The water will flow from the junction at the dispensary towards the dispensary gate then onto the available road reserve. There is evidence of an existing pipeline within the route that can be a guide to the new line. The vertical difference between the dispensary and the water kiosk is approx. 38metres providing sufficient head for water to flow via gravity.

The graphical representation of the line is as below

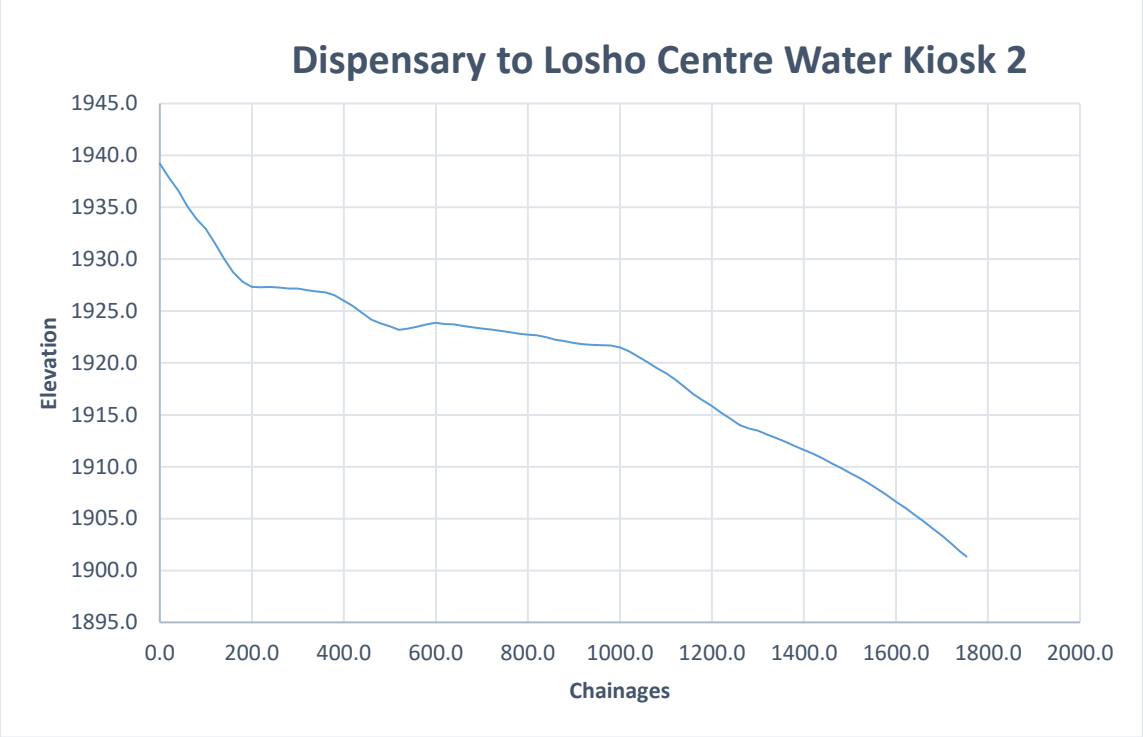

Figure 10: Dispensary to Water Kiosk 3

5.4.3 Silt trap to Water Kiosk 1

The pipeline route from the silt trap to water kiosk 1 traverses through the school compound as the kiosk is located just outside the school in an area selected by the community due to its accessibility. The geographic coordinate of water kiosk 1 is 1° 36' 59.3" S and 35° 30' 34.4" E.

The horizontal distance from the silt trap to the water kiosk is 435.0 metres while the vertical difference is 9.9 metres. The vertical difference is sufficient for water to flow via gravity. Along the route there are two junctions to divert water to the VIP toilets. On KM0+380 there is a diversion to VIP Boys which is 22 metres from the main pipeline route.

The graphical representation of the line is as below

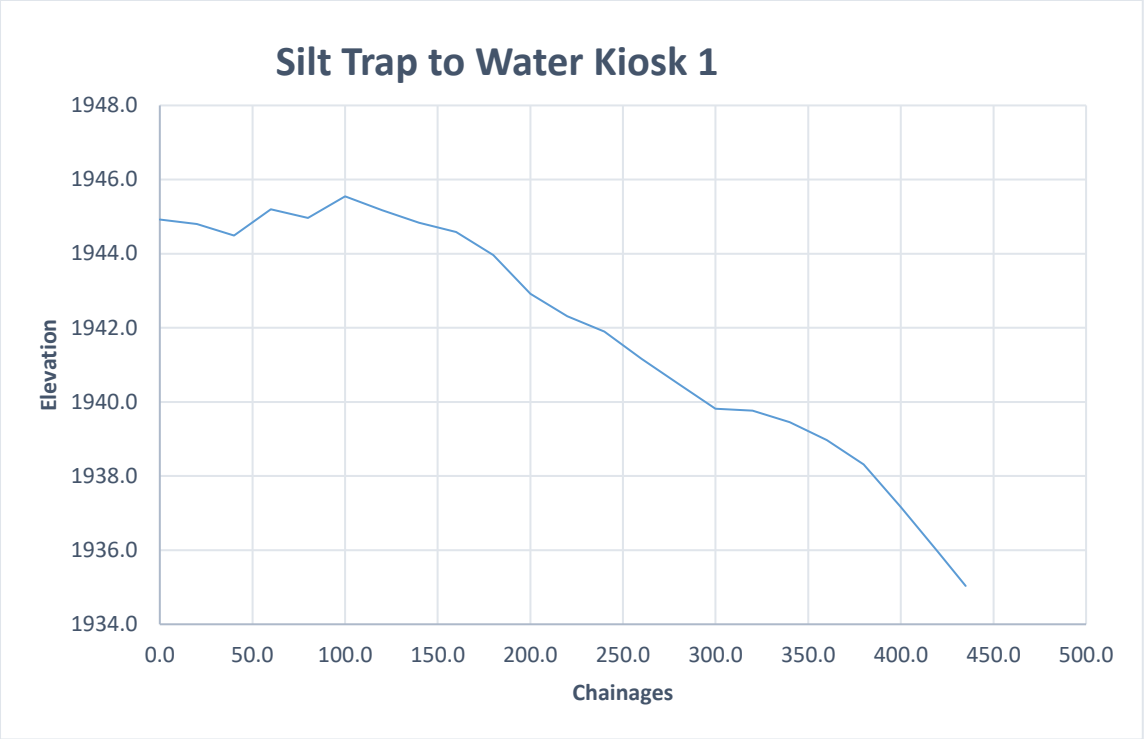

Figure 11: Silt trap to water kiosk 1

5.4.4 T-junction 1 to VIP Girls

The pipeline route from the silt trap to water kiosk 1 traverses through the school compound and at KM0+220 the line diverts towards the VIP Girls toilets. The horizontal distance from the T-junction 1 is 119 metres while the vertical difference is 8.2 metres providing sufficient head for water to flow via gravity. The geographic coordinate of VIP Girls Toilets is 1° 36' 53.7" S and 35° 30' 39.4" E while the elevation is 1934.2m ASL.

The graphical representation of the line is as below

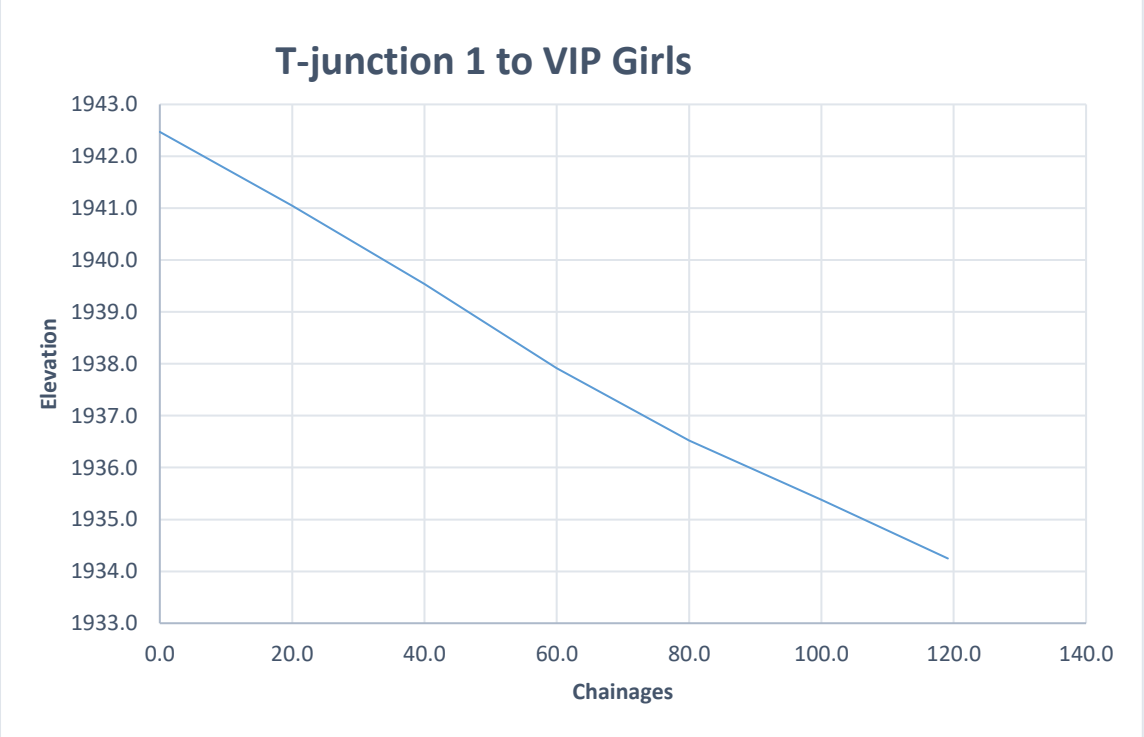

Figure 12: T-junction 1 to VIP girls

5.4.5 T-junction 2 to VIP Teachers

On KM0+040 on the pipeline route from T-junction 1 to VIP girls there is T-junction 2 which diverts towards proposed VIP teachers' toilets. The horizontal distance from the T-junction 2 is 88 metres while the vertical difference is 4.2 metres providing sufficient head for water to flow via gravity. The geographic coordinate of VIP Teachers Toilets is 1° 36' 56.4" S and 35° 30' 37.2" E while the elevation is 1935.8m ASL.

The graphical representation of the line is as below

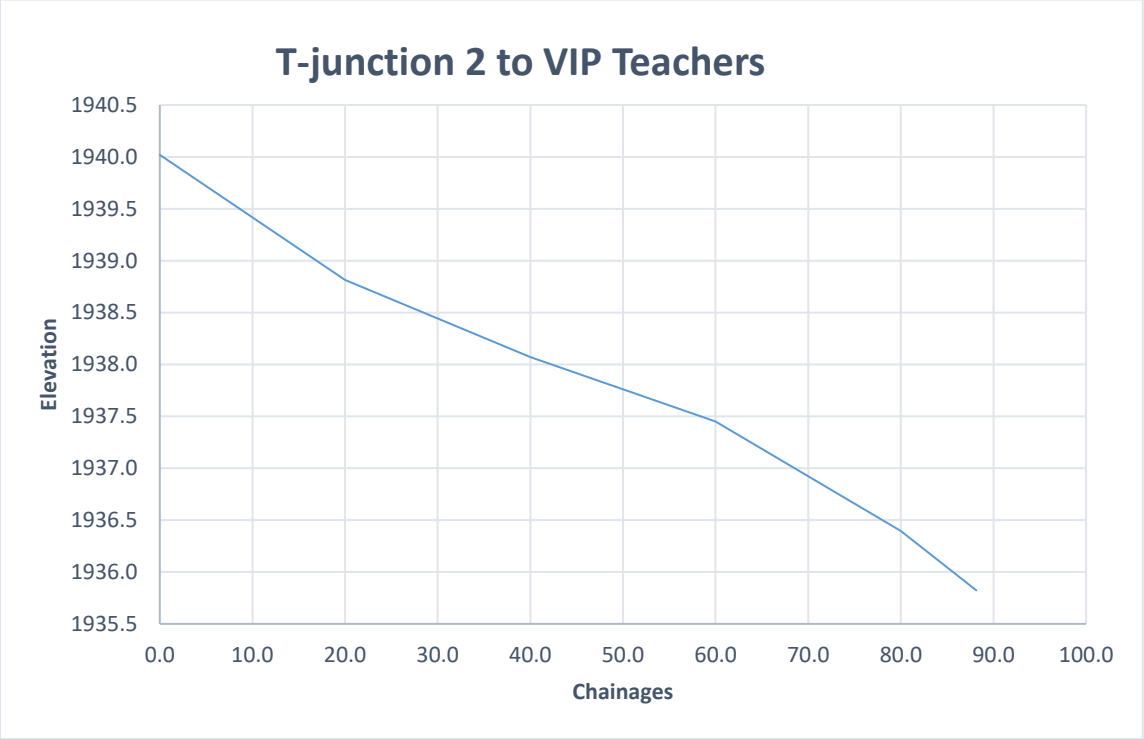

Figure 13: T-junction 2 to VIP teachers

5.4.6 Water Kiosk 1 to Water Kiosk 3

The line starts at the already constructed water kiosk 1 towards the proposed water kiosk 3. The total length of the line is approx. 980 metres. The elevation difference between WK1 and WK3 is an incline of approx. 4 metres. If the water tank is placed at the proposed location of the silt trap whose elevation is 1945 mASL the water can flow for a longer route of approx. 1415 metres to water kiosk 3 whose elevation is 1939. 4 metres. The water cannot flow via gravity from water kiosk 1 to water kiosk 3 however there are alternative routes that can be used to get water to WK3. The line can be represented as below

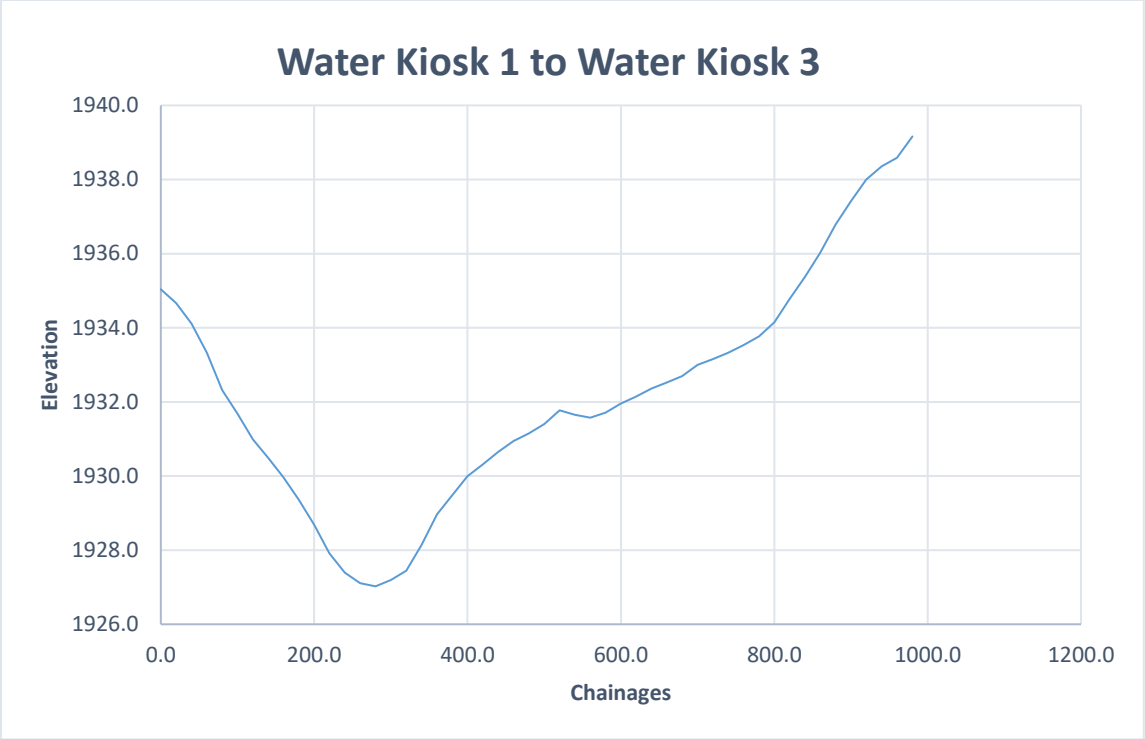

Figure 14: Water Kiosk 1 to Water Kiosk 3

5.4.7 Water Kiosk 3 to Water Kiosk 4

The line is a continuation of the proposed water kiosk 1 to water kiosk 3 line. The total length of the pipeline route is approx. 1474 metres with an elevation decline of approx. 31 metres. The elevation difference is sufficient for water to flow via gravity. The elevation at the proposed location Water Kiosk 4 is 1908.5 metres. The graphical representation of the line is as shown below

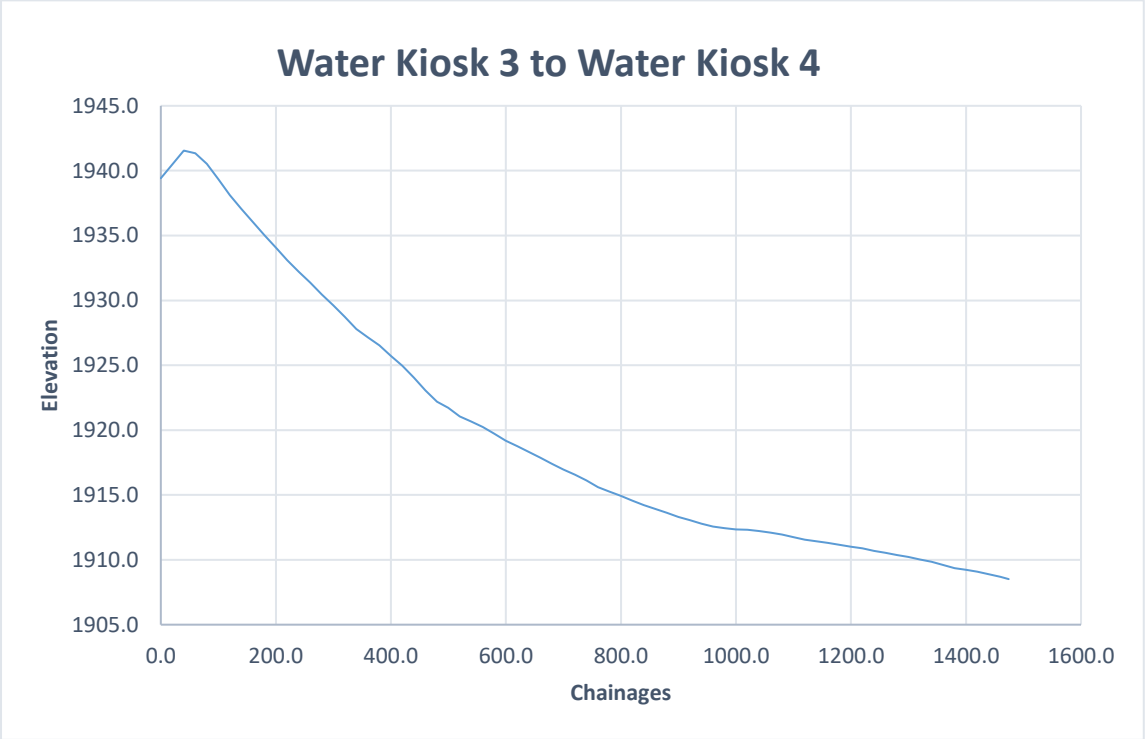

Figure 15: Water Kiosk 3 to Water Kiosk 4

6. AUTOCAD SITE LAYOUT

From source to site on Google Earth View

Figure 16 : AutoCAD maps

7. DIGITAL ATTACHMENTS

The following files are available with regards to this report

- Mpiro and Losho Springs Survey Report NOV.docx — This report;
- Mpiro and Losho Springs Survey Survey Report NOV.pdf — This report;
- Mpiro Layout 2 — AutoCAD dwg
- Losho Layout 2 — AutoCAD dwg
- Mpiro Survey data + Graphs 2 — Excel
- Losho Survey data + Graphs 2 — Excel