

ENEMASI AND ILMOCHIN WASH PROJECTS

TOPOGRAPHICAL SURVEY DRAFT REPORT



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1. INTRODUCTION

The maps available for the Study Area from Survey of Kenya are in 1:50,000 scale that were prepared in the 1970s. Although 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. A pipeline route survey was carried out to collect data and information of the features and elevations along the main and minor pipeline routes. The data collected will be primarily used for the design of the pipeline routes, pipes, fittings, gravity flows, air valve and gate valve points.

The data was collected using GNSS Equipment that utilizes satellites for navigation. During the survey Stonex II RTK equipment was used with a horizontal and vertical accuracy of 0.030m. The sites were clear with little canopy which allowed work to be done along the 2.5km radius to the water kiosk accurately.

The tables attached below contain the survey data collected from the field and indicate the changes in elevations throughout the entire network. In addition, graphs that indicate the pipeline system and slope are provided.

2. 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. Topographical survey of 2 sites; Enemasi and Ilmochin primary schools
2. Survey report to include benchmarks, levels, profile and layouts

3. SITE BENCHMARKS

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

Table 1: Site Benchmark Information

Benchmarks	Northing	Easting	Elevation	Description	Remarks
1	9876483.456	687489.803	1535.240	BME1	Enemasi Primary School-borehole base
2	9855718.849	778730.304	1835.338	BML1	Ilmochin Primary School-close to borehole

4. PIPELINE ROUTE SURVEY

The survey of the pipeline route was done on 23rd and 24th June 2022,

4.1 Enewasi Pipeline Route

Enewasi Primary School is located on Geographic coordinates 1° 06' 59.1" S 34° 41' 10.1" E. The school is approximately 38km from Kilgoris Town. The site is within Enemasi village, Muita sub-location, Muita location, Kereto division of Transmara South District, Narok County. The pipeline route starts off at the Enemasi centre borehole towards the hills at Enemasi Primary School where tanks will be located. The water is then distributed via gravity from the tank site to the primary school, while another route goes to water kiosks to three different locations.

The Enemasi pipeline is an approximately 5km route. The line started at Enemasi primary school and rises diagonally in the North East direction for approx. 600m towards the highest elevation for the tank site. The line was then surveyed further for approx. 280m from the tank site to the existing school tank site within the school compound and further towards the modern toilets. The line from the tank site goes South West to the T-junction for approx. 500m and turns northward to the first kiosk which is further North 1km from the T-junction. From the T-junction the line moves Southward for a further 1km Southward to crossing the main road to the kiosk site. Additionally, the line was surveyed from the T-junction to During the survey at chainage 0+620 the pipeline crosses a lagga section and this was noted.

The co-ordinates were picked in WGS84 36S system and the heights were picked as ellipsoidal with the highest elevation on Enemasi tank site being 1610.936m and the lowest elevation being approx. 1km South East of the borehole site at the kiosk at 1527.030m. The survey was done at an interval of approx. 20 meters. The area is generally slopping towards the South and rises sharply towards the North.

The data picked on site is as indicated in the table below.

Table 2: Survey Points Enemasi

Point Number	Northing (m)	Easting (m)	Elevation (m)	Description
1	9876483.456	687489.803	1535.24	Borehole
2	9876484.177	687505.198	1535.884	pipeline route
3	9876487.792	687521.023	1536.887	pipeline route
4	9876482.571	687525.22	1537.039	church
5	9876483.11	687537.915	1537.581	church
6	9876476.372	687538.098	1537.586	church
7	9876488.907	687537.826	1537.796	pipeline route
8	9876490.445	687553.552	1538.606	pipeline route
9	9876490.146	687571.224	1539.755	pipeline route
10	9876487.435	687588.32	1540.739	pipeline route
11	9876495.244	687583.387	1540.812	house
12	9876495.274	687588.034	1541.008	house
13	9876486.899	687604.025	1541.724	pipeline route
14	9876488.034	687598.039	1541.27	Road CL

15	9876495.153	687622.635	1543.062	pipeline route
16	9876492.752	687605.364	1541.907	pipeline route
17	9876496.12	687637.687	1543.887	pipeline route
18	9876496.407	687655.501	1544.956	pipeline route
19	9876498.455	687669.949	1545.832	fence
20	9876498.723	687674.623	1546.049	pipeline route
21	9876503.479	687693.494	1547.528	pipeline route
22	9876507.191	687712.187	1548.911	pipeline route
23	9876511.79	687730.985	1550.351	pipeline route
24	9876515.873	687749.448	1551.94	pipeline route
25	9876516.033	687751.336	1552.073	maize plant
26	9876519.097	687770.012	1553.625	pipeline route
27	9876523.412	687790.391	1555.409	pipeline route
28	9876528.219	687810.971	1557.245	pipeline route
29	9876534.546	687832.269	1559.133	pipeline route
30	9876535.773	687836.836	1559.49	maize plants
31	9876538.423	687842.668	1560.187	road
32	9876545.814	687857.797	1561.946	pipeline route
33	9876554.139	687876.112	1564.141	pipeline route
34	9876557.853	687875.464	1564.454	pipeline route
35	9876567.022	687892.575	1566.562	pipeline route
36	9876568.248	687895.388	1566.916	pipeline route
37	9876575.52	687912.532	1569.864	pipeline route
38	9876583.432	687930.105	1573.453	pipeline route
39	9876588.508	687946.45	1577.047	pipeline route
40	9876588.235	687946.869	1577.15	fence
41	9876591.762	687947.967	1577.635	pipeline route
42	9876598.226	687964.56	1582.282	pipeline route
43	9876599.282	687984.207	1588.142	pipeline route
44	9876615.426	688000.415	1595.421	pipeline route
45	9876624.023	688013.015	1600.917	pipeline route
46	9876630.157	688029.516	1607.735	pipeline route
47	9876638.891	688038.386	1609.969	tank site
48	9876631.62	688043.667	1609.456	tank site
49	9876639.21	688047.569	1610.936	tank site
50	9876654.146	688032.329	1609.351	line to school
51	9876661.186	688016.937	1606.068	line to school
52	9876664.085	688002.117	1601.423	line to school
53	9876662.612	687992.634	1597.891	line to school maize
54	9876665.928	687935.866	1580.661	line to school maize
55	9876663.31	687916.506	1576.347	line to school
56	9876661.587	687898.4	1572.337	line to school
57	9876658.163	687879.442	1569.06	line to school

58	9876654.986	687860.46	1566.267	line to school
59	9876650.992	687841.864	1564.021	line to school
60	9876646.626	687820.491	1562.227	line to school
61	9876645.254	687811.486	1560.846	tank site
62	9876641.028	687811.931	1561.092	tank site
63	9876635.202	687819.809	1561.594	class
64	9876628.81	687821.267	1561.517	class
65	9876626.745	687836.864	1562.64	existing tank
66	9876626.103	687840.187	1563.042	existing tank
67	9876629.929	687839.187	1562.686	existing tank
68	9876598.344	687822.364	1560.439	transformer
69	9876600.204	687821.575	1560.503	transformer
70	9876597.731	687808.628	1558.951	modern toilet
71	9876565.342	687811.027	1558.371	modern toilet
72	9876499.13	687601.876	1541.459	t-junction
73	9876531.524	687600.933	1541.697	pipeline route
74	9876546.23	687599.802	1541.903	pipeline route
75	9876568.243	687599.301	1542.183	pipeline route
76	9876587.158	687601.494	1542.359	pipeline route
77	9876603.273	687603.752	1542.677	pipeline route
78	9876618.513	687606.598	1543.1	pipeline route
79	9876636.262	687610.902	1543.613	pipeline route
80	9876661.087	687618.859	1544.504	pipeline route
81	9876685.313	687627.363	1545.434	pipeline route
82	9876715.442	687636.999	1546.694	pipeline route
83	9876735.869	687643.614	1547.381	pipeline route
84	9876764.373	687652.46	1548.36	pipeline route
85	9876793.987	687662.89	1549.454	pipeline route
86	9876819.699	687672.017	1550.532	pipeline route
87	9876852.467	687682.931	1551.875	pipeline route
88	9876877.718	687691.923	1552.712	pipeline route
89	9876901.203	687700.278	1553.776	pipeline route
90	9876934.716	687712.226	1555.512	pipeline route
91	9876962.335	687721.76	1557.119	pipeline route
92	9876978.754	687727.536	1557.89	pipeline route
93	9876999.053	687733.695	1559.321	pipeline route
94	9877020.182	687740.489	1561.126	pipeline route
95	9877041.757	687746.672	1562.736	pipeline route
96	9877063.78	687753.245	1564.901	pipeline route
97	9877085.387	687758.97	1567.155	pipeline route
98	9877106.922	687763.891	1569.206	pipeline route
99	9877128.712	687767.464	1570.972	pipeline route
100	9877149.947	687773.12	1572.058	pipeline route

101	9877170.979	687778.287	1572.652	pipeline route
102	9877191.679	687784.297	1573.277	pipeline route
103	9877212.167	687790.195	1574.092	pipeline route
104	9877233.192	687796.877	1575.374	pipeline route
105	9877253.459	687804.808	1576.777	pipeline route
106	9877276.608	687814.614	1577.797	pipeline route
107	9877297.763	687820.705	1578.326	pipeline route
108	9877318.224	687826.618	1578.836	pipeline route
109	9877338.048	687832.828	1579.34	pipeline route
110	9877356.972	687839.285	1579.908	pipeline route
111	9877375.928	687847.188	1580.574	pipeline route
112	9877396.342	687855.829	1581.204	pipeline route
113	9877415.737	687864.713	1582.545	pipeline route
114	9877411.883	687877.873	1584.831	tank site
115	9877413.182	687872.924	1584.199	tank site
116	9877407.225	687871.924	1583.957	tank site
117	9876492.578	687603.118	1541.324	t-junction
118	9876471.559	687596.5	1540.804	pipeline route
119	9876451.196	687591.843	1540.516	pipeline route
120	9876430.466	687588.805	1540.437	pipeline route
121	9876410.224	687585.908	1540.615	pipeline route
122	9876415.758	687587.682	1540.94	clv
123	9876413.771	687582.193	1540.849	clv
124	9876389.406	687584.291	1540.255	pipeline route
125	9876367.421	687583.508	1540.335	pipeline route
126	9876345.845	687583.138	1540.26	pipeline route
127	9876324.453	687582.17	1540.131	pipeline route
128	9876302.373	687582.118	1539.789	pipeline route
129	9876280.584	687582.251	1539.486	pipeline route
130	9876258.591	687582.707	1539.154	pipeline route
131	9876236.632	687585.229	1538.855	pipeline route
132	9876215.519	687591.342	1538.634	pipeline route corner
133	9876195.548	687599.927	1538.316	pipeline route corner
134	9876176.099	687610.754	1538.129	pipeline route
135	9876157.85	687621.873	1537.761	pipeline route
136	9876140.283	687633.247	1537.468	pipeline route
137	9876121.673	687645.932	1537.107	pipeline route
138	9876103.829	687658.315	1536.726	pipeline route
139	9876085.814	687670.231	1536.418	pipeline route
140	9876067.372	687681.82	1536.09	pipeline route
141	9876049.189	687692.777	1535.789	pipeline route
142	9876030.829	687704.114	1535.34	pipeline route
143	9876011.114	687716.174	1534.963	pipeline route

144	9875997.896	687726.576	1534.444	t-junction
145	9875975.433	687722.734	1533.387	pipeline route
146	9875954.462	687715.127	1532.397	pipeline route
147	9875943.46	687711.376	1532.139	road crossing
148	9875938.683	687720.618	1532.249	road crossing
149	9875923.643	687737.16	1531.886	pipeline route
150	9875910.066	687754.153	1531.406	pipeline route
151	9875898.198	687771.754	1531.078	pipeline route
152	9875887.913	687790.78	1530.735	pipeline route
153	9875878.894	687810.095	1530.632	pipeline route
154	9875869.626	687828.182	1530.243	pipeline route
155	9875857.741	687845.181	1529.28	pipeline route
156	9875852.151	687865.037	1529.08	pipeline route
157	9875842.043	687884.501	1529.073	pipeline route
158	9875830.664	687903.421	1529.259	pipeline route
159	9875821.079	687922.385	1529.085	pipeline route
160	9875807.023	687939.451	1528.492	pipeline route
161	9875794.532	687955.946	1527.775	pipeline route
162	9875785.595	687973.494	1527.756	pipeline route
163	9875774.623	687990.571	1527.742	pipeline route
164	9875762.518	688009.208	1527.313	pipeline route
165	9875753.309	688028.106	1527.027	pipeline route
166	9876019.716	687729.7	1535.166	pipeline route
167	9876041.823	687732.805	1535.765	pipeline route
168	9876064.445	687735.157	1536.334	pipeline route
169	9876086.941	687737.764	1537.187	pipeline route
170	9876108.889	687743.867	1538.16	pipeline route
171	9876128.908	687755.055	1538.949	pipeline route
172	9876146.742	687768.959	1540.06	pipeline route
173	9876165.007	687780.652	1540.93	pipeline route
174	9876184.207	687792.733	1541.888	pipeline route
175	9876202.871	687805.017	1542.755	pipeline route
176	9876221.562	687817.311	1543.799	pipeline route
177	9876240.769	687829.446	1544.896	pipeline route
178	9876259.56	687841.212	1546.097	pipeline route
179	9876278.542	687851.912	1547.336	pipeline route
180	9876297.151	687861.723	1548.5	pipeline route
181	9876316.53	687871.609	1549.801	pipeline route
182	9876335.462	687882.724	1551.216	pipeline route
183	9876353.672	687892.973	1552.69	pipeline route
184	9876371.705	687904.091	1554.15	pipeline route
185	9876388.848	687916.219	1555.876	pipeline route

186	9876407.522	687934.018	1557.67	pipeline route junction to school gate
187	9876408.657	687954.921	1558.728	pipeline route
188	9876408.106	687975.608	1559.313	pipeline route
189	9876410.926	687996.721	1560.014	pipeline route
190	9876414.702	688014.841	1560.805	pipeline route
191	9876420.336	688035.558	1561.811	pipeline route
192	9876426.148	688056.351	1562.769	pipeline route
193	9876432.175	688077.076	1563.545	pipeline route
194	9876438.877	688097.528	1564.357	pipeline route
195	9876446.005	688117.51	1565.168	pipeline route
196	9876453.779	688137.43	1565.831	pipeline route
197	9876460.926	688155.017	1566.344	pipeline route
198	9876469.063	688173.113	1566.849	pipeline route
199	9876478.748	688191.89	1567.397	pipeline route
200	9876490.753	688208.647	1568.164	pipeline route
201	9876504.927	688224.933	1568.849	pipeline route
202	9876520.618	688239.588	1569.774	pipeline route
203	9876537.869	688253.56	1570.753	pipeline route
204	9876555.456	688266.539	1571.996	pipeline route
205	9876572.838	688279.053	1573.063	pipeline route
206	9876590.18	688291.258	1574.203	pipeline route
207	9876607.252	688302.787	1575.521	pipeline route
208	9876623.501	688317.21	1577.14	pipeline route
209	9876640.829	688327.026	1578.286	pipeline route saitoti quarry
210	9876658.007	688335.24	1579.194	pipeline route
211	9876677.41	688343.778	1580.321	pipeline route
212	9876696.977	688352.231	1581.701	pipeline route
213	9876717.379	688358.707	1583.099	pipeline route
214	9876736.706	688365.152	1583.828	pipeline route
215	9876756.516	688372.267	1584.516	pipeline route
216	9876776.538	688378.42	1585.4	pipeline route
217	9876795.707	688389.304	1586.076	pipeline route
218	9876816.293	688395.827	1587.176	pipeline route
219	9876836.605	688403.389	1587.914	pipeline route
220	9876836.668	688403.37	1587.715	pipeline route
221	9876855.792	688412.02	1588.635	pipeline route
222	9876874.764	688420.553	1589.548	pipeline route
223	9876894.609	688428.92	1590.19	pipeline route
224	9876913.976	688436.255	1591.114	pipeline route
225	9876933.13	688442.847	1591.926	pipeline route corner ya ngombe
226	9876952.362	688452.23	1593.232	pipeline route

227	9876970.393	688462.374	1594.188	pipeline route
228	9876987.888	688472.487	1595.077	pipeline route
229	9877005.862	688484.688	1595.788	pipeline route
230	9877022.095	688497.675	1596.261	pipeline route
231	9877038.176	688511.435	1596.69	pipeline route
232	9877055.941	688524.097	1597.713	pipeline route
233	9877074.612	688534.842	1598.905	pipeline route
234	9877093.311	688546.048	1600.294	pipeline route
235	9877112.162	688556.909	1601.706	pipeline route
236	9877132.093	688566.501	1602.681	pipeline route
237	9877151.83	688574.752	1603.46	pipeline route
238	9877171.509	688582.945	1604.335	pipeline route
239	9877191.118	688591.63	1605.621	pipeline route
240	9877211.272	688600.5	1607.618	pipeline route
241	9877231.434	688610.527	1609.38	pipeline route
242	9877244.281	688627.954	1608.976	tank site

4.1.1 Main line to Enemasi Centre Kiosks

The line is **700 metres** long and runs from the highest point during the survey which is the site identified for location of the tanks to the centre. The centre is where the borehole is located and the tanks will be located next to the borehole.

They can also be plotted as a graph as shown in the figure below.

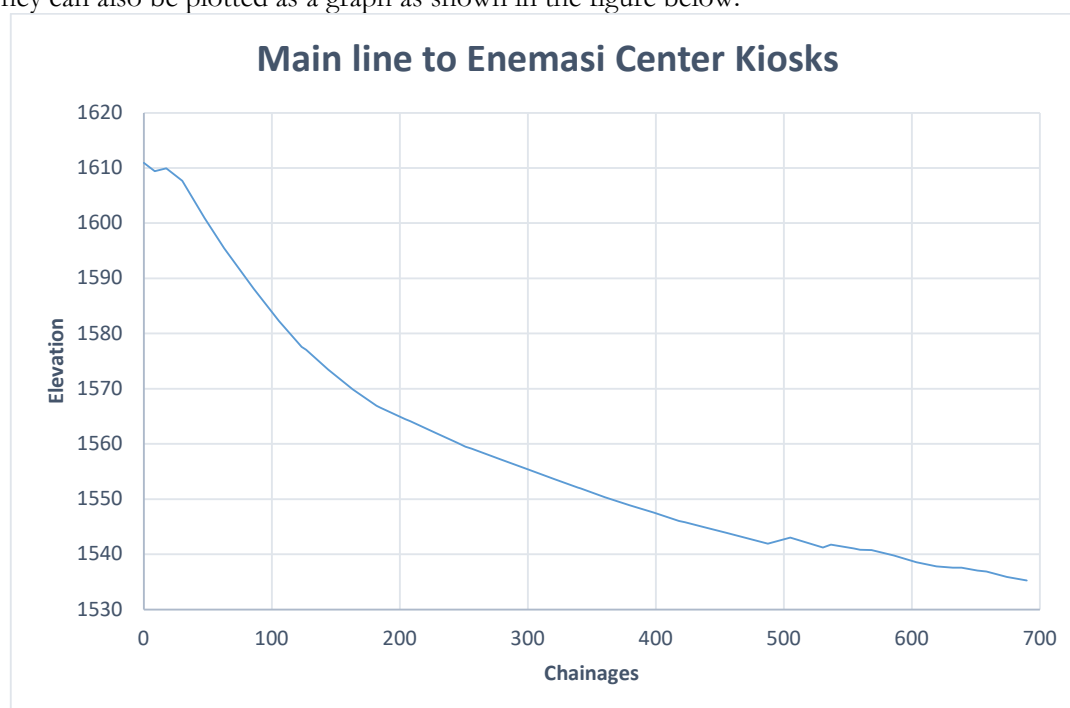


Figure 1: Main line to Enemasi Centre Kiosks

The line from the tank site also flows to Enemasi Primary school, the line is approximately **250metres** long upto the school proposed tank site. In addition, the line from the proposed tank site to the modern toilets is **75metres** long.

4.1.2 Enemasi Tanks to Kiosk 1

The main line from the tank site separates at the T-junction from where it flows to three different locations. Kiosk 1 is located approximately 1km from the T-junction and 1.5km from the main tanks.

The line can be plotted as shown below

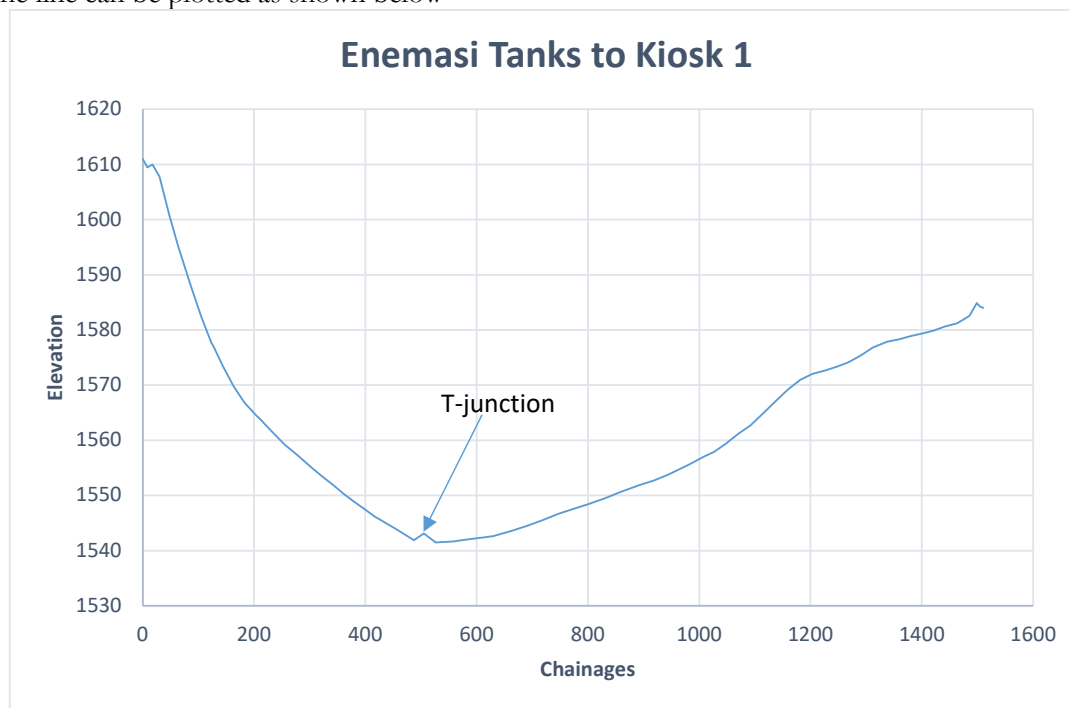


Figure 2: Line to Kiosk 1

4.1.3 Enemasi Tanks to Kiosk 2

The line from the main tanks was also proposed to flow to a Kiosk 2 site. The site is about 1km from the T-junction situated 500m from the main tanks site. The line will the community that's not within Enemasi Centre.

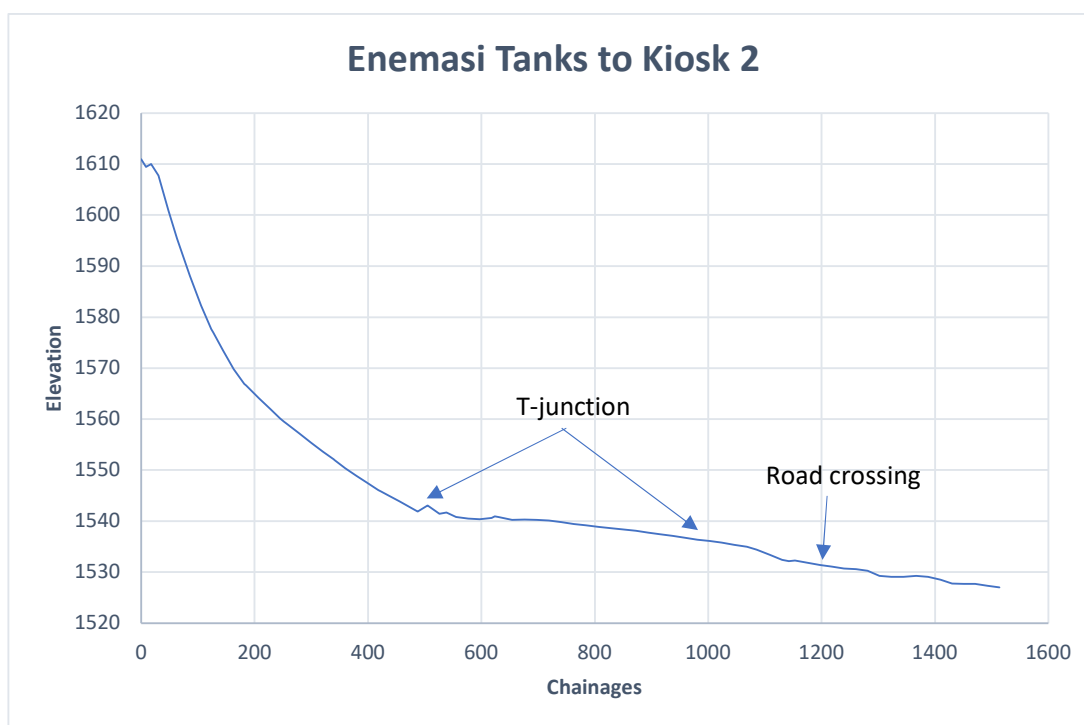


Figure 3: Line to kiosk 2

4.1.4 Enemasi Tanks to Kiosk 3

Kiosk 3 is located on the Northward road towards Saitoti residence and Quarry. The total distance through a T-junction whilst using the school access road is approx. 1.6km. The route from the T-junction at the Enemasi centre is 500m longer, such that the route from the main line through the school is more economical.

The elevation to Kiosk 3 site raises steadily to about the same elevation with the tank site. In this regard, additional options for tank location to enable water flow via gravity were identified. Once the data is analysed for any losses, the most suitable site for Kiosk 3 will be identified.

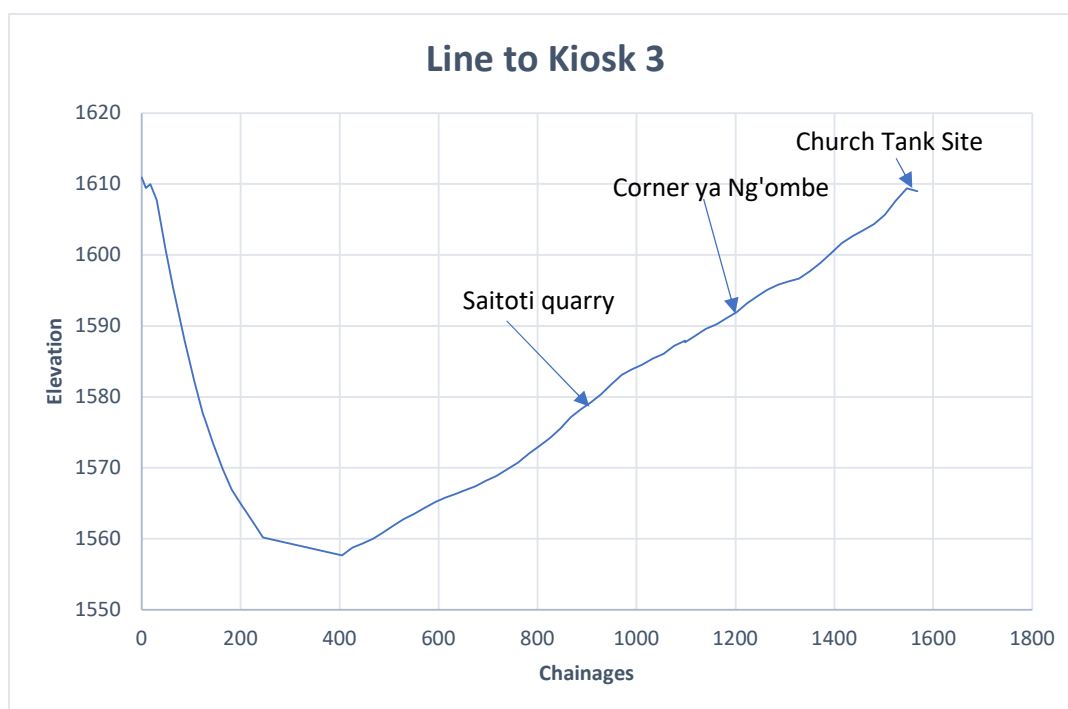


Figure 4: Line to Kiosk 3

4.2 Ilmochin Pipeline Route

The Ilmochin borehole site is located in the lower West side of Endoinyo Narasha at a distance of approx. 7km. The borehole is located within Ilmochin primary school, within Ilmochin village, Endoinyo Narasha sub location, Olkinyei location, Siana Division of Narok West District Narok County.

The tank site which is proposed to be located within the school is at a lower elevation than one of the Kiosks. This site would require tanks to be raised for water to flow via gravity. The highest elevation is southward at the T-junction at a distance of approx. 1.6km from the tank site is at 1858.97m while the lowest elevation is at a distance of approx. 1km North towards Kiosk 2 at an elevation of 1826.67m. The tanks site is at an elevation of 1837.75m while the borehole site is at an elevation of 1835.83m

The coordinates were picked in UTM WGS84 datum Zone 36S while the elevation was ellipsoidal. The data was picked at intervals of approximately 20m with movements of 2km North and 2km South of the Tank site for supply to additional villages. Additionally, there was a proposed line from the tanks to the VIP toilets that are currently under construction and a Y-junction to supply to additional tanks at the school compound. The site was done for a total distance of 5km and for a radius of 2km from the main tank site.

The survey data collected during the survey is as shown

Table 3: Survey Points Ilmochin

Point Number	Northing (m)	Easting (m)	Elevation (m)	Description
1	9855724.132	778735.343	1835.83	borehole
2	9855717.694	778748.235	1835.475	pipeline route
3	9855705.784	778757.769	1835.604	pipeline route
4	9855694.057	778766.979	1835.673	pipeline route
5	9855683.627	778778.362	1835.791	pipeline route
6	9855674.417	778788.003	1835.89	pipeline route
7	9855686.739	778798.79	1836.047	pipeline route
8	9855698.689	778809.732	1836.249	pipeline route
9	9855711.353	778820.766	1836.326	pipeline route
10	9855723.994	778832.565	1836.466	pipeline route
11	9855736.649	778843.412	1836.576	pipeline route
12	9855749.214	778854.736	1836.75	pipeline route
13	9855761.545	778865.606	1836.886	pipeline route
14	9855773.175	778875.704	1837.013	pipeline route
15	9855784.947	778886.138	1837.086	pipeline route
16	9855796.47	778896.413	1837.217	pipeline route
17	9855807.901	778906.442	1837.3	pipeline route
18	9855821.181	778918.202	1837.396	pipeline route
19	9855832.188	778927.807	1837.465	pipeline route
20	9855843.794	778938.04	1837.541	pipeline route
21	9855855.649	778948.428	1837.644	pipeline route
22	9855867.265	778958.557	1837.723	pipeline route
23	9855877.178	778967.942	1837.749	tank site

24	9855877.854	778969.203	1837.754	school gate
25	9855868.332	778981.844	1837.959	pipeline route
26	9855858.917	778993.925	1838.142	pipeline route
27	9855847.542	779007.2	1838.319	pipeline route
28	9855837.487	779019.493	1838.528	pipeline route
29	9855827.55	779030.368	1838.674	pipeline route
30	9855817.812	779042.005	1838.902	pipeline route
31	9855807.775	779053.559	1839.091	pipeline route
32	9855795.969	779063.879	1839.246	pipeline route corner
33	9855783.179	779071.606	1839.413	pipeline route
34	9855766.048	779080.763	1839.584	pipeline route
35	9855751.671	779087.274	1839.621	pipeline route
36	9855737.222	779092.88	1839.695	pipeline route
37	9855722.471	779097.75	1839.737	pipeline route
38	9855707.9	779102.644	1839.73	pipeline route
39	9855693.584	779107.589	1839.8	pipeline route
40	9855680.322	779115.185	1839.833	pipeline route
41	9855666.76	779121.026	1839.831	pipeline route
42	9855652.406	779126.648	1839.86	pipeline route
43	9855638.051	779132.121	1839.912	pipeline route
44	9855623.158	779136.448	1839.897	pipeline route
45	9855598.943	779146.903	1839.933	pipeline route
46	9855578.722	779158.002	1840.028	pipeline route
47	9855557.399	779167.487	1840.058	pipeline route
48	9855535.635	779176.731	1840.053	pipeline route
49	9855513.926	779185.96	1840.056	pipeline route
50	9855492.181	779194.736	1840.065	pipeline route
51	9855470.12	779203.33	1840.089	pipeline route
52	9855448.272	779212.136	1840.105	pipeline route
53	9855426.381	779220.504	1840.021	pipeline route
54	9855404.898	779227.691	1839.997	pipeline route
55	9855384.62	779237.209	1840.053	pipeline route
56	9855363.381	779245.49	1839.992	pipeline route
57	9855341.146	779253.552	1840.005	pipeline route
58	9855319.511	779263.623	1840.033	pipeline route
59	9855298.438	779272.419	1840.032	pipeline route
60	9855275.497	779281.881	1840.014	pipeline route
61	9855254.149	779292.08	1840.032	pipeline route
62	9855232.292	779300.878	1839.975	pipeline route
63	9855209.954	779309.17	1839.878	pipeline route
64	9855188.789	779319.544	1839.823	pipeline route
65	9855167.361	779329.703	1839.763	pipeline route
66	9855156.891	779336.098	1839.768	pipeline route corner
67	9855150.213	779359.771	1840.054	pipeline route
68	9855143.85	779383.827	1840.399	pipeline route
69	9855137.337	779408.338	1840.627	pipeline route
70	9855133.256	779433.515	1840.975	pipeline route
71	9855128.309	779458.56	1841.275	pipeline route

72	9855122.979	779484.01	1841.634	pipeline route
73	9855116.557	779508.828	1842.08	pipeline route
74	9855110.064	779534.037	1842.377	pipeline route
75	9855103.949	779560.508	1842.968	pipeline route
76	9855098.754	779585.508	1843.308	pipeline route
77	9855091.328	779610.127	1843.589	pipeline route
78	9855085.509	779634.842	1843.872	pipeline route
79	9855079.325	779659.296	1844.218	pipeline route
80	9855073.931	779684.16	1844.72	pipeline route
81	9855068.838	779709.86	1845.204	pipeline route
82	9855064.864	779735.765	1845.579	pipeline route
83	9855059.732	779761.696	1846.051	pipeline route
84	9855054.012	779787.623	1846.444	pipeline route
85	9855048.074	779813.908	1846.969	pipeline route
86	9855041.837	779839.973	1847.69	pipeline route
87	9855036.74	779865.72	1848.218	pipeline route
88	9855031.126	779891.206	1848.82	pipeline route
89	9855025.547	779917.383	1849.503	pipeline route
90	9855020.242	779942.775	1850.253	pipeline route
91	9855013.855	779968.444	1851.14	pipeline route
92	9855009.392	779995.595	1852.127	pipeline route
93	9855004.187	780021.514	1853.249	pipeline route
94	9854997.398	780048.719	1854.597	pipeline route
95	9854991.84	780074.986	1855.832	pipeline route
96	9854985.506	780100.023	1856.884	pipeline route
97	9854979.939	780126.629	1858.078	pipeline route
98	9854973.575	780148.483	1859.049	pipeline route
99	9854984.786	780141.652	1858.66	t-junction
100	9855006.266	780151.55	1858.807	pipeline route
101	9855029.757	780158.728	1858.968	pipeline route
102	9855053.793	780165.617	1858.904	pipeline route
103	9855078.931	780170.839	1858.787	pipeline route
104	9855103.526	780177.884	1858.8	pipeline route
105	9855128.254	780185.555	1858.712	pipeline route
106	9855153.45	780191.442	1858.636	pipeline route
107	9855178.807	780200.094	1858.714	pipeline route
108	9855205.101	780206.622	1858.812	pipeline route
109	9855230.025	780213.931	1858.904	pipeline route
110	9855254.088	780221.354	1858.945	pipeline route
111	9855279.595	780228.807	1858.885	pipeline route
112	9855304.033	780237.558	1858.968	pipeline route
113	9855327.995	780240.07	1858.843	pipeline route corner
114	9855896.123	778953.249	1837.542	pipeline route
115	9855913.726	778936.857	1837.32	pipeline route
116	9855930.271	778916.944	1836.963	pipeline route
117	9855945.739	778897.292	1836.68	pipeline route
118	9855964.013	778879.376	1836.415	pipeline route
119	9855981.529	778861.326	1836.179	pipeline route

120	9855997.283	778841.812	1835.844	pipeline route
121	9856014.88	778823.509	1835.479	pipeline route
122	9856031.923	778804.938	1835.157	pipeline route end of school fence
123	9856045.101	778785.783	1834.911	pipeline route
124	9856061.28	778766.156	1834.615	pipeline route
125	9856078.546	778747.421	1834.198	pipeline route
126	9856098.079	778724.236	1833.987	pipeline route
127	9856113.586	778705.801	1833.521	pipeline route end of school fence
128	9856131.437	778687.795	1833.273	pipeline route
129	9856148.08	778669.48	1832.876	pipeline route
130	9856164.842	778650.673	1832.563	pipeline route
131	9856180.012	778630.175	1832.223	pipeline route
132	9856195.838	778610.601	1831.852	pipeline route
133	9856214.102	778594.099	1831.706	pipeline route
134	9856232.042	778577.478	1831.347	pipeline route
135	9856248.328	778558.46	1830.917	pipeline route
136	9856263.189	778538.413	1830.73	pipeline route
137	9856278.92	778519.519	1830.411	pipeline route
138	9856295.085	778501.01	1830.155	pipeline route lagoon on right
139	9856310.784	778483.458	1829.859	pipeline route
140	9856328.548	778466.339	1829.644	pipeline route
141	9856345.957	778447.167	1829.347	pipeline route
142	9856362.503	778428.644	1829.043	pipeline route
143	9856377.661	778409.021	1828.75	pipeline route
144	9856392.953	778389.714	1828.459	pipeline route
145	9856409.851	778371.91	1828.184	pipeline route
146	9856429.583	778356.439	1827.881	cross junction
147	9856449.153	778370.711	1827.817	pipeline route
148	9856465.523	778389.341	1827.867	pipeline route
149	9856480.697	778408.517	1827.814	pipeline route
150	9856495.808	778428.756	1827.434	pipeline route
151	9856511.158	778449.542	1827.264	pipeline route
152	9856530.036	778466.966	1826.956	pipeline route
153	9856544.301	778488.271	1826.665	pipeline route
154	9856563.095	778505.952	1826.708	pipeline route corner
155	9856584.878	778519.853	1826.867	pipeline route
156	9856607.169	778533.609	1827.204	pipeline route
157	9856627.561	778549.702	1827.484	pipeline route
158	9856648.523	778563.097	1827.667	pipeline route
159	9856671.515	778575.272	1827.932	pipeline route
160	9856692.582	778589.38	1828.329	pipeline route
161	9856714.374	778602.838	1828.64	pipeline route
162	9856735.482	778617.335	1829.242	pipeline route
163	9856757.471	778631.586	1829.346	pipeline route
164	9856778.049	778646.416	1829.577	pipeline route
165	9856798.34	778660.074	1829.781	pipeline route

166	9856819.866	778674.819	1830.088	pipeline route
167	9856841.066	778688.764	1830.403	pipeline route
168	9856861.982	778702.537	1830.607	pipeline route
169	9856882.94	778716.891	1830.865	pipeline route
170	9856903.749	778730.713	1831.175	pipeline route
171	9856923.874	778745.639	1830.851	pipeline route
172	9856944.395	778761.304	1831.082	pipeline route
173	9856965.617	778774.533	1831.061	pipeline route
174	9856986.252	778788.713	1830.999	pipeline route
175	9857011.334	778805.626	1830.994	pipeline route
176	9857032.993	778818.627	1831.022	pipeline route
177	9857055.09	778832.475	1831.132	pipeline route
178	9857076.896	778846.631	1831.274	pipeline route
179	9857098.384	778861.387	1831.672	pipeline route
180	9857119.098	778875.816	1831.994	pipeline route
181	9857139.714	778890.486	1832.438	pipeline route
182	9857160.563	778904.338	1832.666	pipeline route
183	9857181.324	778918.111	1832.837	pipeline route
184	9857202.595	778931.325	1832.997	pipeline route
185	9857222.333	778944.703	1833.244	pipeline route
186	9857239.567	778954.355	1833.438	pipeline route brc gate
187	9857249.463	778977.121	1833.663	pipeline route
188	9857259.31	778999.255	1834.081	pipeline route
189	9857269.024	779021.763	1834.396	tank site
190	9855878.407	778959.1	1837.692	pipeline route
191	9855879.888	778934.055	1837.408	pipeline route
192	9855881.414	778910.17	1837.117	pipeline route
193	9855884.417	778885.764	1836.823	pipeline route
194	9855884.454	778861.285	1836.551	pipeline route
195	9855883.312	778832.501	1836.245	pipeline route
196	9855884.284	778806.845	1835.975	pipeline route
197	9855881.847	778781.814	1835.709	pipeline route
198	9855879.858	778756.682	1835.406	pipeline route
199	9855879.914	778731.971	1835.106	y junction
200	9855904.902	778712.43	1834.956	modern toilet boys
201	9855872.344	778684.293	1834.711	modern toilet girls
202	9855838.069	778784.984	1835.958	existing tank
203	9855835.837	778785.744	1835.991	existing tank
204	9855834.081	778785.959	1835.988	existing tank
205	9855831.031	778786.302	1835.994	existing tank
206	9855840.909	778782.456	1835.726	proposed tank
207	9855718.849	778730.304	1835.338	BM01

4.2.1 Main line to Ilmochin Village Kiosk

The line from the borehole to the Ilmochin village is approximately 345 metres long with the highest elevation being at the tank site at 1837.75m while lowest point being at the borehole site at 1835.34m. For this section water will need to be pumped by solar to the community kiosks.

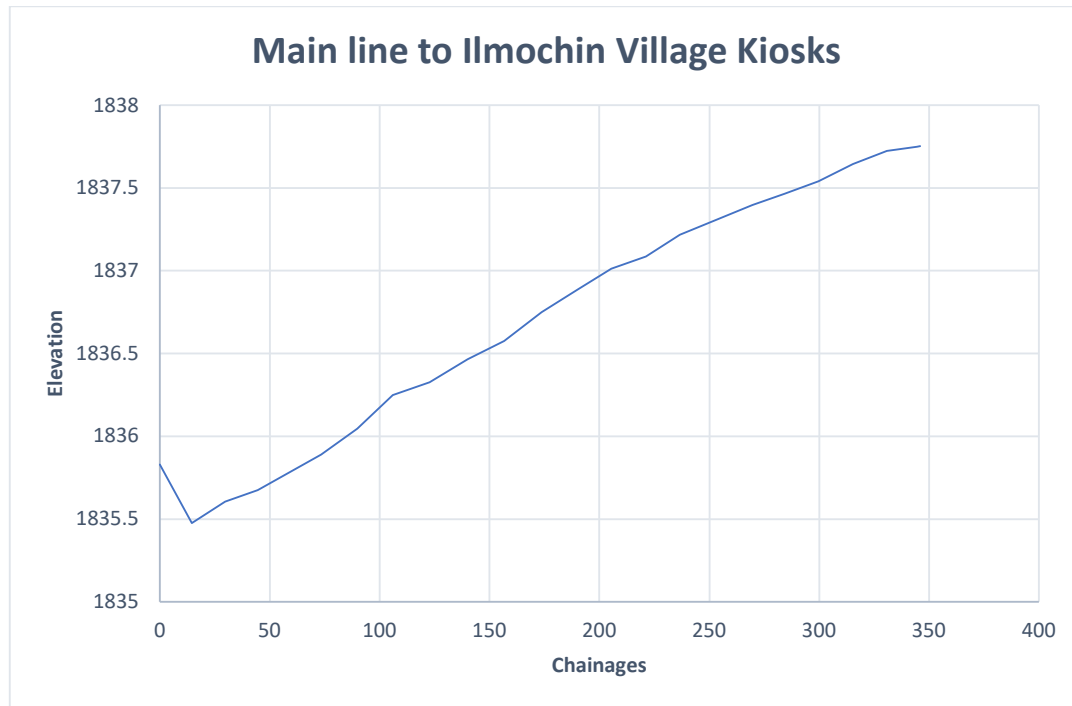


Figure 5: Main line to Ilmochin Village Kiosk

The line from Ilmochin Village Kiosk has to serve the existing Ilmochin Primary school. If this is to be done the line will follow the marked route for **237 metres** upto the Y-junction. The Y-junction serves as the distributor to the proposed tank site at **64 metres** away, the boys' modern toilets at **32 metres** distance and the girls' modern toilets at **48 metres**.

4.2.2 Ilmochin Tanks to Kiosk 1

The main line starts at the Ilmochin tanks site located at the gate of Ilmochin primary school and follows the road southward for a distance of approx. 2.1km. The elevation is lowest at the tank site and rises all through to the location of the water kiosks. Water cannot flow via gravity and would require the supply tanks to be raised or to be pumped using solar. The vertical rise to the kiosk 1 site is approx. 20 meters.

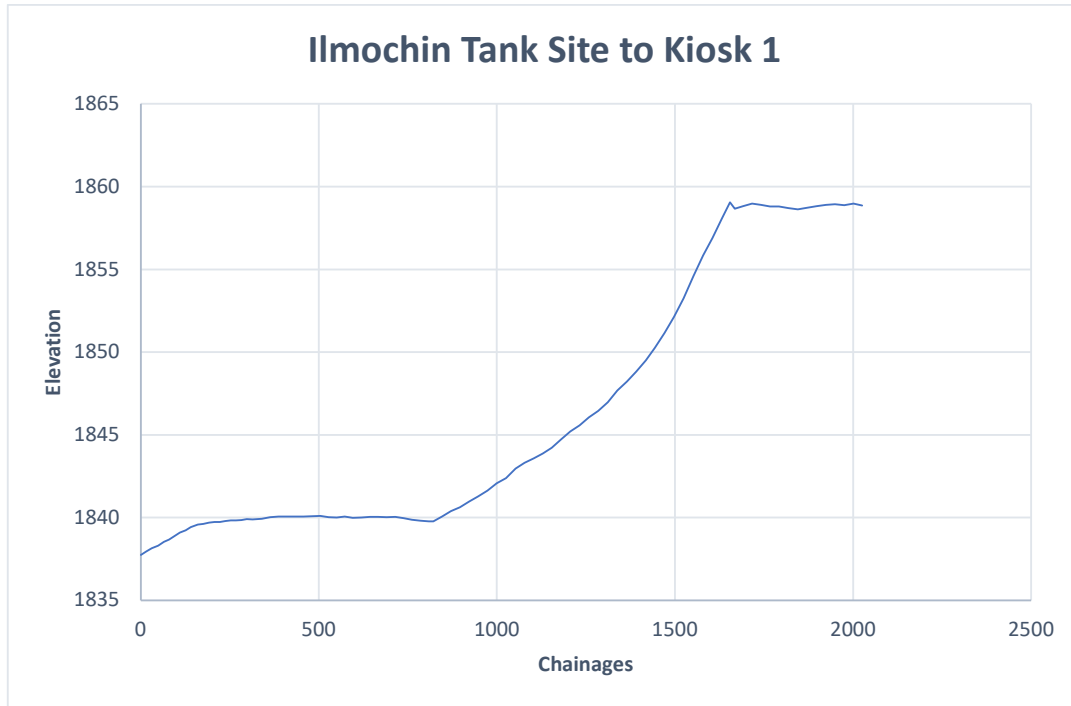


Figure 6: Ilmochin Tank site to Kiosk 1

4.2.3 Ilmochin Tanks to Kiosk 2

The line starts at the tank site and follows road for a distance of approx. 1900 metres. The elevation is highest at the tank site and follows the road to the Kiosk 2 site. The elevation is lowest at the cross junction and the vertical difference at this corner is approx. 10m. The line rises from the cross junction to the tank site for a distance of 900m with a vertical rise of approx. 7m. The vertical difference between the highest point at the Ilmochin tank site and at the tank site is approx. 3.5m. An additional elevated tanks would help in mitigating any frictional losses through the pipes.

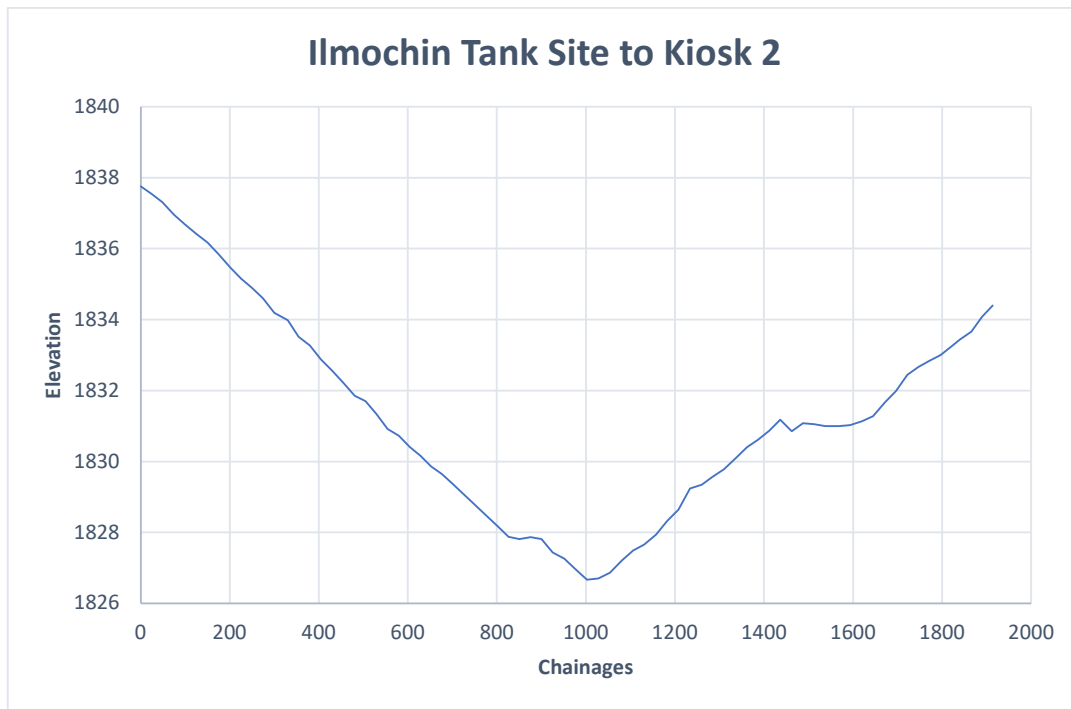


Figure 7: Ilmochin Tank site to Kiosk 2

5. AUTOCAD SITE LAYOUT

From source to site on Google Earth View

Figure 8 : AutoCAD map

6. DIGITAL ATTACHMENTS

The following files are available with regards to this report

- | | |
|---|----------------------|
| • Enemasi and Ilmochin Survey Report.docx | This report; |
| • Enemasi and Ilmochin Survey Report..pdf | This report; |
| • Enemasi.dwg: | AutoCAD site layout |
| • Ilmochin.dwg: | AutoCAD site layout; |
| • Survey Data.xls | excel |