Columbia University – Engineers without Borders
Drawing Package
Authors: Donald Swen, Alice Wu, Nicholas Vallin
Alternative Analysis
April 6, 2019

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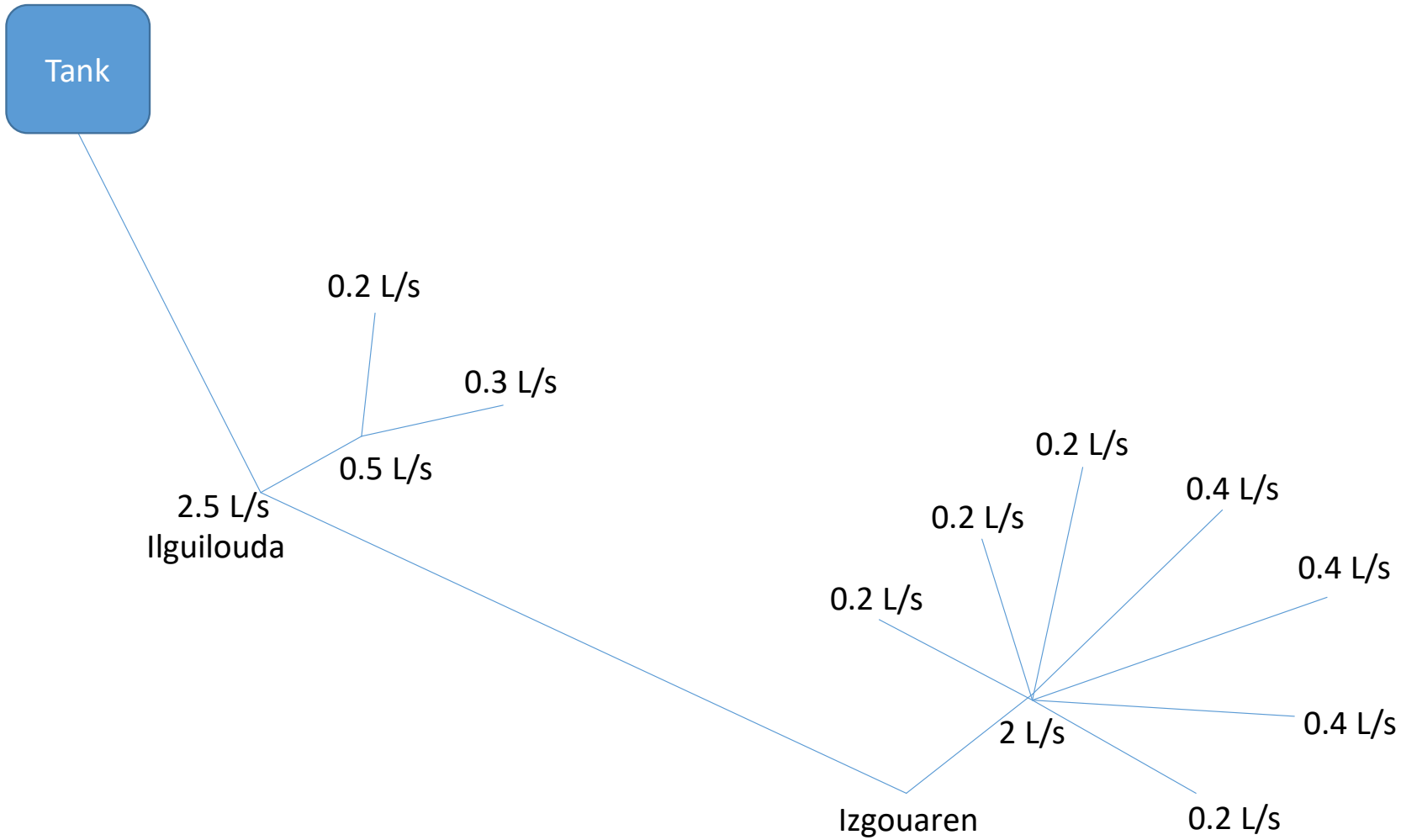
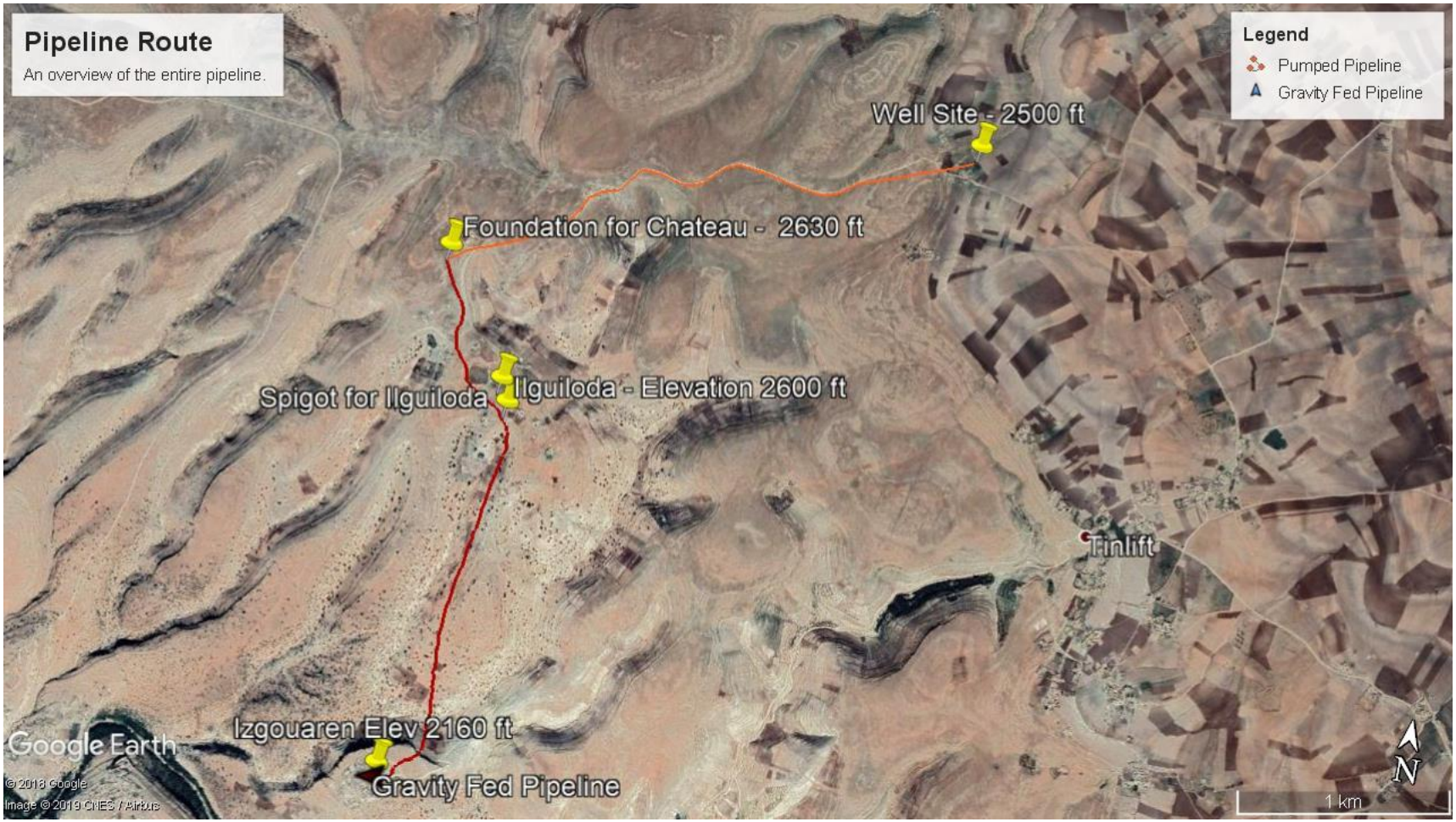
Starting with Daily Demands



When designing this pipeline, we started with listening to the community. In 2015, working closely with a Peace Corp Volunteer, we took a community wide survey assessing daily demands and needs. The total daily demand for both villages (dwars) is 40,000 L. 10,000 L of which will be utilized by the 120 citizens of Iliguilouda. 30,000 L of which will be utilized by the 250 citizens of Izgouaren. Knowing this, we created a variety of taps at each community with varying flow rates. These taps could be run continuously for 4 to 5 hours a day in each community. Compression fittings produced in accordance with ISO 17885 : 2015 will be used for pipe networks within the village.

Pipeline Route



Next, we looked at the terrain of the region. After consulting the community and many iterations, a pipeline route was finalized. A well was drilled in January 2015 after consulting with a Professor of Hydrogeology at the University of Cadi Ayyad in Marrakech, Morocco. The following summer, a pump in the borehole was installed. The route imaged above is corresponding to a HDPE pipeline. HDPE was chosen due to its durability, cost, and its lack of joints. The total pipeline route is roughly 5.9 km long.

Pumped Pipeline Route

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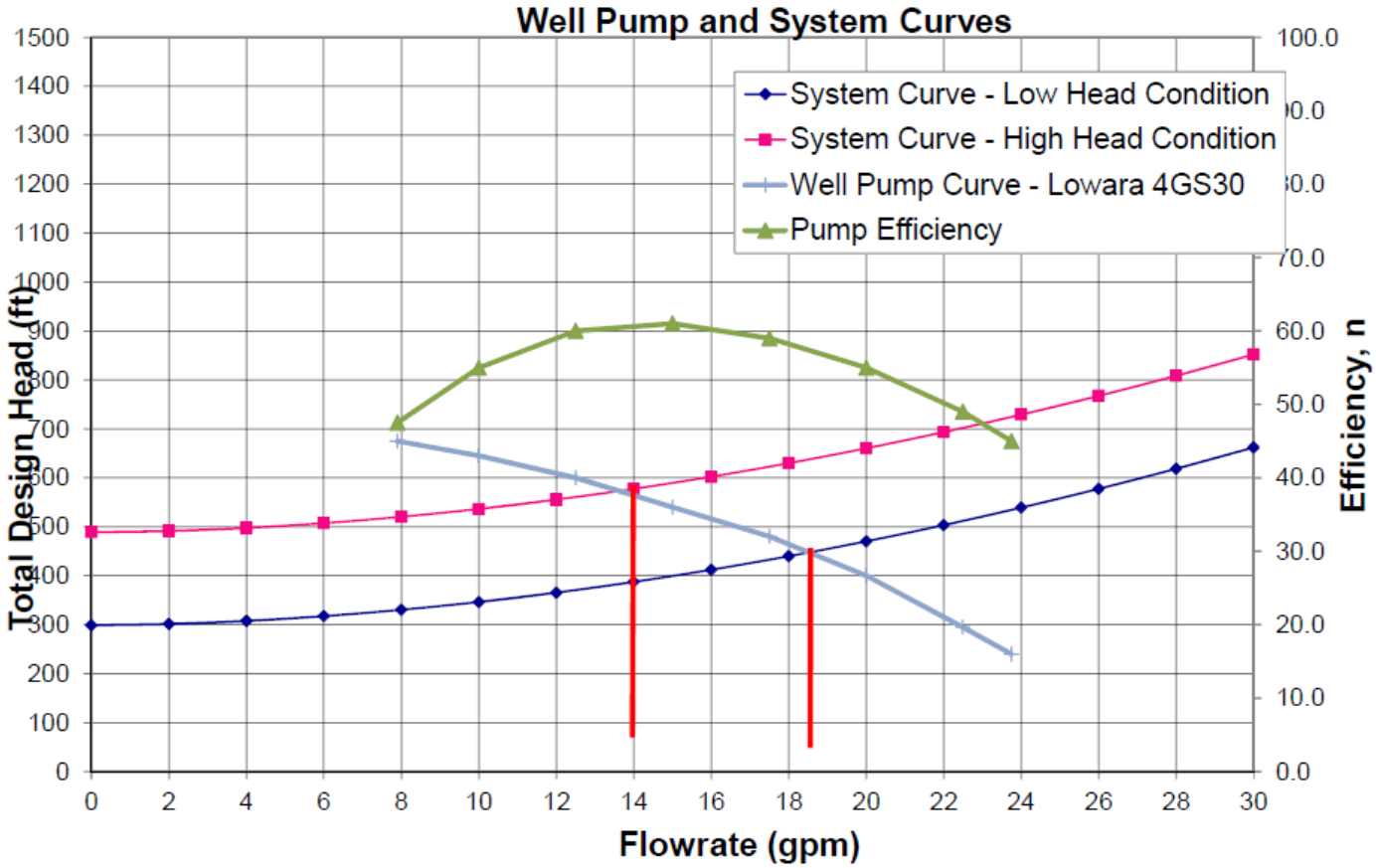
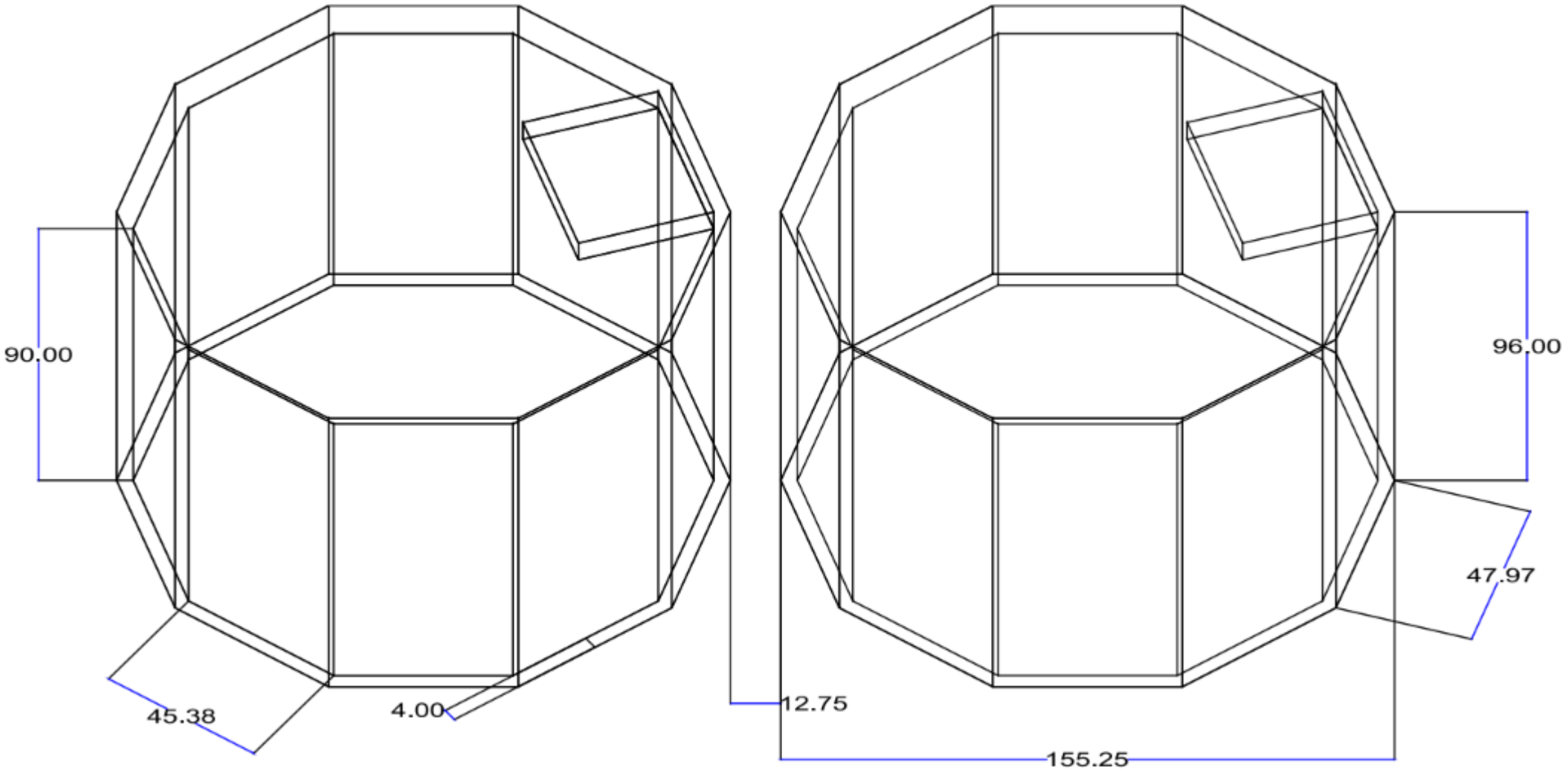
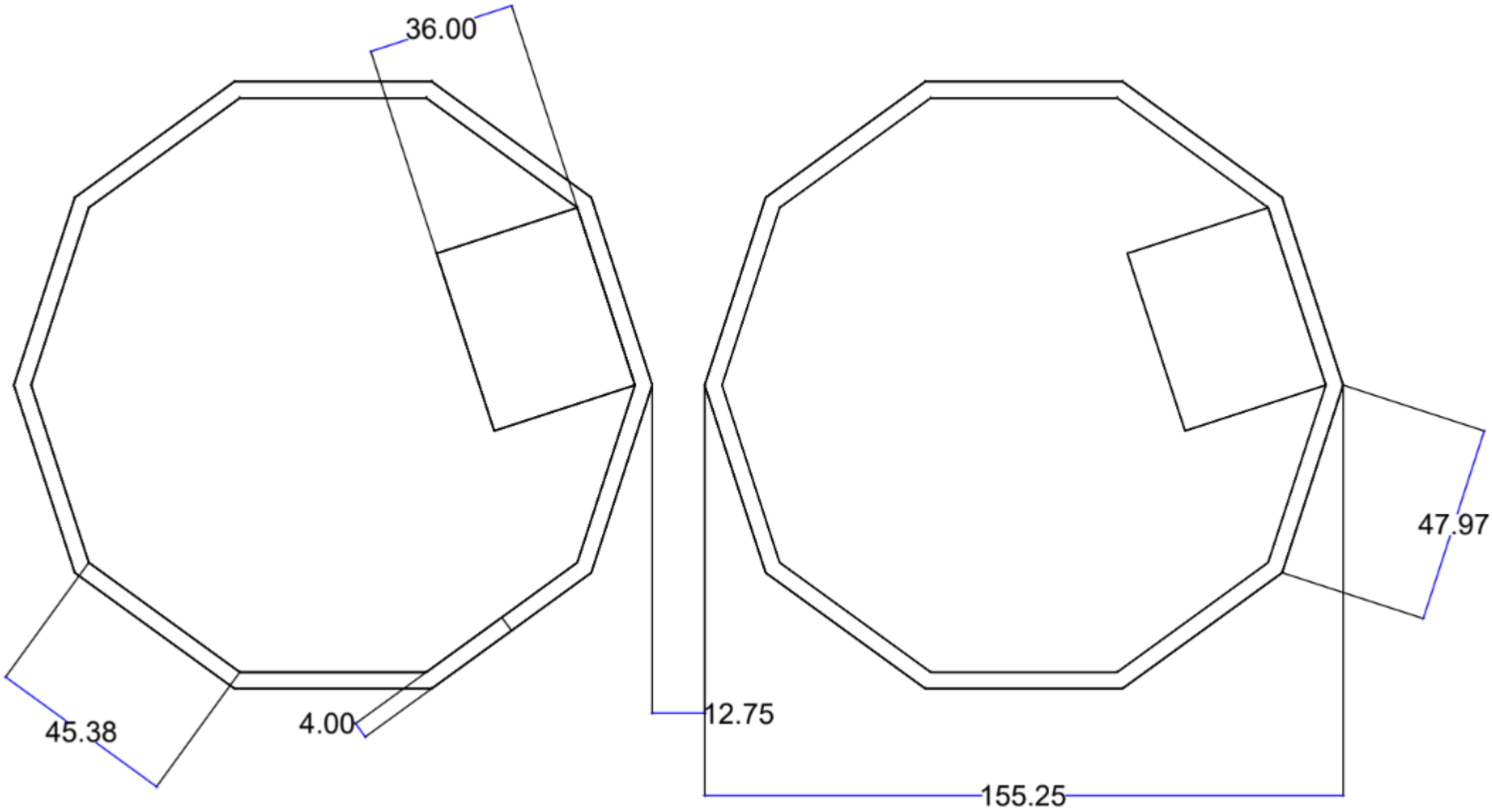
The pipeline is divided into two primary sections. A pumped and a gravity fed portion. The pumped system will bring water from the existing well up towards the highest point in the region which we labeled the Chateau site. A concrete foundation was laid in 2016 in anticipation for two 20,000 L tanks. SDR 11 pipe was chosen after applying a temperature derating factor 0.5 (1.3% for every C above 20 C) to satisfy a static lift of 48m and friction losses resulting from a pumped flow of 1.2 L/s. In 10 hours of pumping, 45 m^3 of water can be provided.

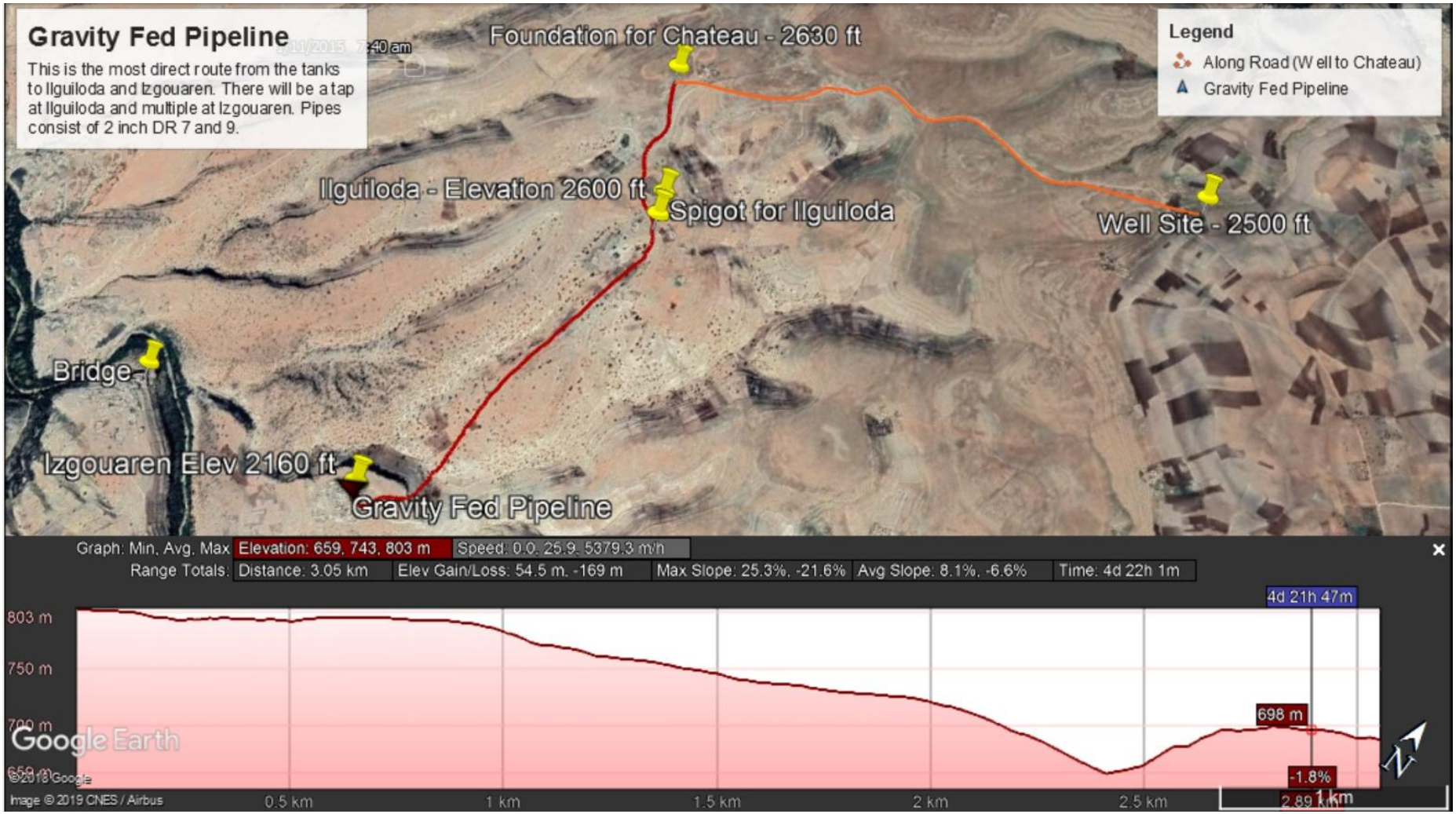


Our optimal operating range is between 15 to 21 GPM using a Lowara 4GS30 pump that has been installed. At the moment we are looking into a solar alternative as well.



Two decagonal 20,000 L concrete decagonal tanks will be constructed on an existing concrete and rebar foundation set in 2016. The dimension of the foundation is 7.1 m x 3.7 m x 1 m. The dimensions of each tank is 96" tall and 155.25" wide between the opposing outer vertices. Water will be pumped from the top of the tank and exit from the bottom.


36.00
45.38
4.00
12.75
155.25
47.97



The gravity fed section starts from the highest point in the region named the Chateau site and flows into the two villages of Ilguilouda and Izgouaren. The accompanying elevation profile is provided above. A hybird of SDR 11 and 17 will be used for this section.

Hydraulic Grade Diagram for Gravity Fed Portion

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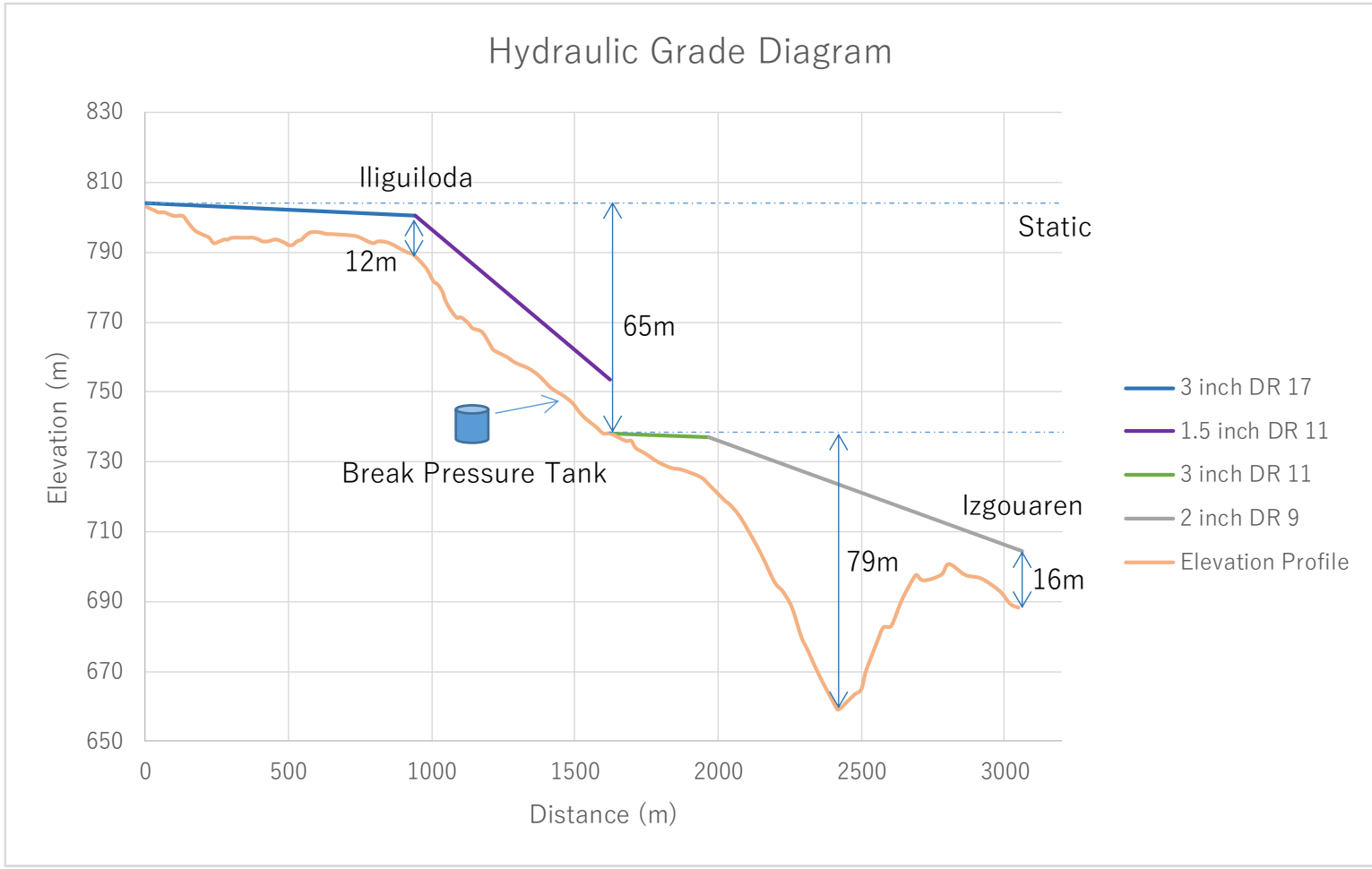

The elevation profile was extracted and a hydraulic grade diagram was calculated for the gravity fed portion of the pipeline. Referring to the water demands schematic on page 3, we design flows correspondingly and require at least 10m of head at each tap. The difference between the highest and lowest point (in the valley) requires a 1 m^3 break pressure tank to satisfy pressure requirements after de-rating. 3" SDR 17 is required to provide adequate head at Ilguilouda. The first reach is followed by 1.5" SDR 11. The third reach is an extendable 3" SDR 11 section, finished with 2" SDR 11.

Hydraulic Grade Diagram for Gravity Fed Portion

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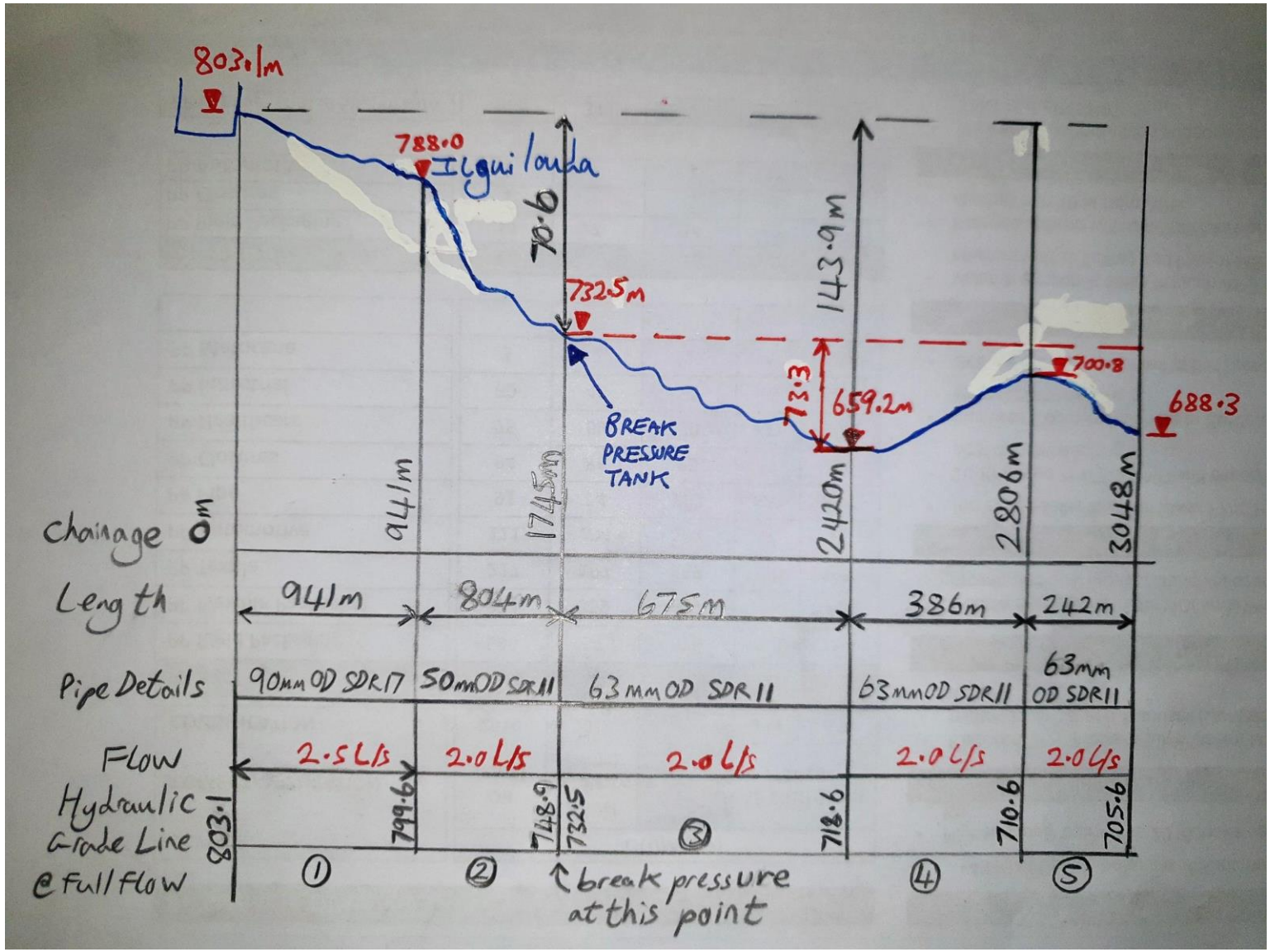

A sketch version of the hydraulic grade diagram for a metric pipeline if the material is PE100RC or PE100. Credit for this specific version goes to our mentor Mr. Andrew Wedgner of Lyondellbasell.

Hydraulic Grade Diagram for Gravity Fed Portion

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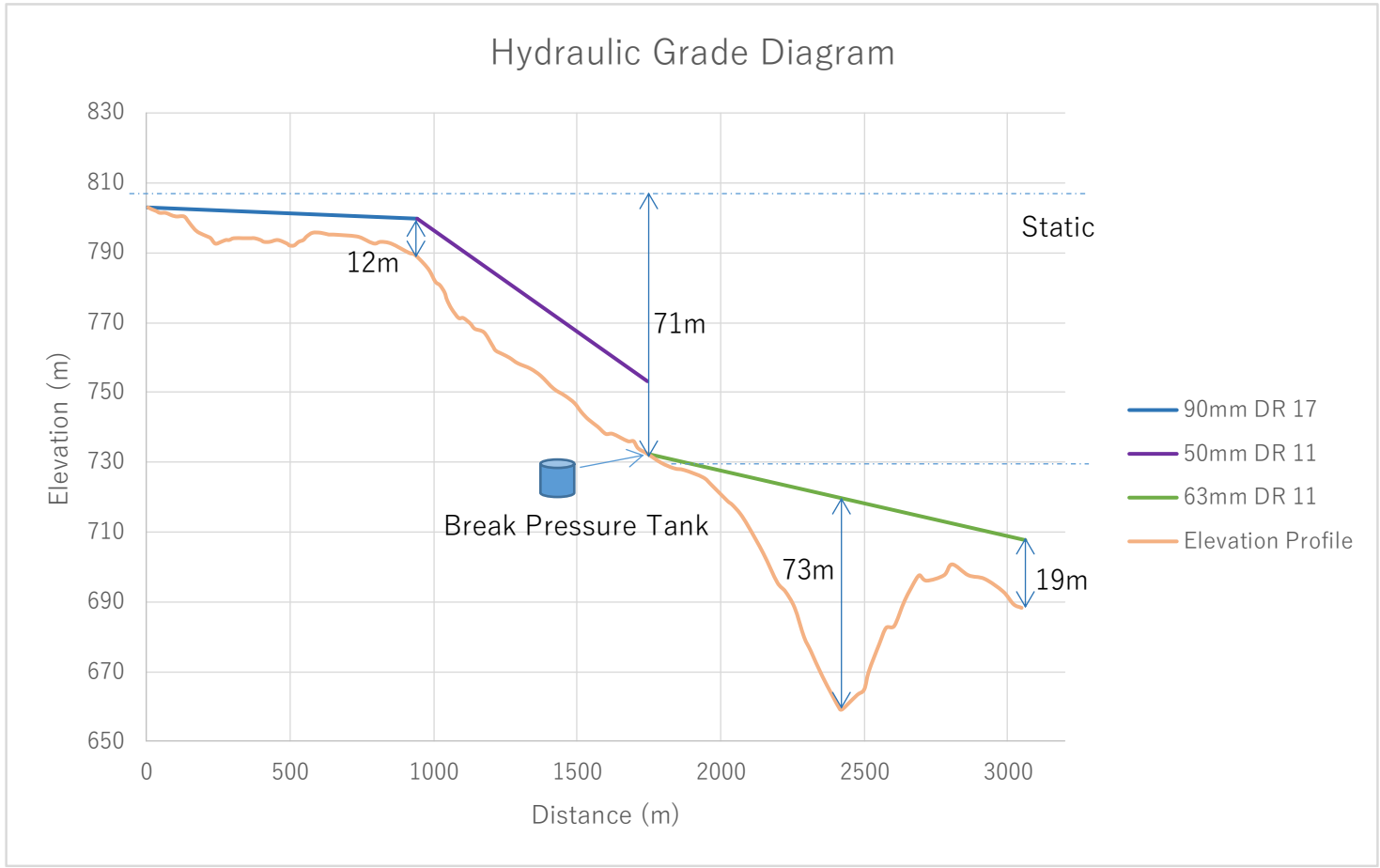
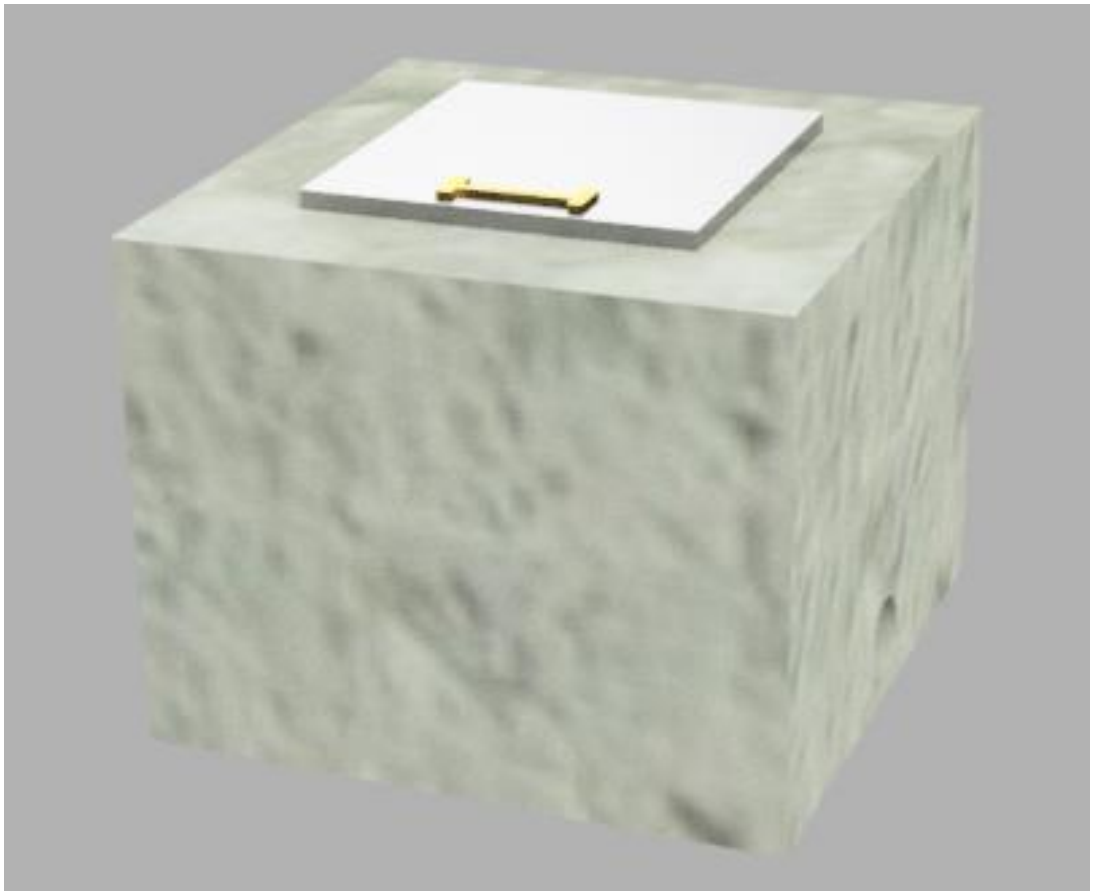


Similar to the PE4710 pipeline, here is a PE100RC or PE100 pipeline based on ISO standards whereas previously we used ASTM standards. This is simply a digitized version of the previous drawing.

Communal tapstands (left) can have up to six spouts with controllable flow rates set by a globe valve secured in a locked valve box to prevent tampering. The base will be concrete and all fittings will be in metric and sourced locally. Just before the tapstands, we will fuse PE4710 with PE100 or use mechanical fittings such as MULTI/JOINT, iJOINT by Georg Fischer, or compatible flange adapters. Locations of the communal tapstand and individual tapstands will be consulted with the community.



A break pressure tank will be installed roughly half way down the valley to renormalize pressure to atmosphere. The size is approximately 1 m^3 and will be made either of rock and mortar or reinforced concrete similar to the larger tanks at the Chateau. It will be locked on the top with a metal opening to provide entry. There will be a float valve, overflow pipe, inlet, outlet, and a gate valve to flush sediment. A gate valve will be installed before the inlet to allow for easy service. A detailed design will be shown in the upcoming implementation reports.