



Astro Hill Watermain Replacement

Final Feasibility Report

January 26, 2021

Prepared for:

City of Iqaluit

Prepared by:

Stantec Architecture Ltd.
1088 C Mivvik Street
Iqaluit, NU
X0A 0H0






ASTRO HILL WATERMAIN REPLACEMENT

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Prepared by 
(signature)
Matt Follett, M.A.Sc., P.Eng.

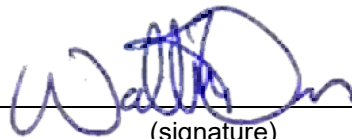
Reviewed by 
(signature)
Walter Orr, P.Eng.



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Executive Summary

In November 2018, the City of Iqaluit (City) had experienced a failure within the municipal water line that caused limited operation and service disruption to the Astro Hill complex, Creekside Village, and Lower Iqaluit. During the investigation of the issue, it was determined that ground movement caused failure of a joint within the piped system. Work at this time included replacement of asbestos-containing (AC) pipe with new High-Density Polyethylene (HDPE) pipe. Aside from the 2018 failure, an important issue for the City is to have access to this portion of the municipal system. Currently, this portion of municipal watermain is diverted to the Astro Hill complex (i.e. Frobisher Inn, 8-story apartment building, and WG Brown Building) and access for City maintenance becomes limited.

Stantec Architecture Ltd. (Stantec) has been working with the City to develop options for rerouting the municipal main around the Frobisher Inn so it will remain accessible. The intent of this document is to provide a compiled list of design criteria that will be used in the preparation for eventual detailed design and construction of the Astro Hills Watermain Upgrades project. This will include current and future demands (based on City-provided data and population data), environmental impacts, boundary limits, and a discussion of any known technical challenges. The next phases of this project are expected to begin in 2022.

The site is located close to the geographic centre of Iqaluit, just south of the Qikiqtani General Hospital and Niaqunngusariaq Road. Access to the Astro Hill complex is from a bridge on the north side of Queen Elizabeth Way, crossing the Lake Geraldine drainage channel. Additional pedestrian access is located just south of Tammaativik Boarding Home via gravel footpath. Most of the site is developed with graded gravel fill and off-street parking and paved parking lots. North side drainage enters into the Lake Geraldine drainage channel with south side drainage over land and through Creekside Village or past Palaugaa Street. The existing above ground utilidor hugging the eastern side of the WG Brown Building and Astro Hill parking lot is in fairly rough condition. Visual observations of the insulated pipe appear to range from 250mm (10”) to 300mm (12”) pipe, assuming 2” of insulation and wrapping is on the exterior. Record drawings identify this as 250mm, therefore, our design figures and understanding of the existing system will be assumed at 250mm insulated pipe. A topographic survey was completed on September 30, 2020; however, an additional option (Option 3) was requested by the City at a later date. This option was not captured within the survey.

There are no major environmental impacts or concerns with this project, or construction of the watermain realignment. As described within this document, general requirements include submission of:

- Sediment and Erosion Control Plan
- Spill Contingency Plan
- Health and Safety Plan



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Should the contractor require dewatering into the Lake Geraldine drainage channel, some advice and coordination may be required from CIRNAC. Coordination or permitting with Nunavut Water Board (NWB) is not required for realignment of an existing distribution line. Most of the Asbestos-Containing (AC) pipe can be left in place, as discussed for the line entering into the Astro Hill complex. Some minor removal may be required on the south east side of the complex at the connection point. Any AC pipe can be disposed of in accordance with:

- The Government of Nunavut Department of Environment (GN-DOE), Environmental Guideline for Waste Asbestos (revised January 2011)
- GN-DOE, Environmental Guideline for the General Management of Hazardous Waste (revised October 2010)

Likely, any AC pipe will be disposed of at the City's landfill, however, carriers and receivers must be registered with the Nunavut Department of Environment.

An overall review of the City of Iqaluit Municipal Design Guidelines was performed, as they relate to this project. For the most part, it is expected that detailed design and construction will follow all items outlined within these documents. The depth of watermain may vary, depending on route. Flow requirements and pipe sizing were calculated in consideration of the Nunavut Bureau of Statistics (NBS) population growth rate of 1.13% and the City-provided annual growth rate of 3.38% from the Consolidated General Plan. NBS projected a future population of 9,870 (22% increase over 20 years) and the City's Consolidated General Plan projected a population of 15,727 by 2040 (94% increase over 20 years). This will confirm the appropriate details as they relate to the entire system. The recommended increase in watermain size using NBS is 350 mm HDPE DR 11 and 450 mm HDPE DR 11 using the Consolidated General Plan. One of the main recommendations of this is to ensure this number for future growth and pipe size is checked with the in-progress water model being prepared for the City at this time. For the purposes of this assignment and conceptual figures, a 350mm HDPE DR 11 watermain was used.

Three pipeline routing options were considered, each involving the addition of a new access vault (AV) on the eastern side of the Astro Hill parking lot, where the main turns 90° and enters the Astro Hill complex. The differences in each of the options are where new line will run before reconnecting into the municipal main just north of Creekside Village. These differences are summarized below:

- Option 1
 - Estimated cost ~ \$1.3M (lowest cost)
 - Direct route crossing the new Astro Hill development parking lot
 - Most direct alignment
 - Requires a 6m easement bisecting Nunastar's Astro Hill property and development, therefore, legal requirements for engagement and negotiations
 - Future plans may impede this as a feasible option



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- Option 2
 - Estimated cost ~ \$1.7M (mid cost)
 - Avoids crossing Astro Hill development parking lot and hugs southern side of the parking lot
 - Will require a 6m easement, however, shared between Astro Hill and the garage at building 511 (Lot 188, B1-H32)
 - Requires engagement and negotiations with Nunastar and the owner of building 511
- Option 3
 - Estimated cost ~ \$2.05M (highest cost)
 - Avoids all requirements for easement, consultation, and negotiations
 - Provides the most accessible site, should future maintenance be required

While each of the three options presented within this document will work technically, the final recommendation has been determined as Option 3. This recommendation is largely dependent on the value associated with not having an easement and consultation requirement, as well as future serviceability.



ASTRO HILL WATERMAIN REPLACEMENT

Introduction

1.0 INTRODUCTION

1.1 BACKGROUND

In November 2018, the City of Iqaluit (City) had experienced a failure within the municipal water line that caused limited operation and service disruption to the Astro Hill complex, Creekside Village, and Lower Iqaluit. During the investigation of the issue, it was determined that ground movement caused failure of a joint within the piped system. Work at this time included replacement of asbestos-containing (AC) pipe with new High-Density Polyethylene (HDPE) pipe. Aside from the 2018 failure, an important issue for the City is to have access to this portion of the municipal system. Once the loop is diverted to the Astro Hill complex (i.e. Frobisher Inn, 8-story apartment building, and WG Brown Building), access for City maintenance becomes limited. The purpose of this project is to complete a feasibility study identifying an optimal rerouting of the municipal watermain that is not inaccessible without changing the existing service connections to the Astro Hill complex. This report will also identify and discuss the technical requirements, constructability considerations, environmental risk and mitigation measures, execution strategy, and provide an estimate of probable cost (EOC).

1.1.1 Existing Conditions

The City of Iqaluit provides water and wastewater to residents of Iqaluit by truck delivery and collection and, primarily, through buried and above ground linear water and sanitary infrastructure. The misfortune of underground infrastructure is that it is out of sight and out of mind until problems arise. Iqaluit's system is complicated, operating within a series of municipal loops and reheat stations through HDPE and Ductile Iron pipes, steel access vaults, concrete manholes, pumping stations, forcemain and gravity segments, and continuous premise supply and recirculation. As with any municipal design within the City of Iqaluit, the Astro Hill watermain upgrades are considerate of climate change, aging condition and deterioration, permafrost placement and continuous recirculation requirements, and population growth with seasonal impacts. Sizing, placement, and future conditions are discussed in the subsequent sections. As for protection of the pipe, for insulated HDPE material, 1 m of cover is acceptable for pipe protection from on-ground activities and freezing. With varying and disappearing permafrost conditions from climate change, installation and compaction of pipe surround granular material becomes extremely important in the installation.

As mentioned, in November 2018, a problem occurred with the watermain leading to the Astro Hill complex and eventually through Creekside Village and Lower Iqaluit. The Astro Hill complex consists of the Frobisher Inn Hotel, Storehouse Restaurant and Bar, the WG Brown Building (GN commercial), the 8-story residential apartment complex, and the currently under construction Astro Hill development. The new development is intended to house a new pharmacy and upgraded movie theatres. On September 7, 2020, Stantec walked the site to complete a visual reconnaissance of the site details.



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ASTRO HILL WATERMAIN REPLACEMENT

Introduction

The site is located close to the geographic centre of Iqaluit, just south of the Qikiqtani General Hospital and Niaqunngusiariaq Road. Access to the Astro Hill complex is from a bridge on the north side of Queen Elizabeth Way, crossing the Lake Geraldine drainage channel. Additional pedestrian access is located just south of Tammaativik Boarding Home via gravel footpath. Most of the site is developed with graded gravel fill and off-street parking and paved parking lots. North side drainage enters into the Lake Geraldine drainage channel with south side drainage over land and through Creekside Village or past Palaugaa Street. Geotechnical and subsurface information is currently unknown for this area; however, exposed bedrock is present on the northwest portion of the complex. Tundra, glacial till, glacial erratics, and some outcrops are visible on the south side of the building.

Existing water service from Niaqunngusiariaq Street to the Astro Hill complex is primarily above ground by an insulated 250 mm (10") utilidor with galvanized metal protection. The utilidor runs south east on the southern side of the Lake Geraldine drainage channel until it reaches the pedestrian trail. At this point, the line is buried and runs perpendicular to the Astro Hill complex to a point between the Storehouse Restaurant and Bar and the WG Brown Building.

The size of the water main within this 250m (10") utilidor is described in differing record information as variously 200 mm, 250 mm and 300 mm. Given the dimensions of the utilidor, it is considered to be most likely 250 mm, however we have evaluated both 200 mm and 250 mm existing watermains in our pipe sizing (Section 4.1).

On the southeast side of the Frobisher Inn, the services appear again, partially buried and partially above ground. At this section, above ground 200 mm (8") insulated steam heating pipes are present, leaving the Frobisher Inn and heading toward the units within Creekside Village. A concrete footpath is found on the eastern side of the petal encased steam pipes. Sanitary lines from the Astro Hill complex and continued municipal watermain run in the same direction, southeast of the site. Municipal lines are partially buried and protected with galvanized cover. The overall condition of the pipe is unknown, however, in all segments of the above ground utilidor galvanized protection is in poor condition. Many covers have blown away, leaving insulated and wrapped pipe exposed to the elements. Some punctures to the wrap and insulation were observed. All infrastructure leaving the Frobisher Inn on the southeast side of the complex is crowded and in moderate to poor condition. There is a large fuel tank and containment, a small shed (likely acting as an access to the above ground lines), and some unstable decking.

The new Astro Hill development is nearing completion, with a paved lot and landscape features installed. On the southwest corner of this parking lot there is some NorthwesTel satellite receivers and infrastructure. All major components around this area should be avoided in the pipeline routing options.

Photos of the site reconnaissance are found in Appendix B.



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ASTRO HILL WATERMAIN REPLACEMENT

Environmental Impacts & Considerations

1.1.2 Topographic Survey

Stantec coordinated a topographic survey with a third-party surveyor. The survey was received on September 30, 2020. Later in the project, the City requested Stantec consider a third option (Option 3), which would avoid the requirement of an easement. This portion of the design was not captured in the topographic survey and elevations have been estimated.

In addition to that, Stantec has requested existing cadastral data from the City, inclusive of the most recently available road, building, and contours for the area. This information was received on Friday, September 11, 2020 and was considered in the preparation of the preliminary figures found in Appendix A.

Following our background review, we understand that the site features topographic variety. The lower portion of the site has an existing grade slope of 4-10%, with slopes in some areas increasing up to 20%. The area where the Frobisher Inn Hotel is located is relatively flat with a steep bank to the southwest. This bank has a slope of over 33% (3:1 ratio).

2.0 ENVIRONMENTAL IMPACTS & CONSIDERATIONS

Environmental impacts of this work are expected to be minimal. Any disturbance to existing land from the trenching and excavation process would be reinstated. This includes any crossing next to or across developed properties. All three pipeline routing options presented within this feasibility study involve portions of trenching and excavation along the southern edge of the Lake Geraldine drainage channel. The potential impacts to this are related to potential life stages within that water body (primarily seasonal flow) and disturbance to the vegetation in the area. Stantec does not consider either of these to be major concerns that would prevent the feasibility of construction of either pipeline route. Portions of the drainage channel that would require trenching and excavation have mostly already been disturbed and reinstatement should be relatively straight forward. Though a fish study is likely not warranted in this channel, items such as a silt fence should be used to protect the stream from fines and sediments from entering. If possible, work should be completed during periods of low flow. Fuel spill kits should be available on site in the event of an equipment leak. It should be noted that approval may be required before the contractor begins working near this channel.

2.1 GENERAL SUBMISSION REQUIREMENTS

The contractor should submit a Sediment and Erosion Control Plan, Spill Contingency Plan, and a Health and Safety Plan to the City (or City's representative) prior to complete work. These plans should include and consider any work on the southeast corner of the Frobisher Inn while working near the fuel storage tank and the steam lines. CIRNAC may require the contractor to sample any water resulting from trench dewatering before that water is permitted to enter the drainage channel. The contractor should notify CIRNAC prior to



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Environmental Impacts & Considerations

excavation and activities working in these areas. While no formal application or permit is required with CIRNAC, plans listed above may be provided, as well as figures and schedules for the work.

2.2 ASBESTOS

The AC pipe leading into and through the Frobisher Inn is intended to remain in place and functioning and does not require replacement with this work. This line will become the service line for the Astro Hill complex. Though minimal within the scope of this work, any AC pipe that may be replaced on the southeast side of the Frobisher Inn will need to be disposed of in accordance with environmental requirements. Asbestos waste needs to be stored and contained in containers that are impervious to asbestos and asbestos waste. The Government of Nunavut Department of Environment (GN-DOE), Environmental Protection Division, is the key environmental agency responsible for ensuring parties properly manage waste asbestos and will provide advice and guidance on its management. The GN-DOE has issued the “Environmental Guideline for Waste Asbestos” (revised January 2011), which outlines the overall procedure for disposal. In addition to that, there is also an “Environmental Guideline for the General Management of Hazardous Waste” (revised October 2010). The City of Iqaluit accepts small to medium quantities of asbestos to the municipal solid waste disposal site. The City of Iqaluit should also provide approval for disposal at their facility.

Asbestos-related Resources:

- https://www.gov.nu.ca/sites/default/files/waste_asbestos_2011.pdf
- http://www.nwb-oen.ca/sites/default/files/cms_uploads/techguides/Guideline%20-%20General%20Management%20of%20Hazardous%20Waste%20%28revised%20Oct%202010%29.pdf

Documentation confirming disposal location and practices must be presented to the City. Carriers and receivers operating in Nunavut must be registered with the Nunavut Department of Environment. Once received, asbestos containing material should be immediately buried and covered with at least 300mm of soil to ensure further contact with humans and heavy equipment is minimized.

2.3 OTHER APPLICATION REQUIREMENTS

Though not directly related to environmental considerations, some applications are required to the City of Iqaluit for this project. Those are listed below.

- Road Closure Permit
- Water and Sewer Connection / Disconnection Permit
- Utility Permit



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City of Iqaluit Municipal Design Guidelines Review

Other information, such as proposed work, workplan, methodology, traffic control plan, and measures to ensure public safety may be required. These may be included within the items identified within Section 2.1. Typical processing time for these applications are 15 – 20 days and must be approved prior to starting any construction work. The contractor must leave any time to complete requested revisions.

3.0 CITY OF IQALUIT MUNICIPAL DESIGN GUIDELINES REVIEW

The City of Iqaluit Municipal Design Guidelines (2005) are intended to guide the design and construction of municipal works in Iqaluit as they pertain to such items as water distribution, sanitary collection, critical components, and installation of such systems. These design guidelines are usually compared with normal engineering best practice for arctic municipal design, sometimes requiring slight variation to ensure the most reliable design is used.

The Astro Hill Watermain Upgrades primarily will be considering the section of the Municipal Design Guidelines that pertains to the water distribution system, access vaults, and trenching and excavation standards. While some sanitary work is expected on the south east corner of the Frobisher Inn, this is primarily for reconnection to the system. The main purpose of this work is to provide an alternate accessible route for the watermain to bypass the Astro Hill complex while maintaining the existing service connections.

The following items are important in consideration of this system upgrade.

3.1 FLOW REQUIREMENTS

The City of Iqaluit Municipal Guidelines defines the typical daily demands for use in calculating water demand for residential developments. Due to the potential variation in commercial development water demand, the Municipal Guidelines recommend following other best practices for calculation of commercial water demand estimates. Table 1 summarizes the relevant information outlined in the Municipal Guidelines used for estimated residential water demand.

Table 1 City of Iqaluit Municipal Guidelines for Residential Water Demand Estimation

Parameter	Demand
Average Daily Demand	400 L/person/day
Population Density / Residence	3.5 people/residence
Maximum Daily Demand	2 * Average Daily Demand



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City of Iqaluit Municipal Design Guidelines Review

Peak Hourly Demand

4 * Average Daily Demand

Notes:

- Minimum supply and return line size are 25 mm (1 in), which can be used if supplied within a 100 mm carrier pipe for protection.

The Astro Hill complex includes the hotel, conference facilities, movie theatre and new commercial development, the 8-story apartment building, and the W.G. Brown Building Government of Nunavut offices. The existing service will be maintained across the parking lot with the new Astro Hill bypass tying into the point north east of the hotel. There will be minimal disruption that is expected during commissioning / connection of the new line.

As the Astro Hill Watermain Upgrades is intended to reroute the existing line within the municipal loop, Stantec understands that maintaining the existing main size is appropriate for current demands based upon our understanding of the system. This project considers rerouting an existing line rather than confirming size for a particular development. However, a discussion on future population and demand can be found in Section 4.1.

3.2 PIPE SIZING

Upon our first visual field investigation, we observed the existing line to be 250 mm (10") utilidor, with a Ductile Iron (DI) pipe. If as is noted above, the pipe size within the utilidor is 250 mm, to maintain the existing functional size, the new HDPE line will be increased to 300 mm DR 11 (10"). As the existing Frobisher Inn complex service line will continue to be in service, this has the effect of doubling the capacity (node to node). It should be noted that the size of this main is shown as different sizes ranging from 200 mm to 300 mm. Therefore, it is recommended to be somewhat conservative in pipe sizing the new main.

To date, we have not received confirmation of the service and recirculation sizing from the Astro Hill complex, which should be completed during the detailed design stage of this project. For now, we assume that a 250 mm (10") line runs to the complex. It is likely that recirculation is performed within the building directly to the watermain. The City of Iqaluit Municipal Design Guidelines states that any water service greater than 50 mm (2") must be connected and valved directly inside an access vault (AV).

The Municipal Design Guidelines also require a 3.0 m/s maximum flow velocity. This maximum flow velocity is the driving characteristic for sizing the diameter of any new water main in the absence of a water model including head losses in the system.

Based upon our current understanding, a minimum 250 mm (10") DR11 insulated HDPE line would be required to match the current functional pipe size. Section 4.1 will include an analysis of current and future demand requirements and address the sizing for future growth.



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City of Iqaluit Municipal Design Guidelines Review

Sanitary reconnection from the Astro Hill complex can be completed by upsizing to one functional size larger than the existing from the building to the tie-in point. We can also recommend upsizing the downgradient portion of the sanitary connection at the access vault and connection with a reducer, allowing for future sanitary upsizing at this point.

3.3 WATERMAIN ALIGNMENT AND LOCATION

Watermains shall be located within the road right-of-way and outside the carriageway. In addition to that, the Municipal Design Guidelines specify distances from buried water lines to sanitary lines with a 230 mm horizontal distance and 300 mm vertical distance existing between the two service lines. While most of this upgrade project is related to watermain realignment, the connection point on the south east corner of the Frobisher Inn will be an access vault, tying in both sanitary from the Astro Hill complex and the newly aligned municipal watermain. Finally, Public Utility Lot (PUL) lot widths shall be at least 6.0 m for a single utility and 8.0 m for two utilities. Depending on the pipeline routing option selected, the single watermain line may require a 6.0 m wide easement crossing. This is described further in Section 5.0 (Pipeline Routing Options).

Overhead power lines exist around the site; however, minimal underground conflicts are expected in the area. Locates must be performed by the contractor prior to any excavation.

3.4 REQUIRED DEPTH FOR WATERMAINS & SANITARY SEWER

Ideally, watermains will maintain a depth of 2.5 m as measured from the finished grade to the top of pipe, though variations of this guideline can be seen across the Iqaluit system. Sanitary line design should aim to achieve a minimum of 3.0 m of cover, with building service lines able to achieve 2.0 m of cover at the property line and able to feed into the system by gravity. As with watermain cover requirements, variations in this can be seen throughout Iqaluit.

With insulated pipe, the minimum required depth of pipe cover is about 1.0 m, in consideration of best practice for northern municipal system design. This provides protection of the pipe from on-land activities. Freeze protection is provided by the insulation rather than the depth of bury.

3.5 PIPE MATERIAL & INSTALLATION

All pipe material used within this realignment will be new, insulated HDPE. Pipe materials and fabrication shall conform to AWWA, CSA, and ASTM standards. HDPE material will be DR11 and 50 mm (2") of insulation.

The pipe installation will be in accordance with manufacturer guidelines and specifications, including any required deflections or bends. Prior to placing new lines into service, the pipe must be flushed of all dirt, stones, and lubricants and disinfection procedures (AWWA C651) must be followed for potable water service lines.



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Current and Future Demands

All trenching, bedding, and backfilling must be completed in accordance with Occupational Health and Safety Guidelines. Granular material will be specified within the detailed design documents. Granular C pipe bedding will be used below the pipe and have a minimum depth of 100mm. This material will extend up both sides of the pipe with a minimum cover of 300 mm. If silt is present in the existing ground upon excavation, 450 mm of that material will be excavated and replaced with Granular B material, compacted at 95% Standard Proctor Density (SPD). The minimum trench width will be 450 mm minimum on each side of the pipe. All material will be kept free of water and all layers of material compacted in 150 mm lifts. Any lines running under roads shall be compacted to 98% SPD to 1.5 m below original ground surface and 95% after 1.5 m.

3.6 ACCESS VAULTS

Steel access vaults (AVs) will be prefabricated, complete with all piping, fittings, and accessories. This project will not utilize cast-in-place concrete manholes. Following construction award, the contractor will be required to submit shop drawings of the AVs, showing dimensions, testing certificates, and all pipe and fitting horizontal and vertical details. Each AV will be constructed of steel plates (sides of cover, interior, and exterior 6 mm and bottom 10 mm). Urethane foam insulation will be existing between both layers in accordance with ASTM standards. Metal pipe materials and fittings will be hot dipped galvanized inside and outside after fabricated, as well as pipe supports. Bolts and washers will be cadmium plated. All AVs will be spaced at a maximum of 120 m and located at alignment or grade changes. The granular material below the AV will be Granular C material at a 300 mm minimum thickness. This material will be compacted to 95% SPD. A layer of insulation will be below each AV. AVs will extend between 150 mm and 450 mm above the existing grade surface.

The new AVs will likely not require consideration for a future sanitary line, as that does not fit within the boundaries of this work. The only sanitary considerations are given to the line leading from the Frobisher Inn through Creekside Village, which has been included in the conceptual figures and described in Section 5.0.

4.0 CURRENT AND FUTURE DEMANDS

Stantec understands that the watermain upgrades should be designed and constructed in accordance with the City of Iqaluit Municipal Design Guidelines, including the materials for piping and access. Insulated HDPE pipe will be buried with access through insulated steel access vaults. The watermain would be replaced with a minimum 300 mm (12") insulated HDPE pipe, corresponding with leading and connecting portions of the municipal system. On the south side of the Astro Hill complex (Pt. E and Pt. F in the Utilidor Map Booklet), Stantec recommends replacement of the existing sanitary segment to the AV to be increased one functional size from 250 mm to 300 or 350 mm. Any AC or DI pipes at this location will be replaced with insulated HDPE. The down gradient portion of this AV can be upsized and connected to the existing system with a reducer. Should the City wish to upgrade the line from Creekside Village at a later date, this can be done without modification to the AV.



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ASTRO HILL WATERMAIN REPLACEMENT

Current and Future Demands

4.1 POPULATION AND FORECAST

Analysis of the impact of this replacement on the entire municipal system level is well beyond the scope of this project and cannot be performed without a full system analysis. Our understanding is that the line from Astro Hill feeds through Creekside Village to Lower Iqaluit, which will be maintained at the tie-in point south east of the Frobisher Inn. To complete an accurate analysis of future demand, utilization of the City's water model (in progress) is required to consider the system as it pertains to flows, pressures, sizing, and population growth. Simply reviewing population growth may not be indicative of the future main size as additional lateral connections and water flow calculations may not be linear with population. For the purposes of this study, we have considered a 20-year population growth, as shown in Table 2.

The City of Iqaluit has an estimated population of 7,082 (Statistics Canada 2016), an increase of ~10% from the 2011 census (Reference: Statistics Canada – Census Profile, 2016 Census). Population projection done by the Nunavut Bureau of Statistics (NBS) are available for 2014 – 2035 for the City of Iqaluit (Reference: Nunavut Bureau of Statistics, Nunavut Population Projections by Region and Community, 2014 to 2035), estimating the 2016 population of Iqaluit to be 7,697, however, this was from the 2014 projection. Since the population projection from the NBS end in 2035, the same overall growth rate will be used to project to 2040. This estimated yearly growth rate between 2036 and 2040 is 1.13% and would provide a 2040 population projection of 9,870, and an increase of 22% from the 2020 population.

Following consultation with the City and Colliers Project Leaders, it was requested that Stantec would utilize the High Annual Population Growth rate of 3.38% from the consolidated general plan (October 2015). This was requested to provide additional resiliency with respect to future growth. Following the 2016 Statistics Canada population of 7,082, this rate will project a 2020 population to 8,089 and a 2040 population to 15,727. In comparison with the NBS projected rate (22% increase), this is equivalent to an increase of 94% from the 2020 population. This growth rate will be used for prediction of future requirements.

Table 2 Population Projects for City of Iqaluit

Year	Population
2020	8,089
2040	15,727

(References: City of Iqaluit Consolidated General Plan, October 2015 & Statistics Canada 2016 Census)



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ASTRO HILL WATERMAIN REPLACEMENT

Current and Future Demands

With what we understand with the future population growth of the entire City, we will assume for the purposes of this report that the required capacity of the line will increase at least linearly with population growth. This discussion has been furthered in Section 4.2.

4.2 FUTURE GROWTH AND RECOMMENDED PIPE SIZE

Assuming that population growth has a linear impact on the water system and pipe capacity, the following is being considered. Based upon historical records, we are assuming an average daily water consumption of 3,500 m³/day.

Table 3 Pipe Sizing for Future Growth

Year	Population (Persons)	Demand (L/person/day)	Capacity Requirements ¹ (m ³ /day)	Required Watermain Pipe Size
2020	8,090	435 ²	3,500	200 mm (8") Ductile Iron
2040	9,870	435	4,300 ³	350 mm HDPE DR11
2040	15,727	435	6,841 ⁴	450 mm HDPE DR11

1. This assumes that the current capacity of the line is suitable for current population
2. This is slightly higher than the recommended assumption rate as outlined in the City of Iqaluit Municipal Design Guidelines
3. This represents an increase of about 22% over 20 years (Nunavut Bureau of Statistics)
4. This represents an increase of about 94% over 20 years (City of Iqaluit Consolidated General Plan)

Table 4 Pipe Sizing for Future Growth

Pipe Size and Type	Flow at 3 m/s	Percent Increase to 250 DI	Percent Increase to 200 DI
200 DI	1,860 USGPM	66%	100%
250 DI	2,820 USGPM	100%	152%
250 HDPE DR 11	1,860 USGPM	64%	98%
300 HDPE DR 11	2,550 USGPM	91%	137%
350 HDPE DR 11	3,075 USGPM	109%	166%
400 HDPE DR 11	4,019 USGPM	143%	216%
450 HDPE DR 11	5,087 USGPM	181%	274%
500 HDPE DR 11	6,280 USGMP	223%	338%



ASTRO HILL WATERMAIN REPLACEMENT

Pipeline Routing Options

Based upon Table 3 and 4, and our current assumptions for pipe capacity to population growth, we recommend increasing the pipe size to 350 mm HDPE DR 11 to accommodate 20 years of population growth, based upon the NBS growth rate. Based upon the City of Iqaluit Consolidated General Plan, we would recommend increasing the pipe size to 450mm HDPE DR 11 to accommodate 20 years of population growth. Both of these potential sizes should be confirmed with the water model (currently in progress), as that looks into the entire municipal system, rather than just this single link in the system. In addition, it must be understood that the appropriate size for this main replacement may be driven primarily by fire flow considerations, which are not tightly coupled to the population growth rate. The fire flow considerations are understood to be addressed by the system water model.

The appropriate pipe diameter for future requirements, is most likely within the size range between 350 mm and 450 mm. Note however, that either is sized for future growth instead of current requirements. This could have negative impacts on the rest of the municipal system, such as reducing flow through to other secondary flow loops due to reduced head-loss in this primary flow path. For the purposes of this feasibility study, conceptual figures have been based upon a 350mm HDPE DR 11 pipe.

5.0 PIPELINE ROUTING OPTIONS

All pipeline routing figures and preliminary details can be found in Appendix A. Note that any option (Options 1 and 2) that require easements will require negotiations with the property lease holder. Any easements granted will mean that no permanent infrastructure shall be built over the asset.

5.1 OPTION 1

Option 1 involves a direct route that crosses the paved new Astro Hill development parking lot (Lot 4-3-3-1-1, B1-H32). This option will require a 6 m easement that approximately bisects this parking lot. Technical challenges for this work would be to avoid NorthwesTel infrastructure on the southwest portion of the lot and ensure quality reinstatement of the asphalt within this lot is completed. B1-H32 is divided into three sub-lots. Efforts can be made to route the line and easement considerate of the development plans.

As shown in Figure C-101 (Appendix A), the point of intercept with the existing utilidor is found around 63°44'54.25"N, 68°30'35.59"W. A new access vault (AV, AV20A) will be installed at this location creating a "T" between the existing watermain, the Frobisher Inn water service, and the new pipeline route. AVs will be spaced at a maximum of 120 m, or at major turns or topographic changes. A second AV (AV20B) will be installed around 60-65m south east of AV20A. The third new AV (AV20C) will be installed just south west of the bridge entering from Queen Elizabeth Way around 63°44'51.73"N, 68°30'29.93"W. From here, the watermain will bisect the new Astro Hill development parking lot and connect into a fourth AV (AV20D), located around 63°44'49.67"N, 68°30'34.38"W. The fourth AV will require water and sanitary connections from the Frobisher



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ASTRO HILL WATERMAIN REPLACEMENT

Pipeline Routing Options

Inn, connection of the newly routed watermain, and connections into the downstream (Creekside Village / Lower Iqaluit) portion of the system.

This option requires a total pipe length of 215m, 4 new AVs, and an approximate 6m easement across the new Astro Hill development. As mentioned, Figure C-101, found in Appendix A, shows the approximate route of Option 1. The plan and profile figure is shown in C-201.

5.2 OPTION 2

Option 2, though a longer length of pipe, aims to avoid the new Astro Hill development and parking lot. It will run underground and eventually hug the southern side of the parking lot. A 6 m easement will also be required for this route; however, it would be shared between the Astro Hill property line and the garage at building 511 (Lot 188, B1-H32).

As with Option 1, the point of intercept with the existing utilidor is found around 63°44'54.25"N, 68°30'35.59"W. A new AV (AV20A) will be installed at this location creating a "T" between the existing watermain, the Frobisher Inn water service, and the new pipeline route. AVs will be spaced at a maximum of 120 m, or at major turns or topographic changes. The second new AV (AV20B) will be installed around 60-65m south east of AV20A. The third new AV (AV20C) will be installed just south west of the bridge entering from Queen Elizabeth Way around 63°44'51.73"N, 68°30'29.93"W. A fourth new AV (AV20E) will be installed west of building 511, on the west side of Lake Geraldine drainage channel. The approximate location of this AV is 63°44'49.12"N, 68°30'26.81"W. The buried line will hug the new Astro Hill development lot and connect into a fifth AV (AV20F), located approximately at 63°44'49.12"N, 68°30'33.73"W. This buried line will run between property lines just north of Building 511. As with Option 1, the fifth AV within Option 2 will require water and sanitary connections from the Frobisher Inn, connection of the newly routed watermain, and connections into the downstream (Creekside Village / Lower Iqaluit) portion of the system.

This option requires a total pipe length of 315m, 5 new AVs, and an approximate 6m easement, split between the south east edge of the new Astro Hill development and the north property line of Building 511. As mentioned, Figure C-102, found in Appendix A, shows the approximate route of Option 2. The plan and profile figure is shown in Figure C-202.

5.3 OPTION 3

Option 3, though requiring the longest length of pipe and most AVs, aims to avoid the new Astro Hill development and parking lot and an easement between Astro Hill development and Building 511 lot lines. It will run underground and eventually cross between the south side of Buildings 511 and Block 300. Stantec understands that no easement is required at this location. This is to be confirmed during future design phases.



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ASTRO HILL WATERMAIN REPLACEMENT

Pipeline Routing Options

As with Options 1 and 2, the point of intercept with the existing utilidor is found around 63°44'54.25"N, 68°30'35.59"W. A new AV (AV20A) will be installed at this location creating a "T" between the existing watermain, the Frobisher Inn water service, and the new pipeline route. AVs will be spaced at a maximum of 120 m, or at major turns or topographic changes. The second new AV (AV20B) will be installed around 60-65m south east of AV20A. The third new AV (AV20C) will be installed just south west of the bridge entering from Queen Elizabeth Way around 63°44'51.73"N, 68°30'29.93"W. A fourth new AV (AV20G) will be installed west of building 511, on the west side of Lake Geraldine drainage channel. The approximate location of this AV is 63°44'49.12"N, 68°30'26.81"W. Continuing south past Building 511, the new line will connect with a fifth new AV (AV20H). The buried line will run between Building 511 and Block 300 and connect to a sixth and final AV (AV20I). As with Options 1 and 2, the sixth AV within Option 3 will require water and sanitary connections from the Frobisher Inn (and upstream Creekside Village), connection of the newly routed watermain, and connections into the downstream (Creekside Village / Lower Iqaluit) portion of the system.

This option requires a total pipe length of 380m, 6 new AVs, but no easement is required between Building 511 and Block 300. As mentioned, Figures C-103, found in Appendix A, shows the approximate route of Option 2. The plan and profile figures (approximate, no survey completed for this section) can be found in Figures C-203 and C-204.

5.4 BOUNDARY LIMITS & TECHNICAL CHALLENGES

Stantec understands that the project is limited to the portion of the municipal watermain that is currently routed under the Astro Hill complex. Though all services to the complex and Frobisher Inn will be maintained and undisturbed within this work, some disruption should be expected. A geotechnical investigation could be conducted at a future design phase to determine the subsurface conditions and predict the required level of effort for placement of the buried infrastructure. The location of work does not imply any atypical constructability challenges.

This work should take place during the summer months. Considering the required background work, detailed design phases should begin in May such that field investigations can be planned and coordinated. Following summer investigation, design can be completed during fall and early winter, issuing tender package in early winter (February) with award expected in early March. This will allow the successful proponent adequate time to procure, manufacture, and ship the required materials. Later award for construction will increase the risk of project delay and potentially increase price of manufactured items.

A summary of the technical challenges associated with each pipeline routing option are described below.

- Option 1 involves a direct route that crosses the paved new Astro Hill development parking lot (Lot 4-3-3-1-1-, B1-H32). This option will require a 6 m easement that approximately bisects this parking lot. Technical challenges for this work would be to avoid NorthwesTel infrastructure on the southwest



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ASTRO HILL WATERMAIN REPLACEMENT

Opinion of Probable Cost

portion of the lot and ensure quality reinstatement of the asphalt within this lot is completed. B1-H32 is divided into three sub-lots. Efforts can be made to route the line and easement considerate of the development plans.

- Option 2, though a longer length of pipe, aims to avoid the new Astro Hill development and parking lot. It will run underground and eventually hug the southern side of the parking lot. A 6 m easement will also be required for this route; however, it would be shared between the Astro Hill property line and the garage at building 511 (Lot 188, B1-H32).
- Option 3 does not require an easement; however, it requires the longest length of pipe and most AVs and will be the costliest of all options.

Technical challenges for all options will be in working in and around the congested area southeast of the Frobisher Inn. Fuel tanks and above ground steam pipes create an extremely congested area. All options will require excavation and installation of a new AV and water and sanitary line segments.

6.0 OPINION OF PROBABLE COST

An Opinion of Probable Cost (OPC) has been completed for the pipeline routing options identified in Section 5.0. A 30% contingency has been applied to the cost, which can be found in Table 4. Unit prices are based upon 2020 costs received from local contractors on a similar Iqaluit job. This OPC does not include costs for engineering design fees, stakeholder engagement, or construction administration. Mobilization and demobilization costs vary depending on contractor and have not been estimated.

Table 4 Opinion of Probable Cost

Component	Unit Cost (\$/unit)	Option 1		Option 2		Option 3	
		Unit	Cost	Unit	Cost	Unit	Cost
Excavation	\$550/L.M.	215	\$118,250.00	315	\$173,250.00	380	\$209,000.00
Access Vaults	No.	4	\$714,000.00	5	\$892,500.00	6	\$1,071,000.00
Insulated HDPE (Supply & Install)	\$785/L.M.	215	\$168,688.24	315	\$247,147.88	380	\$298,146.65



ASTRO HILL WATERMAIN REPLACEMENT

Construction Schedule

Sub-total:	\$1,000,938.24	\$1,312,897.88	\$1,578,146.65
Contingency (30%):	\$300,281.47	\$393,869.31	\$473,444.00
Total:	\$1,301,219.71	\$1,706,767.25	\$2,051,590.65
Opinion of Probable Cost:	\$1.3M	\$1.7M	\$2.05M

7.0 CONSTRUCTION SCHEDULE

A reasonable construction schedule to complete this work has been considered and is summarized in Table 5. Stantec understands that the City is planning on completing detailed design and construction of this work in 2022, so all dates have been set within that calendar year. A more detailed schedule breakdown is found in the Gantt Chart in Appendix C.

Table 5 Construction Schedule

Task	Date
RFP Detailed Design	Issued April 2022
RFP Award	May 2022
Field Investigation	June – August 2022
Detailed Design	September – December, 2022
Tender Documents	January 2023
RFT Construction	Issued February 2023
Construction Award	March 2023
Construction	Planning: April – June 2023 Materials Shipment: June – July 2023 Construction: July - September 2023
Project Completion	October 2023



ASTRO HILL WATERMAIN REPLACEMENT

Recommendation & Future Work

8.0 RECOMMENDATION & FUTURE WORK

Some recommendations for future work are listed below.

1. Confirm existing services size and elevations. A discrepancy between record drawing sets at tie-in points (north of Frobisher Inn and south east of Frobisher Inn) was observed.
2. A geotechnical investigation could be performed to understand sub surface conditions and excavation constraints along the selected route.
3. Topographic survey should be extended to include Option 3.
4. Pipe sizing and future demands must be confirmed using the water model, which is currently in progress for the City of Iqaluit.

Each of the three options presented within this feasibility study will work, technically. Access for Option 3 will provide some ease to construction, operations, and maintenance; however, it is the costliest. Options 1 and 2 are both suitable options, technically; however, each will require consultation with the property lease holder and legal negotiations. Based upon the development within the Astro Hill complex, we recommend the City of Iqaluit proceeds forward with Option 3 to avoid any future conflicts with developments.



APPENDIX A

Preliminary Figures & Details



Suite 200 4910 53rd Street PO Box 1777
Yellowknife NT Canada X1A 2P4
Tel. 867.920.2882
www.stantec.com

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City of Iqaluit

ASTRO HILL WATER RELOCATION

IQALUIT, NU

Title

CIVIL LOCATION PLAN

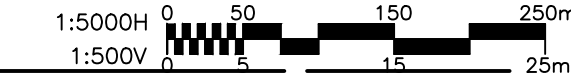
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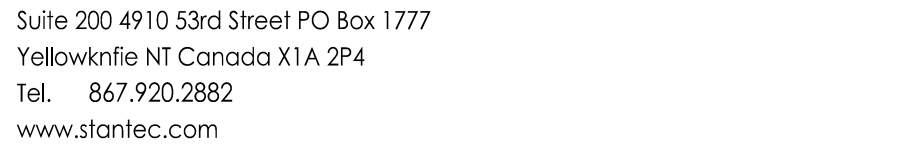
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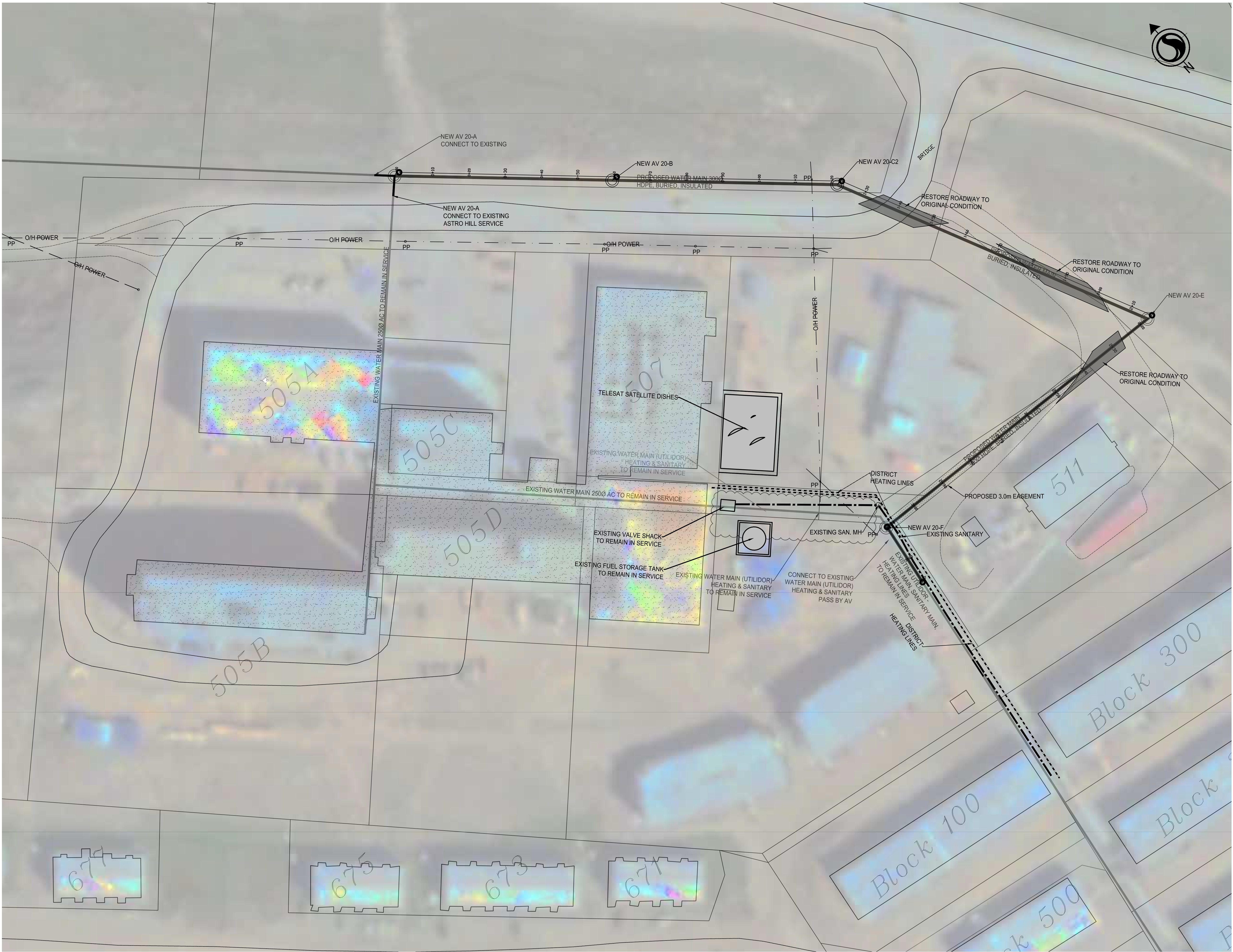
ASTRO HILL WATER RELOCATION

IQALUIT, NU

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OPTION 2

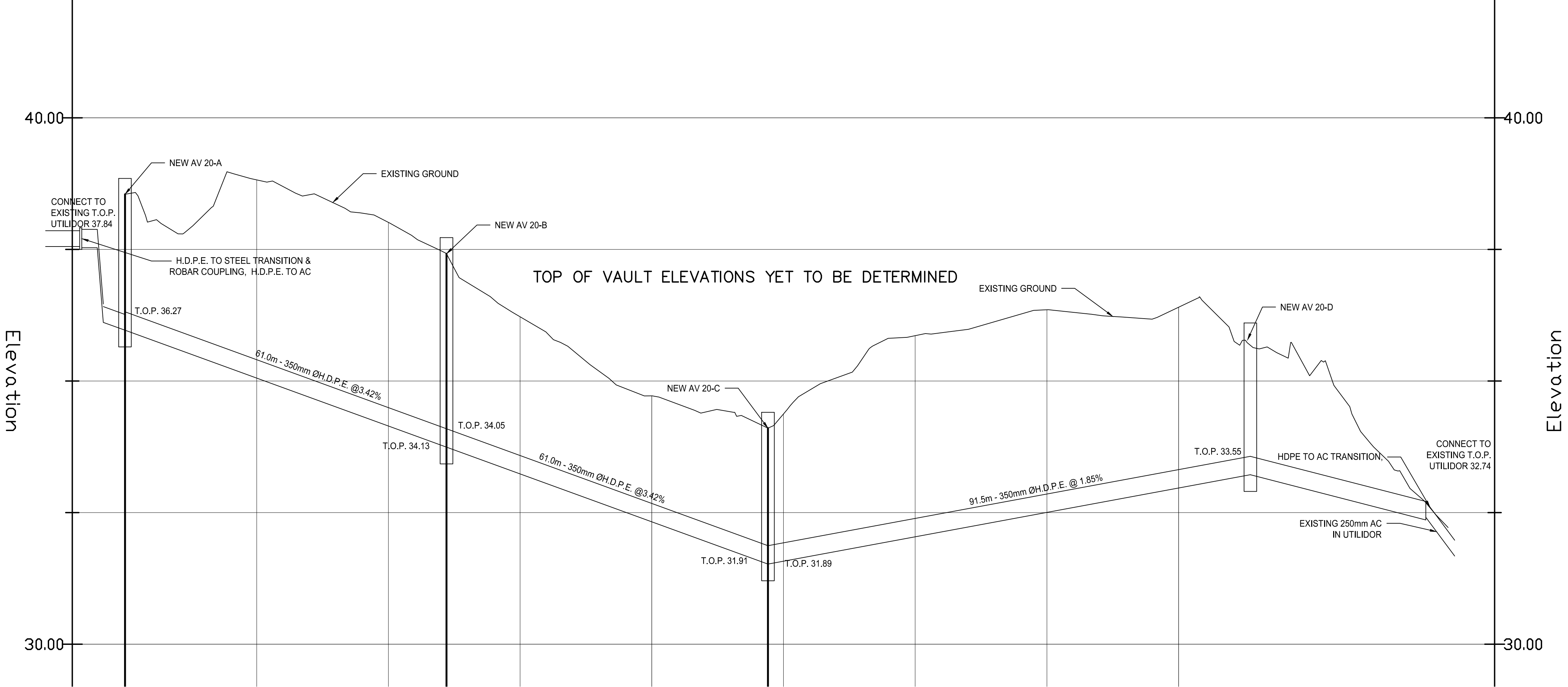
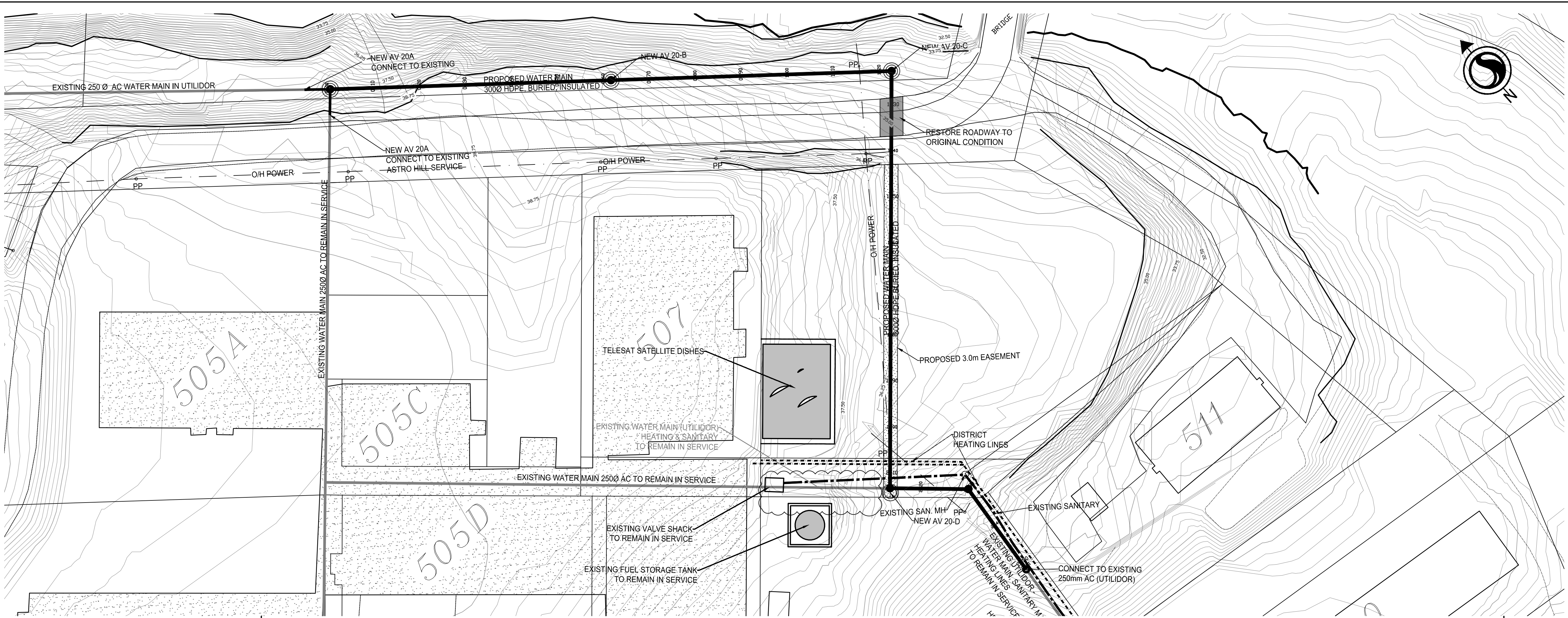
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ASTRO HILL WATER RELOCATION

IQALUIT, NU

Title
CIVIL PLAN & PROFILE
OPTION 1

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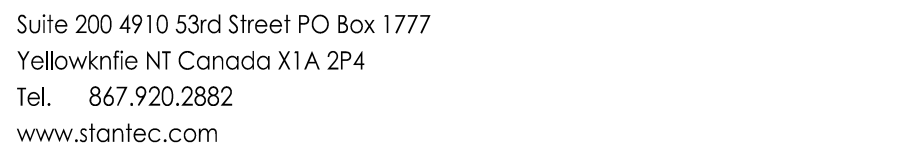
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City of Iqaluit

ASTRO HILL WATER RELOCATION

IQALUIT, NU

Title

CIVIL PLAN & PROFILE
OPTION 2

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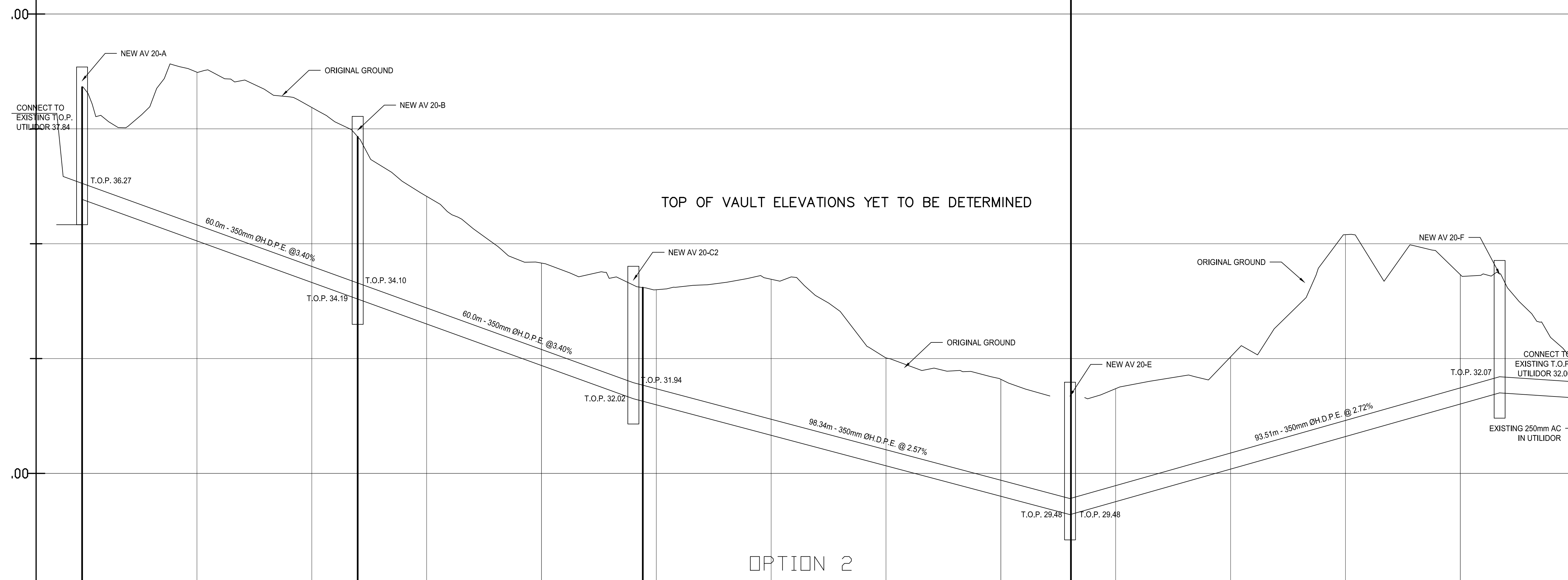
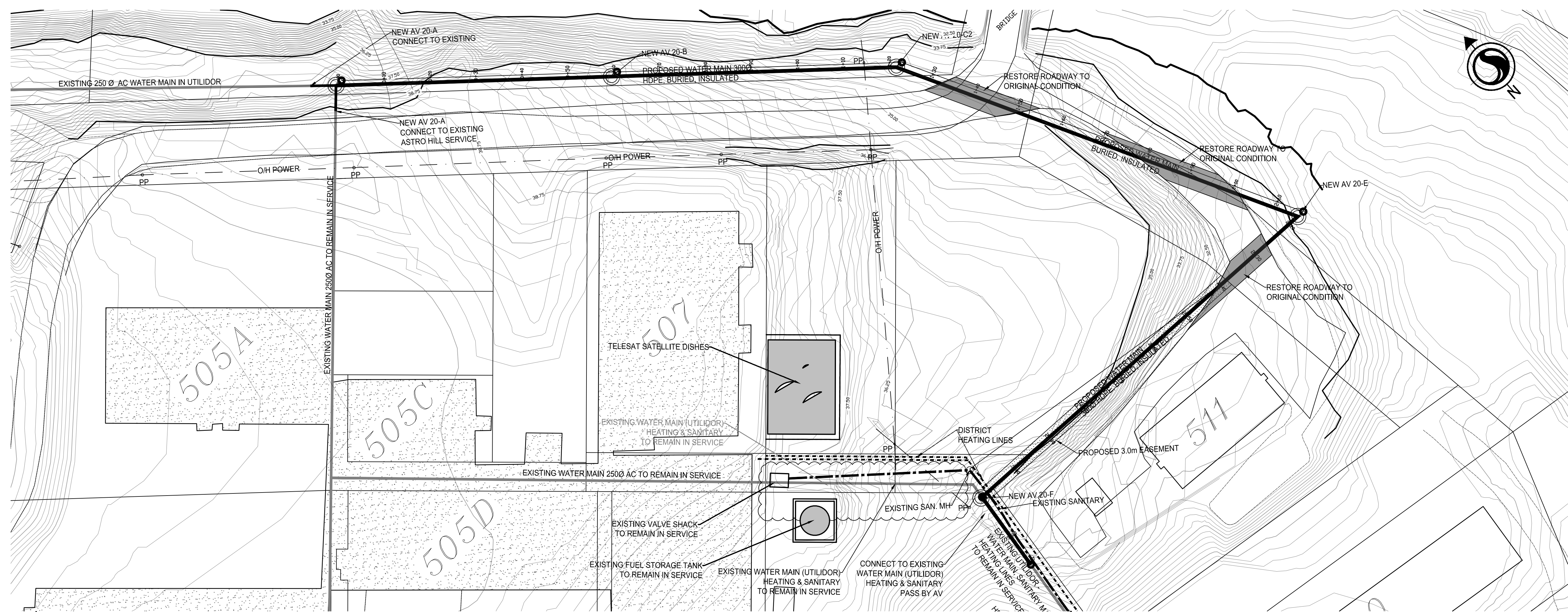
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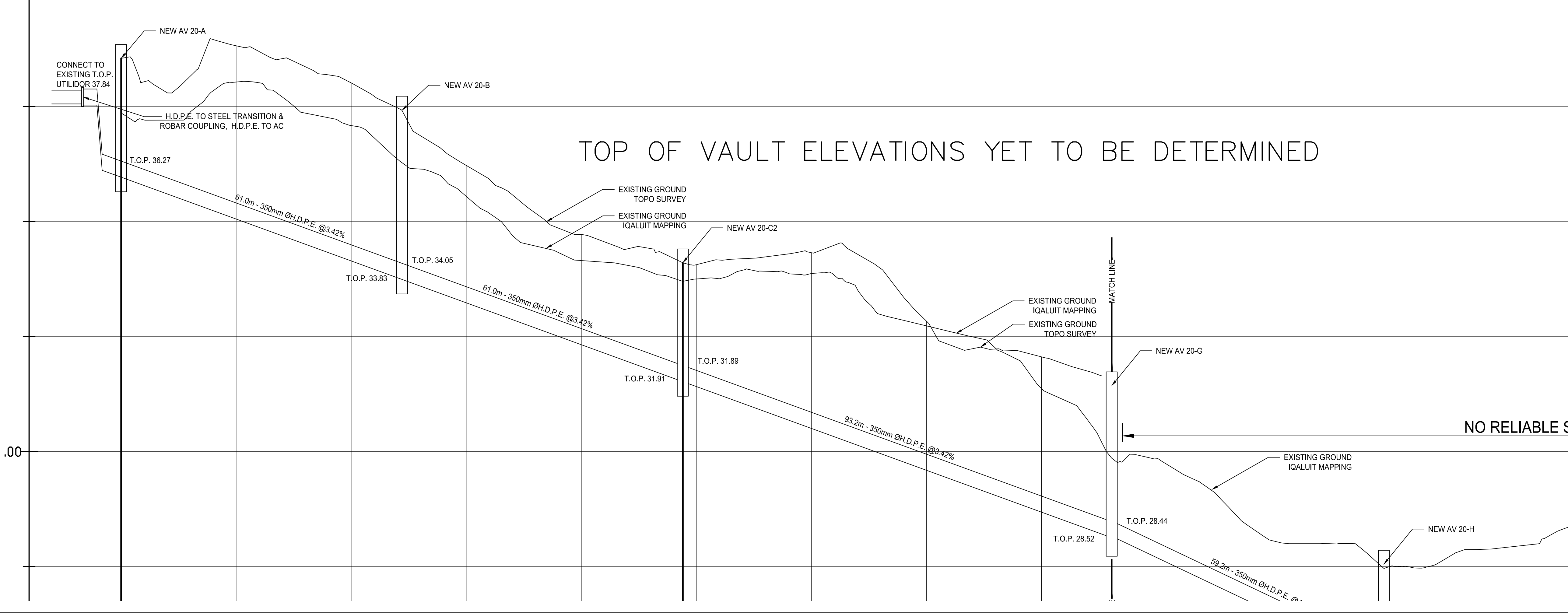
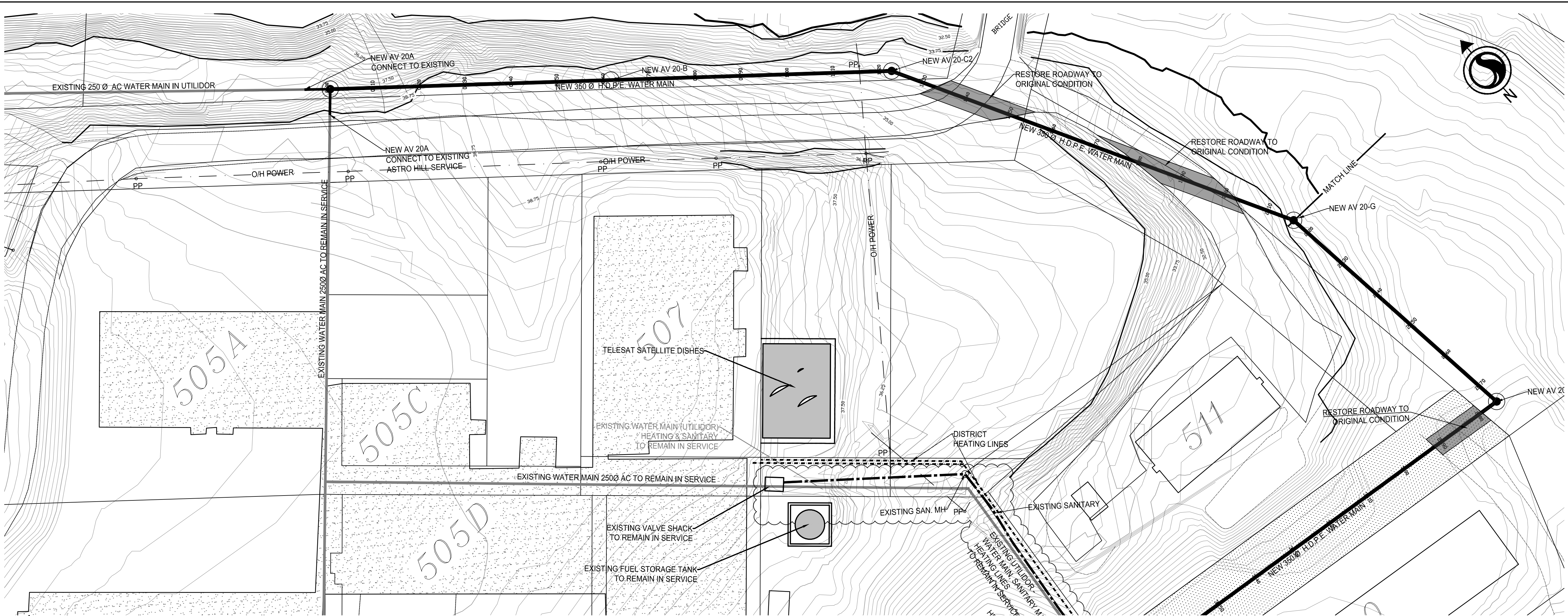


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2021.01.26 7:49:28 PM By: Mathers, Ian

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B	ISSUED FOR 99% REVIEW	IGM	MF	21.01.20
A	ISSUED FOR REVIEW	IGM	MF	20.08.31
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File Name: 144903028-C-101.dwg		##	##	##
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Client/Project

City of Iqaluit

ASTRO HILL WATER RELOCATION

IQALUIT, NU

Title

CIVIL PLAN & PROFILE
OPTION 3

Project No.

144903028

Drawing No.

A/0

Scale

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Revision

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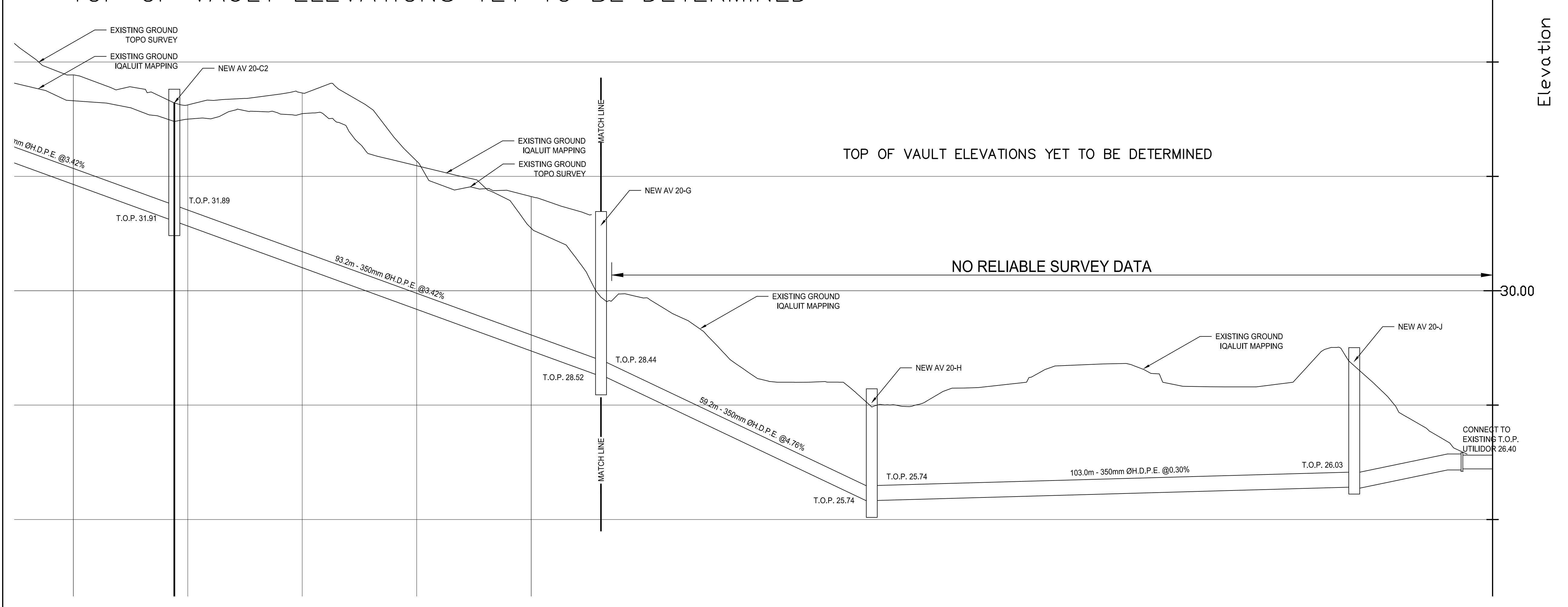
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C-203



Suite 200 4910 53rd Street PO Box 1777
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City of Iqaluit

ASTRO HILL WATER RELOCATION

IQALUIT, NU

Title
CIVIL PLAN & PROFILE
OPTION 3

Project No. 144903028

Drawing No. A/0

Revision 05

TBD

C-204

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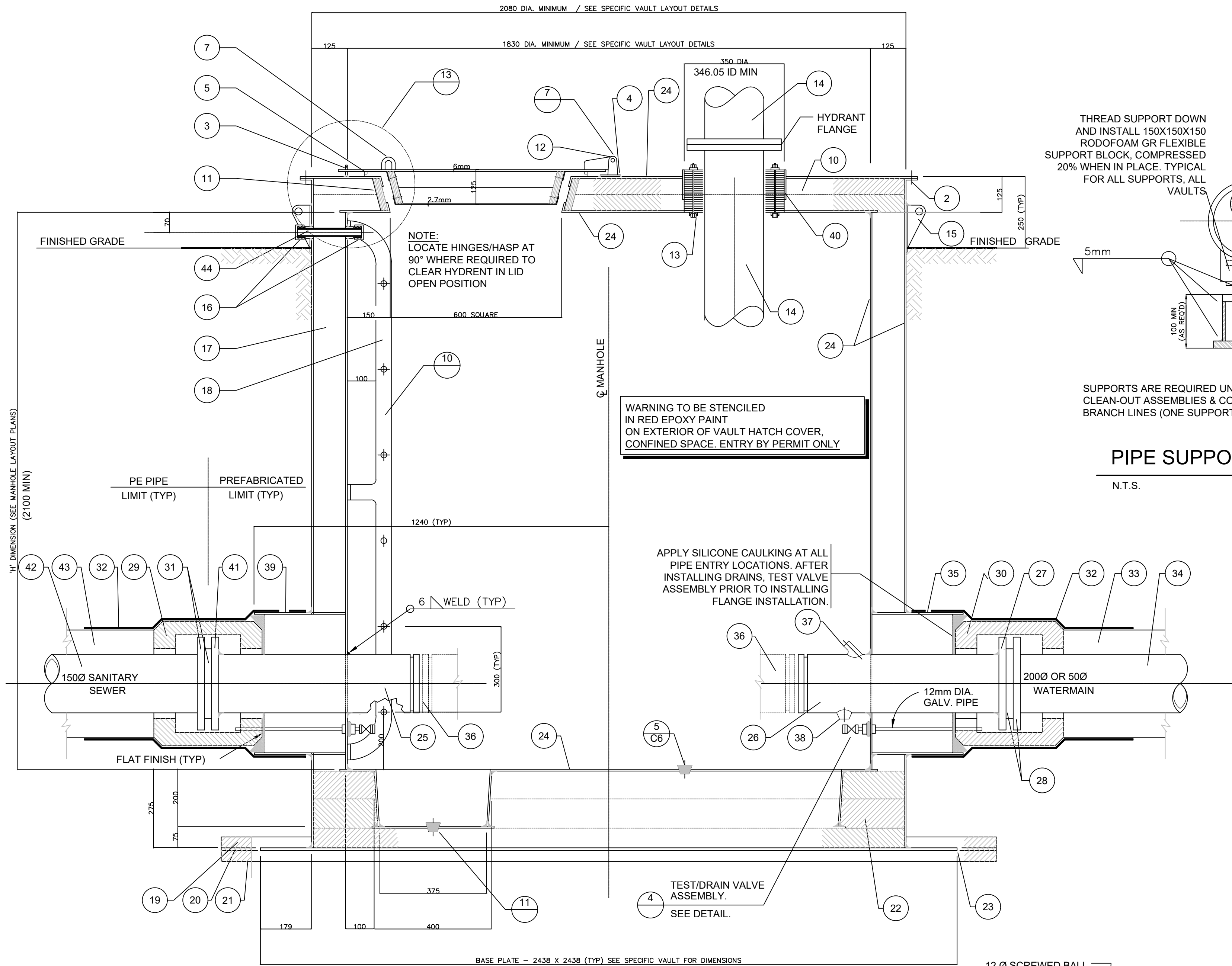
ORIGINAL SHEET - ANS500

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KEY TO NUMBERED PARTS:

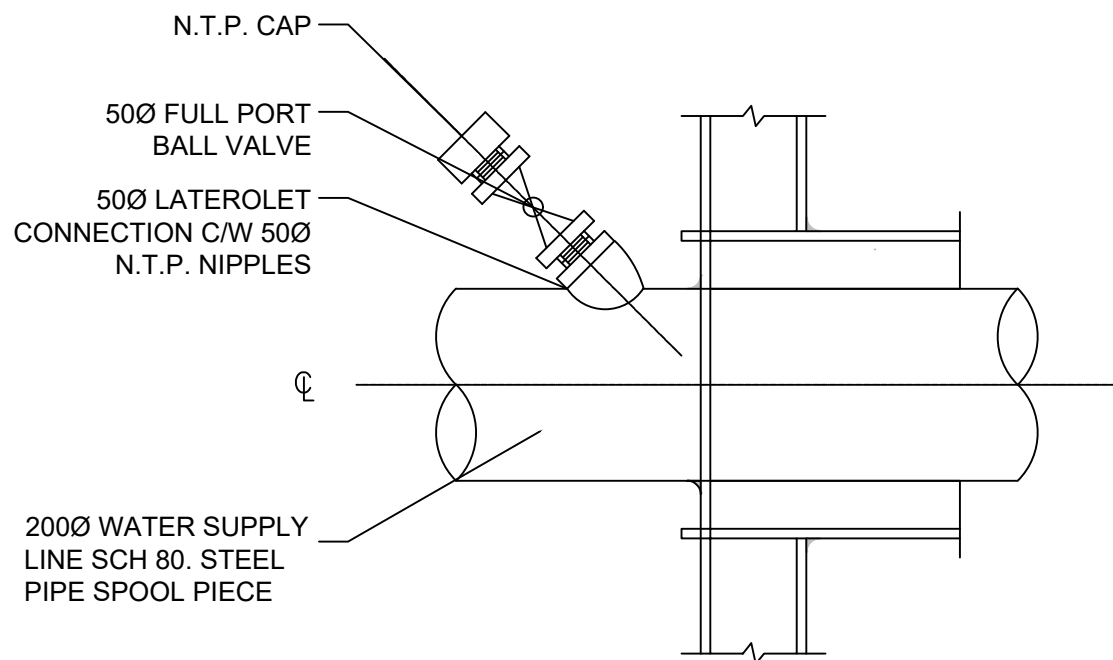
- 20mm THK HD POLYETHYLENE SHEET, THERMAL BREAK
- 12mmØ GALVANIZED STEEL BOLTS, NUTS, AND WASHERS
210mm EQUAL SPACING.
- HASP ASSEMBLY (DETAIL 2-C5)
- 50mm X 60mm X 12mm STEEL HINGE BASE PLATE
WELDED TO ACCESS VAULT TOP
- 19mm X 38mm 35 DUROMETER SOFT NATURAL RUBBER
STRIP (REVERSIBLE) GASKET TO ACHIEVE AIRTIGHT &
WATERPROOF SEAL ALL AROUND (DETAIL 3-C5)
- 50mm X 10mm BAR, WELD CONTINUOUS AROUND TOP OF
VAULT BARREL, DRILL TO MATCH TOP LID.
- LIFTING EYE 12mmØ STEEL X 40mm INSIDE LOOP
- 6mm GALVANIZED STEEL NUT. COUNTERSUNK SHEET METAL
SCREWS @ 100mm CENTERS
- 6mm X 19mm GALVANIZED STEEL COUNTERSUNK SHEET
METAL SCREWS @ 100mm CENTERS
- POLYURETHANE SHEET INSULATION, 240 kPa CUT TO SIZE
- 20mm THICK HIGH DENSITY POLYETHYLENE
- HINGES SPACED @ 400mm APART.
- THUNDER-LINE CORP. LINK-SEAL MODEL LS-500-C
(200X350) OR APPROVED EQUAL TO FIT ITEMS 14 & 40
- 200mmØ CRANE McAVITY M-67 "IN-LINE" FIRE HYDRANT
- LIFTING LUGS - TWO PER ACCESS VAULT. 150mm X
75mm X 12mm THICK WITH 38mmØ LIFTING EYE, C/W 200
X 200 X 12 STEEL REINFORCING PLATE CURVED TO RADIUS,
CONTINUOUSLY WELDED.
- 65mmØ THREADED STEEL HALF NIPPLE CONDUIT SLEEVE
(FOR EXTENSION CORD OR SUMP PUMP DISCHARGE) IN
APPROPRIATE LOCATION, C/W THREADED GALVANIZED STEEL
CAPS
- SPRAYED POLYURETHANE INSULATION 240kPa.
- LADDER, LENGTH AS REQUIRED. 450m WIDE MADE FROM
65mm X 12mm FLAT BAR VERTICALS & SUPPORTS WITH
20mmØ RUNGS. WELDED CONSTRUCTION THROUGHOUT ALL
EDGES TO BE GROUND SMOOTH GALVANIZED AFTER
FABRICATION. FASTEN WITH STEEL STUDS WELDED TO INNER
WALL.
- 38mm THICK STYROFOAM, 4 PIECES, OUTER EDGE TO
MATCH ITEM 21 - DOW CHEMICAL HI 60, 410 kPa
COMPRESSIVE STRENGTH.
- FILLER PIECE 10mm THICK STYROFOAM DOW CHEMICAL HI
60
- 38mm THICK STYROFOAM DOW CHEMICAL HI 60. SEE
SPECIFIC VAULT DETAIL FOR DIMENSIONS
- POLYURETHANE SHEET INSULATION CUT TO SIZE, 240kPa
- 10mm THICK SQUARE STEEL BASE PLATE. SEE SPECIFIC
VAULT DETAILS FOR DIMENSIONS.
- 6mm THICK STEEL PLATE ACCESS VAULT CONSTRUCTION
- 150mmØ SANITARY SEWER ENTRY, SCHEDULE 8 STEEL PIPE
SPOOL PIECE.
- 200mmØ OR 50mmØ WATERMAIN ENTRY. SCHEDULE 80
STEEL PIPE SPOOL PIECE.
- 200mmØ OR 50mmØ WELDED STEEL SLIP-ON FLANGE.
- 200mmØ OR 50mmØ (IP SIZE) DR 17 PE/50mmØ SERIES
DR 17 STUB END, ASA 125# CAST IRON (DUCTILE) METAL
BACKUP FLANGE, CADMIUM PLATED NUTS, BOLTS AND
WASHERS AND STUB END GASKET
- FLANGE INSULATION KIT, 470mm OD FOR 200mmØ PE PIPE,
407mm OD FOR 150mmØ PE PIPE, 290mm OD FOR
50mmØ. (MASTIC COATED INNER SURFACES) AND FRP
COATING.
- FLANGE INSULATION KIT, 290mm OD FOR 50mmØ PE PIPE,
407mm OD FOR 150mmØ PE PIPE, 470mm OD FOR
200mmØ PE PIPE, 535mm OD FOR 250mmØ PE (MASTIC
COATED INNER SURFACES) AND FRP COATING.
- 200mmØ/150mmØ (I.P. SIZE) DR 17 PE/50mmØ DR 17
PE STUB END, ASA 125# CAST IRON (DUCTILE) METAL
BACKUP FLANGE, CADMIUM PLATED NUTS, BOLTS &
WASHERS, AND STUB END GASKET
- RAYCHEM THERMACLAD HEAT SHRINK TAPE, 2 LAYERS MIN.
50% OVERLAP EACH WRAP.
- 50mm THICK POLYURETHANE INSULATION HALVES OR PE
PIPE PRE-INSULATION TO SUIT PIPE SIZES
- 200mmØ (IP SIZE) PE WATERMAIN OR 50mmØ (IP SIZE) PE
WATERMAIN
- STEEL RING SECTION WELDED TO ACCESS VAULT OUTER
WALL 6mm THICK X 470mm OD FOR 200mmØ, 290mm OD
FOR 50mmØ
- HOT DIPPED GALVANIZED STEEL PIPING.
- 50mmØ LATROLET
- 25mmØ THREADOLET
- STEEL RING SECTION WELDED TO ACCESS VAULT OUTER
WALL 6mm THICK X 407mm OD FOR 150mmØ SEWER LINE,
470mm OD FOR 200Ø SEWER LINE.
- HYDRANT COLLAR, 350mmØ SCHEDULE 10 (346mm ID)
STEEL PIPE X 100mm LONG WELDED TO ACCESS VAULT
EXTERIOR TOP PLATE
- 200mmØ/150mmØ WELDED STEEL SLIP-ON FLANGE
- 200mmØ (IP SIZE) PE SEWER MAIN.
- 50mm THICK POLYURETHANE INSULATION HALVES OR PE
PIPE PRE-INSULATION TO SUIT PIPE SIZES
- POLYETHYLENE LINER TUBE, PACK WITH STYROFOAM
INSULATION.



TYPICAL STEEL VAULT CONSTRUCTION

N.T.S.

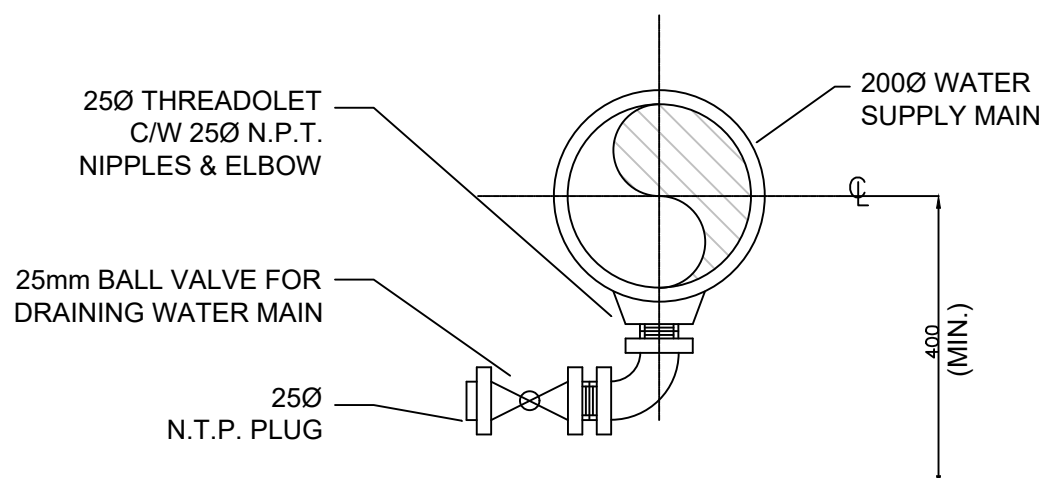
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VENT VALVE DETAIL

N.T.S.

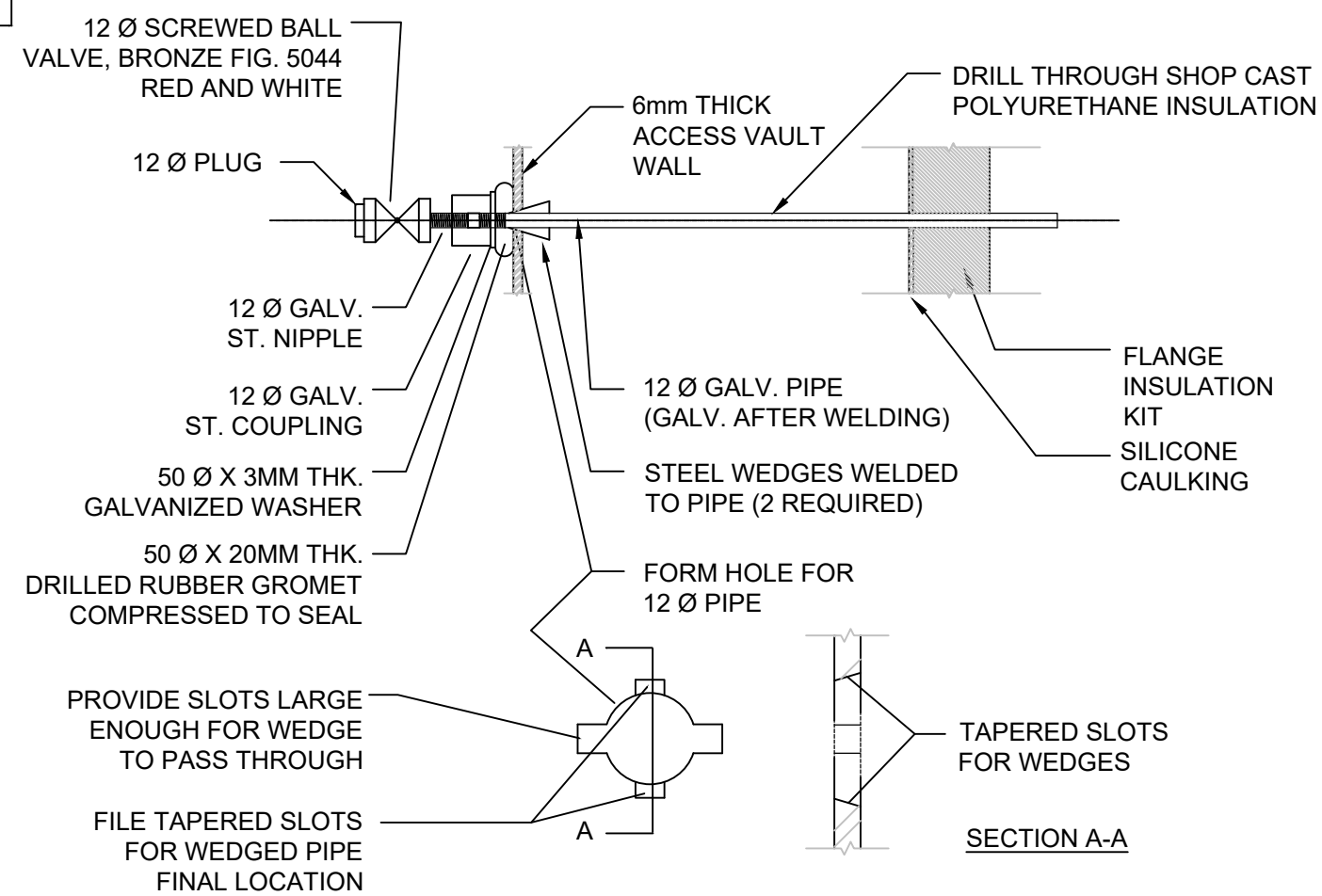
2



DRAIN VALVE DETAIL

N.T.S.

3



TEST / DRAIN VALVE ASSEMBLY

N.T.S.

4

PIPE SUPPORT DETAIL

N.T.S.

5

THREAD SUPPORT DOWN
AND INSTALL 150X150X150
RODOFOAM GR FLEXIBLE
SUPPORT BLOCK, COMPRESSED
20% WHEN IN PLACE. TYPICAL
FOR ALL SUPPORTS, ALL
VAULTS

NOTE:
PIPE SUPPORT TO BE HOT DIPPED
GALVANIZED AFTER FABRICATION

SUPPORTS ARE REQUIRED UNDER HYDRANTS, SEWER
CLEAN-OUT ASSEMBLIES & CONNECTION POINTS FOR
BRANCH LINES (ONE SUPPORT MIN PER LINE)

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Client/Project

City of Iqaluit

ASTRO HILL WATER RELOCATION

Iqaluit, NU

Title

CIVIL ACCESS VAULT DETAILS 1

Project No.

144903028

Drawing No.

A/0

Scale

AS NOTED

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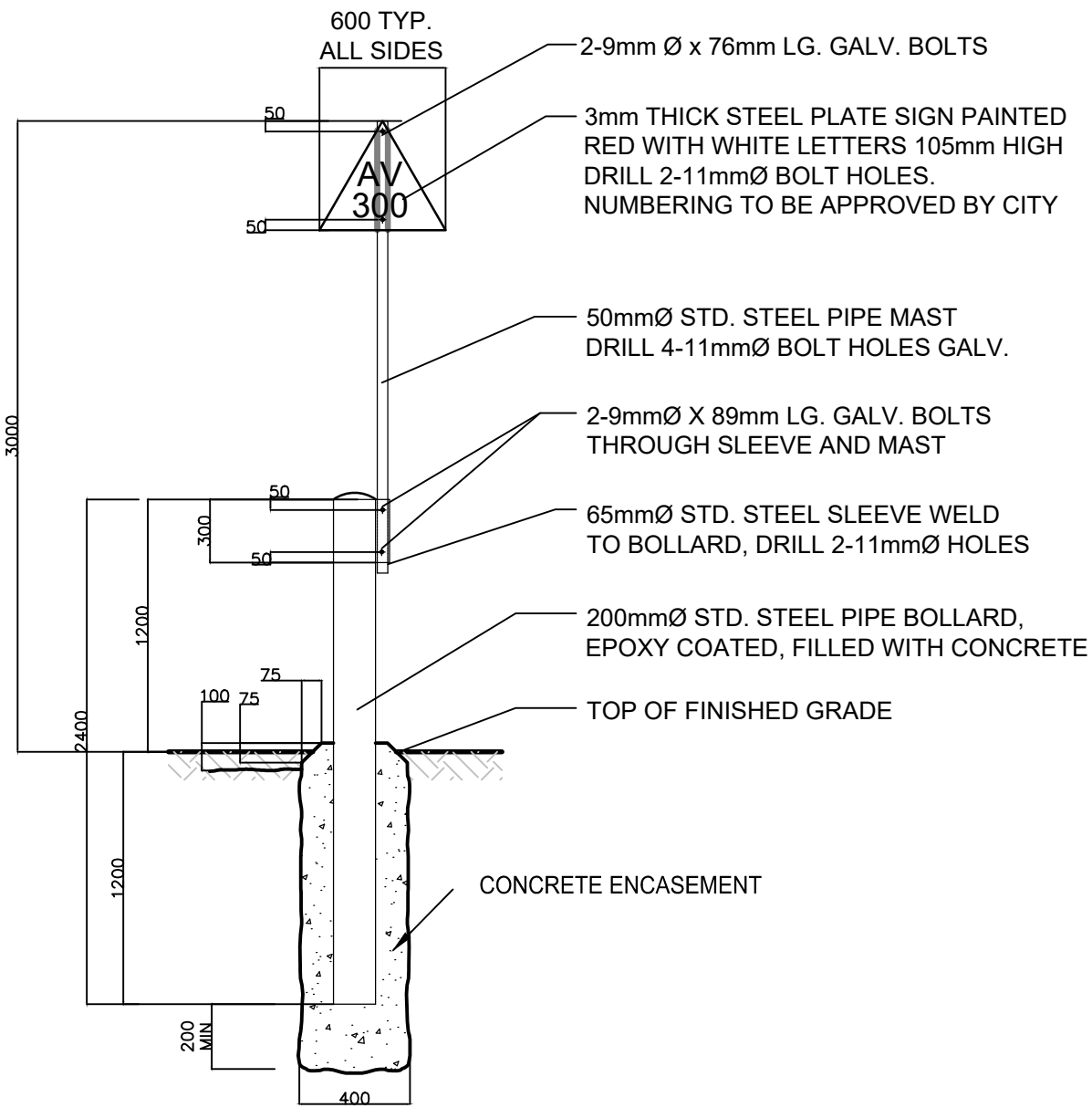
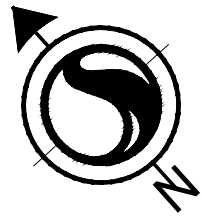
03 TBD

Revision

C-500

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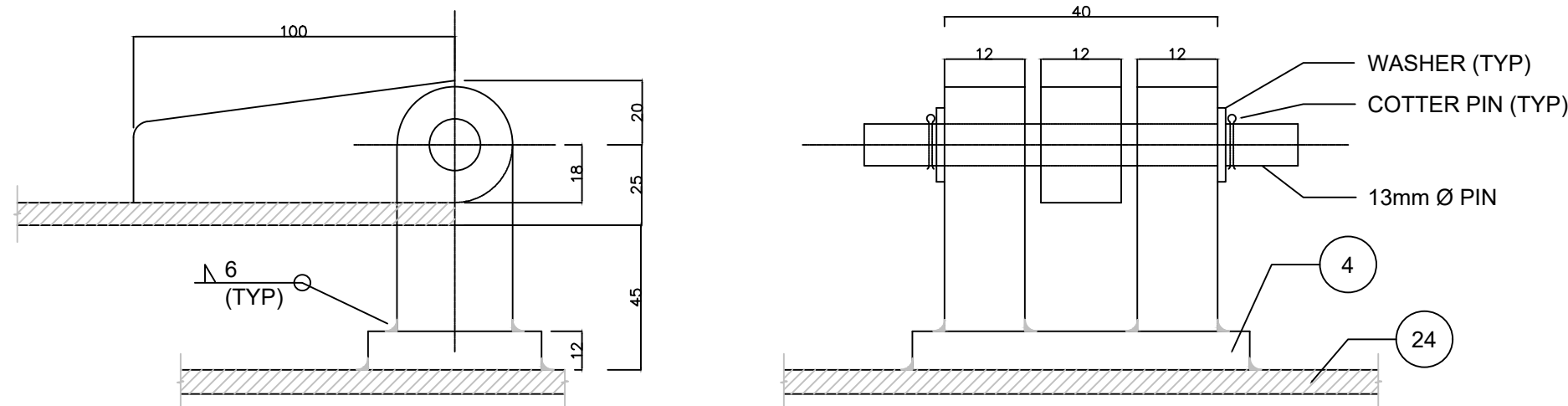
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NOTE:
1. MARKER SIGNS ARE REQUIRED, DOUBLE SIDED C/W BOLLARD
2. BOLLARD, SLEEVE AND MAST TO BE PAINTED RED AFTER FABRICATION

BOLLARD AND MARKER DETAIL

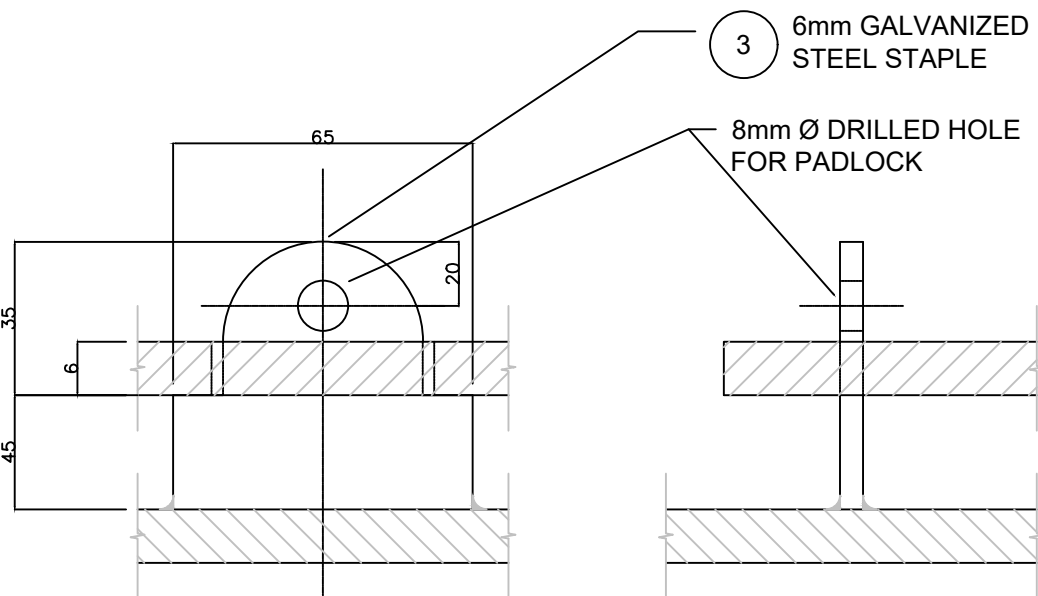
N.T.S.



NOTES:
1. TWO HINGES ARE REQUIRED FOR EACH COVER.
2. HINGES TO BE SPACED AT 400mm APART

COVER HINGE DETAIL

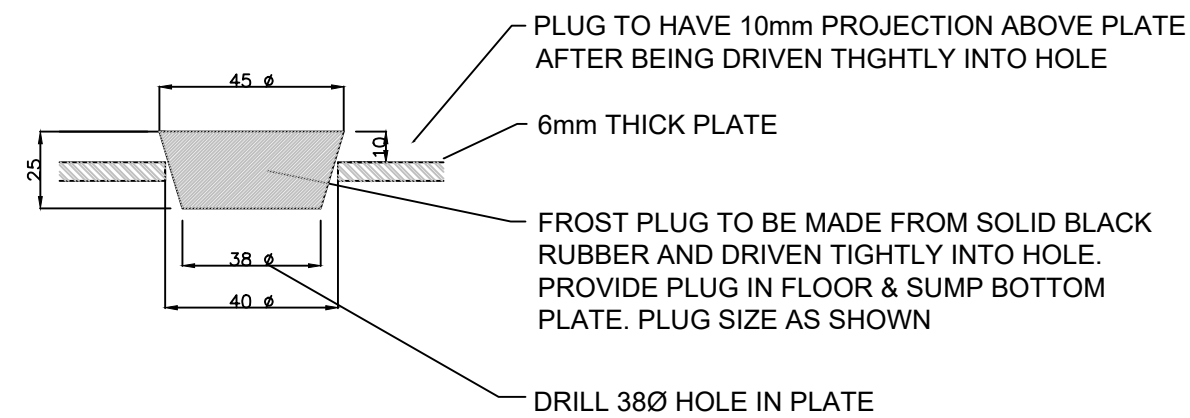
N.T.S.



NOTE:
HEAVY DUTY PADLOCKS TO BE INSTALLED TO EACH ACCESS VAULT.
C/W DUST COVER. USE BEST LOCK COMPANY NO. 2B-7-72-C.
ALL KEYED TO THE CITY OF IQALUIT PUBLIC WORKS LOCK SYSTEM.

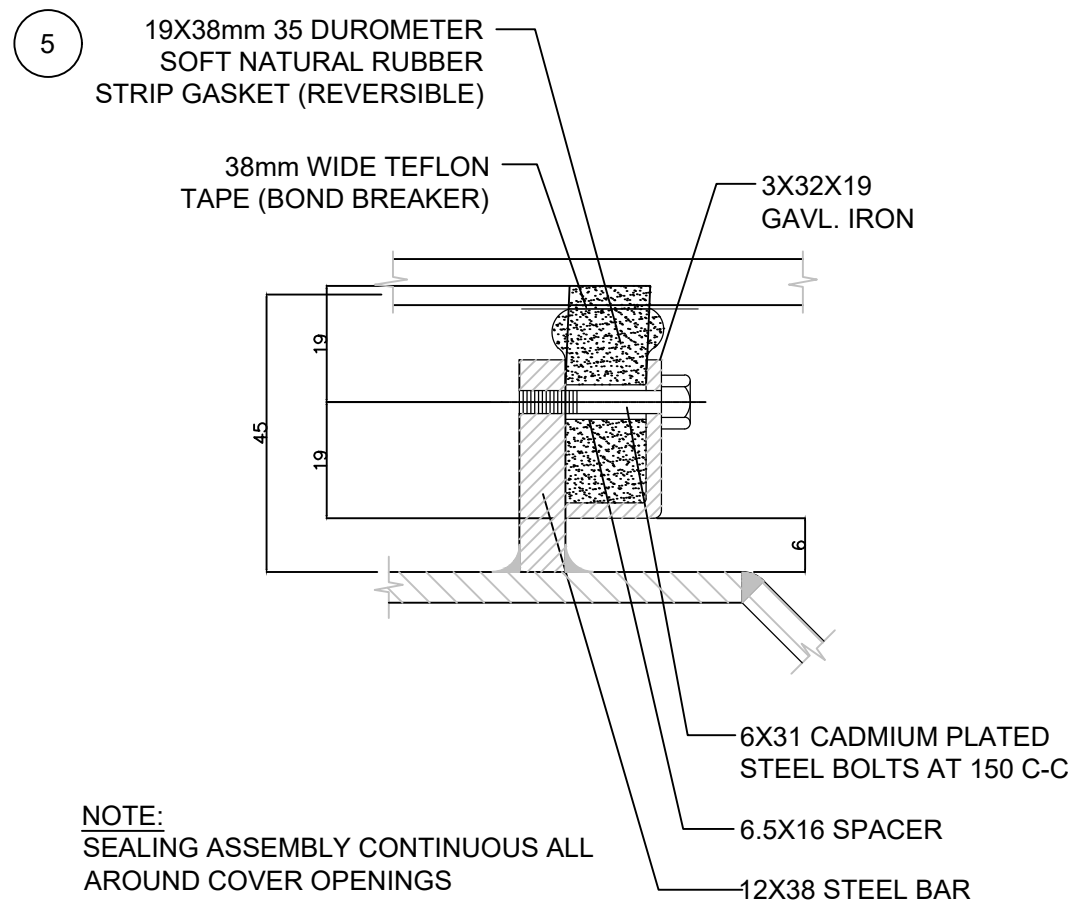
LOCK HASP DETAIL

N.T.S.



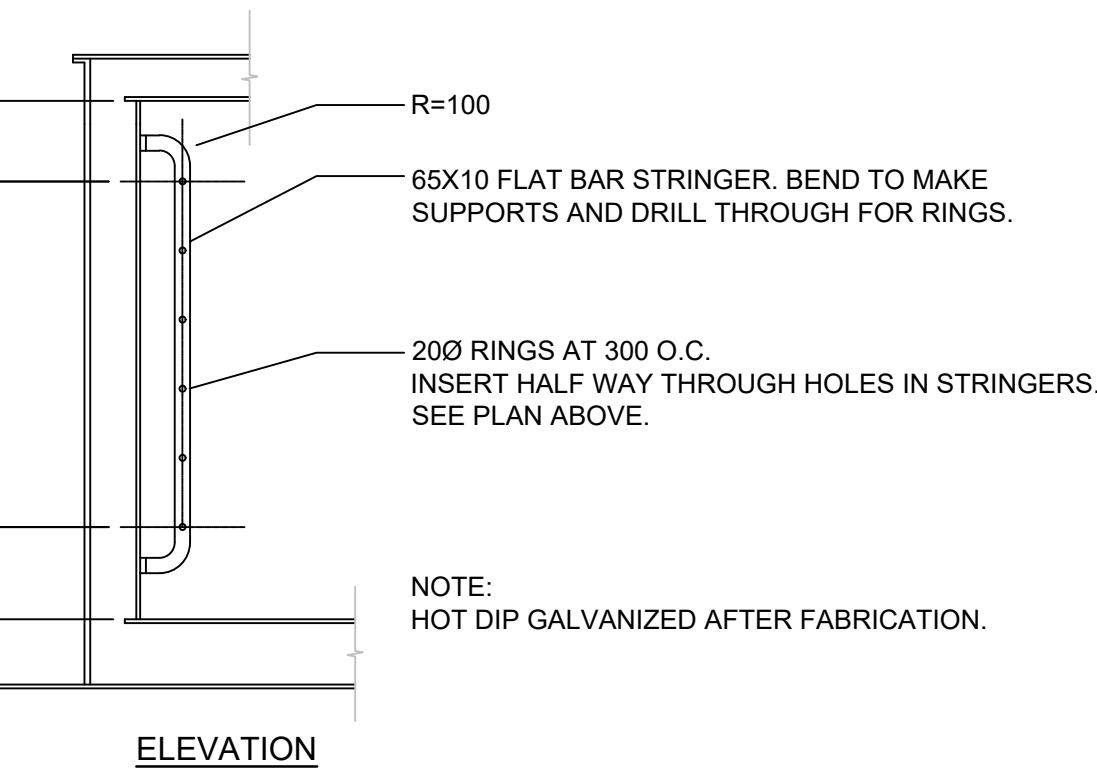
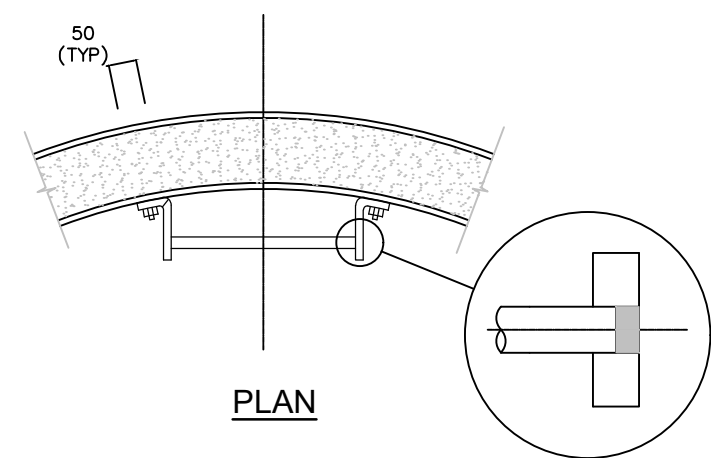
FROST PLUG DETAIL

N.T.S.



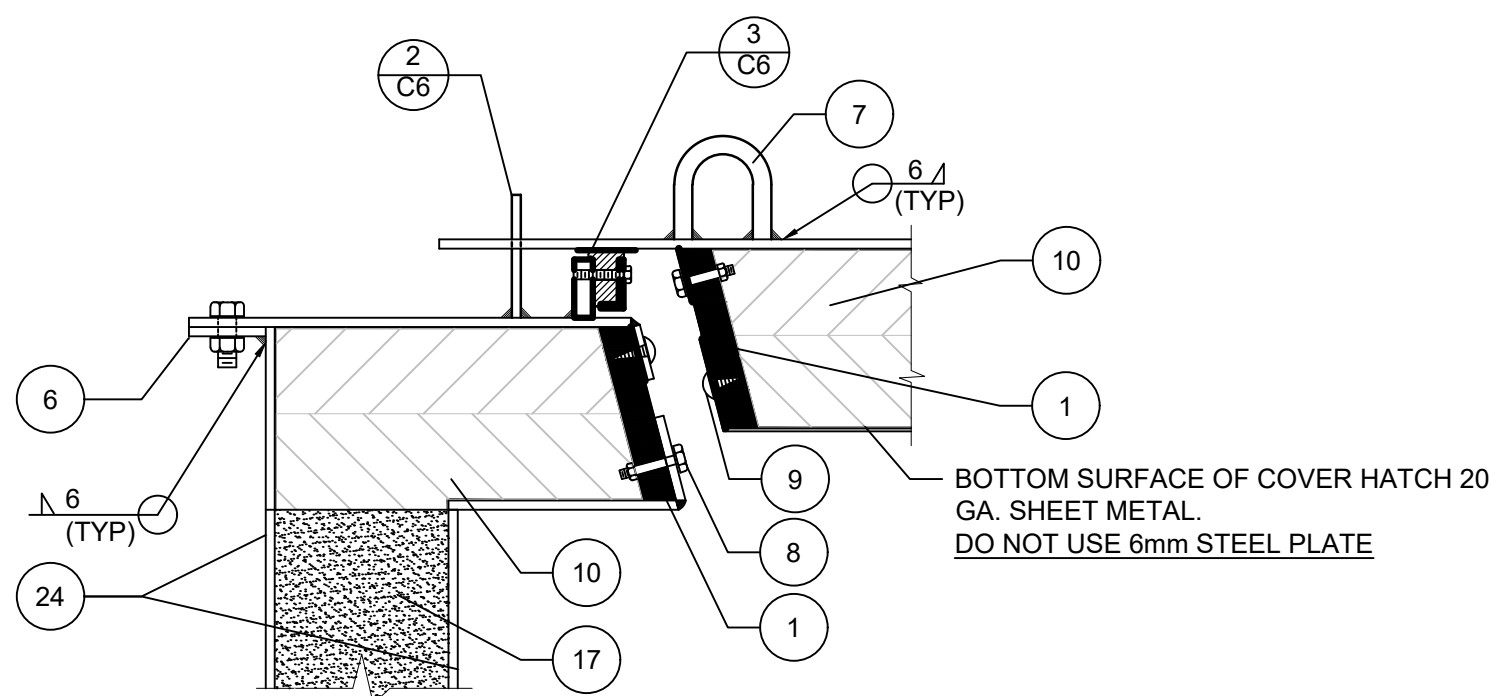
COVER SEAL DETAIL

N.T.S.



ACCESS VAULT LADDER DETAIL

N.T.S.



COVER CONSTRUCTION DETAIL

N.T.S.

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ASTRO HILL WATER RELOCATION

IQALUIT, NU

Title

CIVIL ACCESS VAULT DETAILS 2

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Drawing No.

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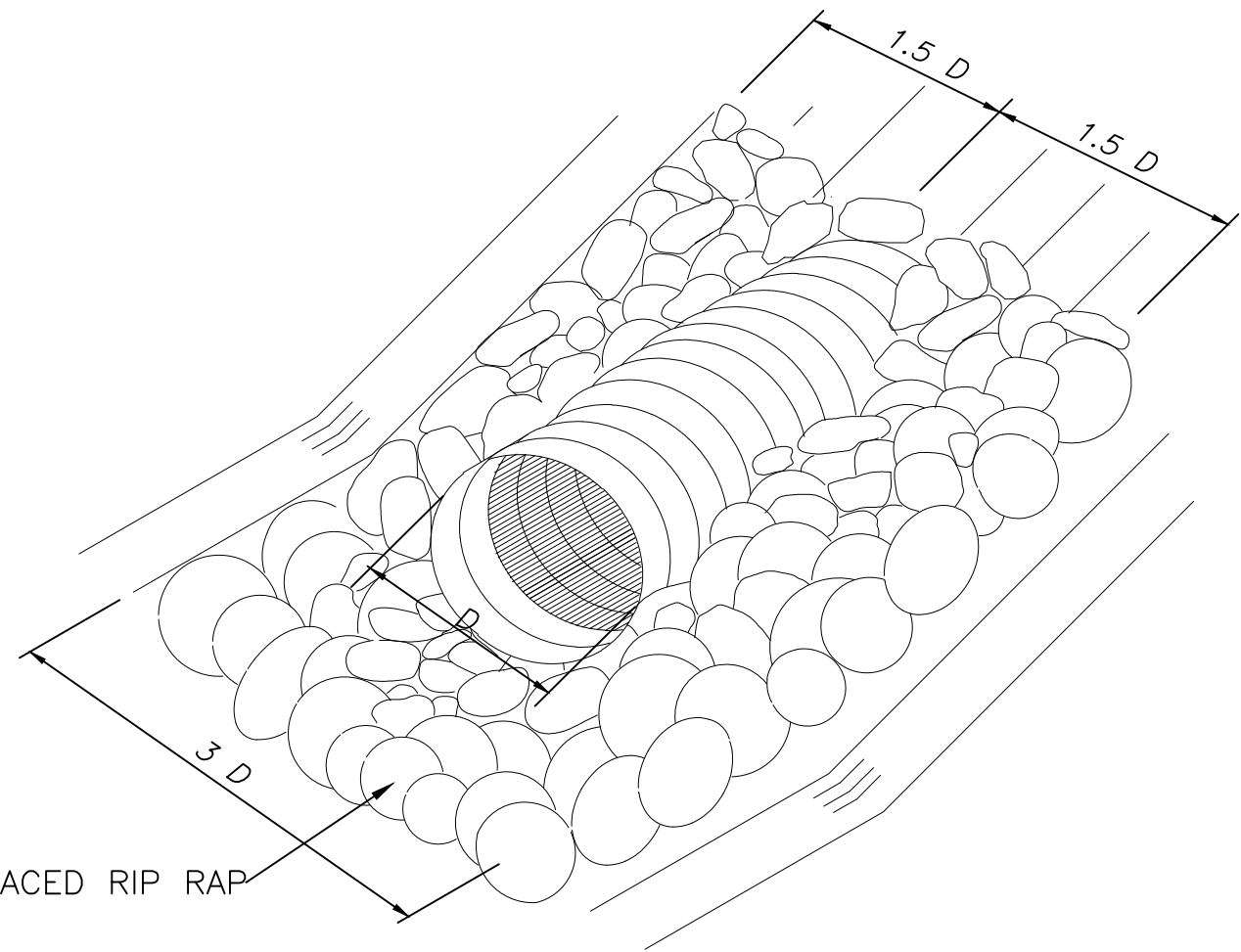
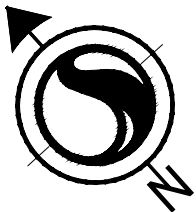
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C-501

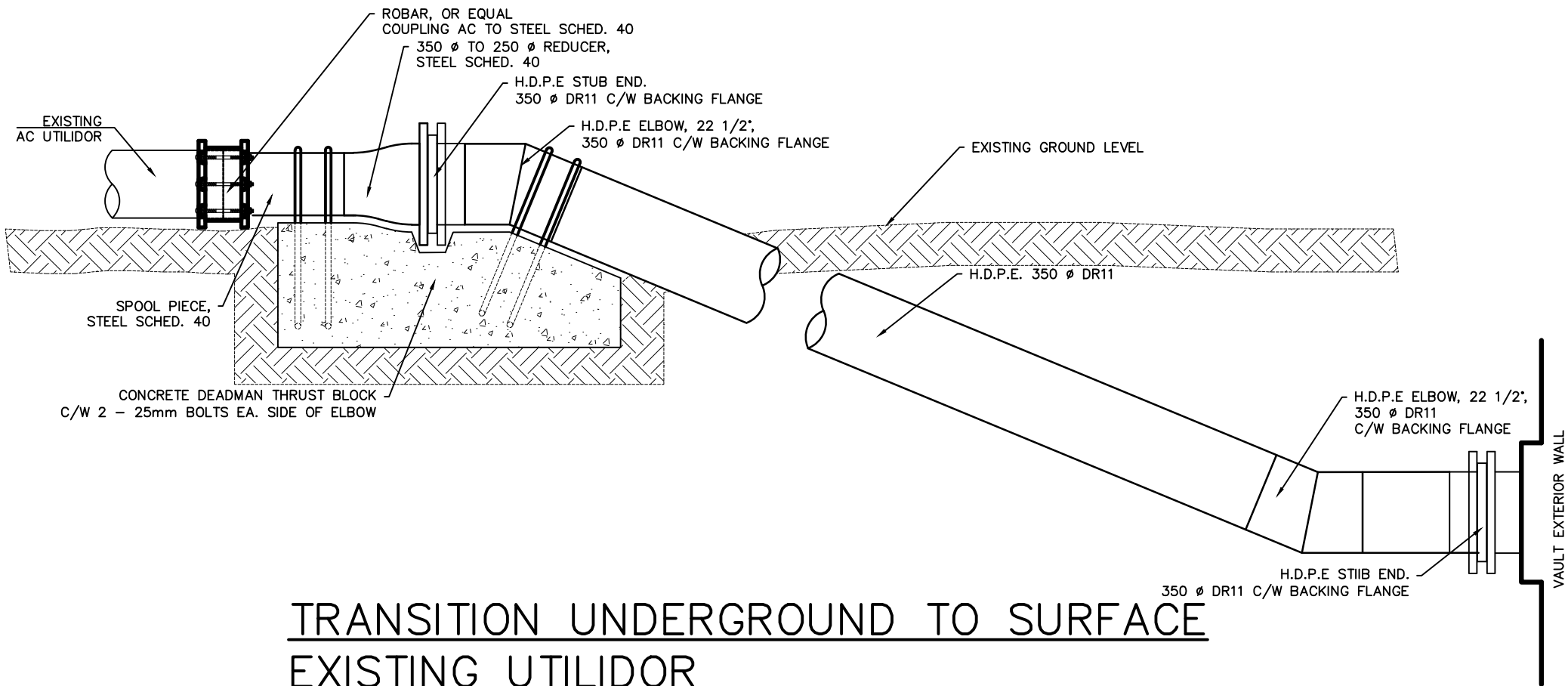
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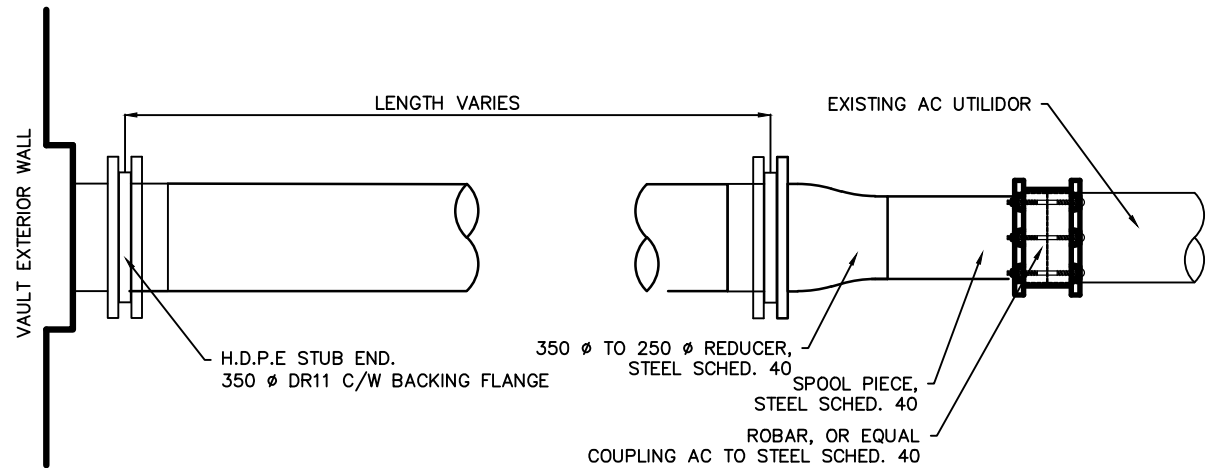
ISOMETRIC VIEW CULVERT END

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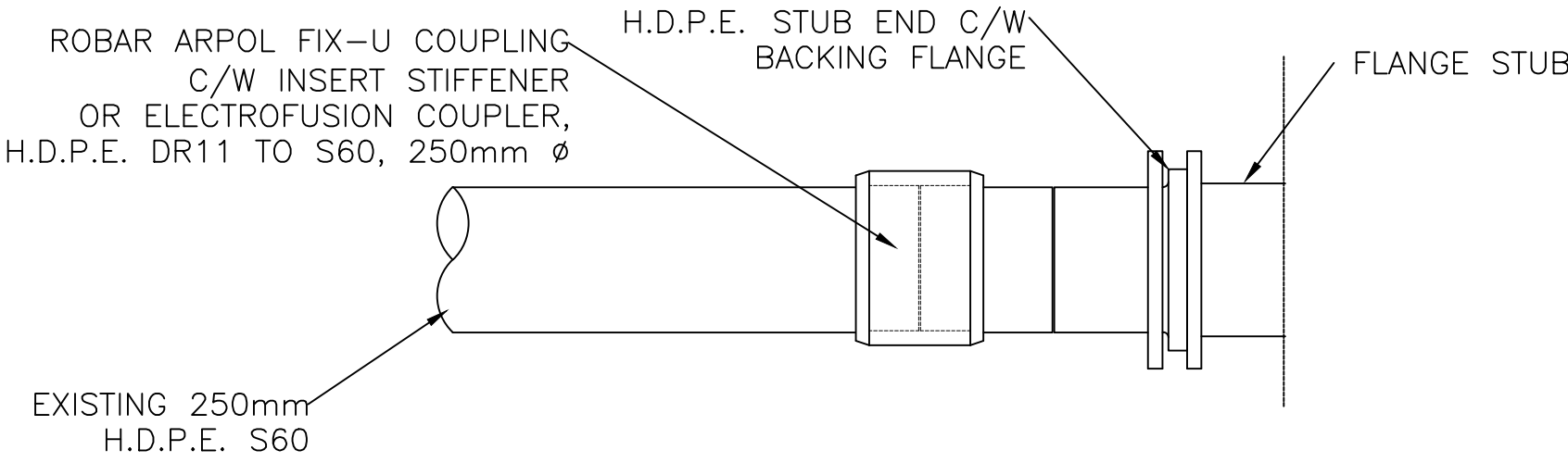
TRANSITION UNDERGROUND TO SURFACE
EXISTING UTILIDOR

NOT TO SCALE



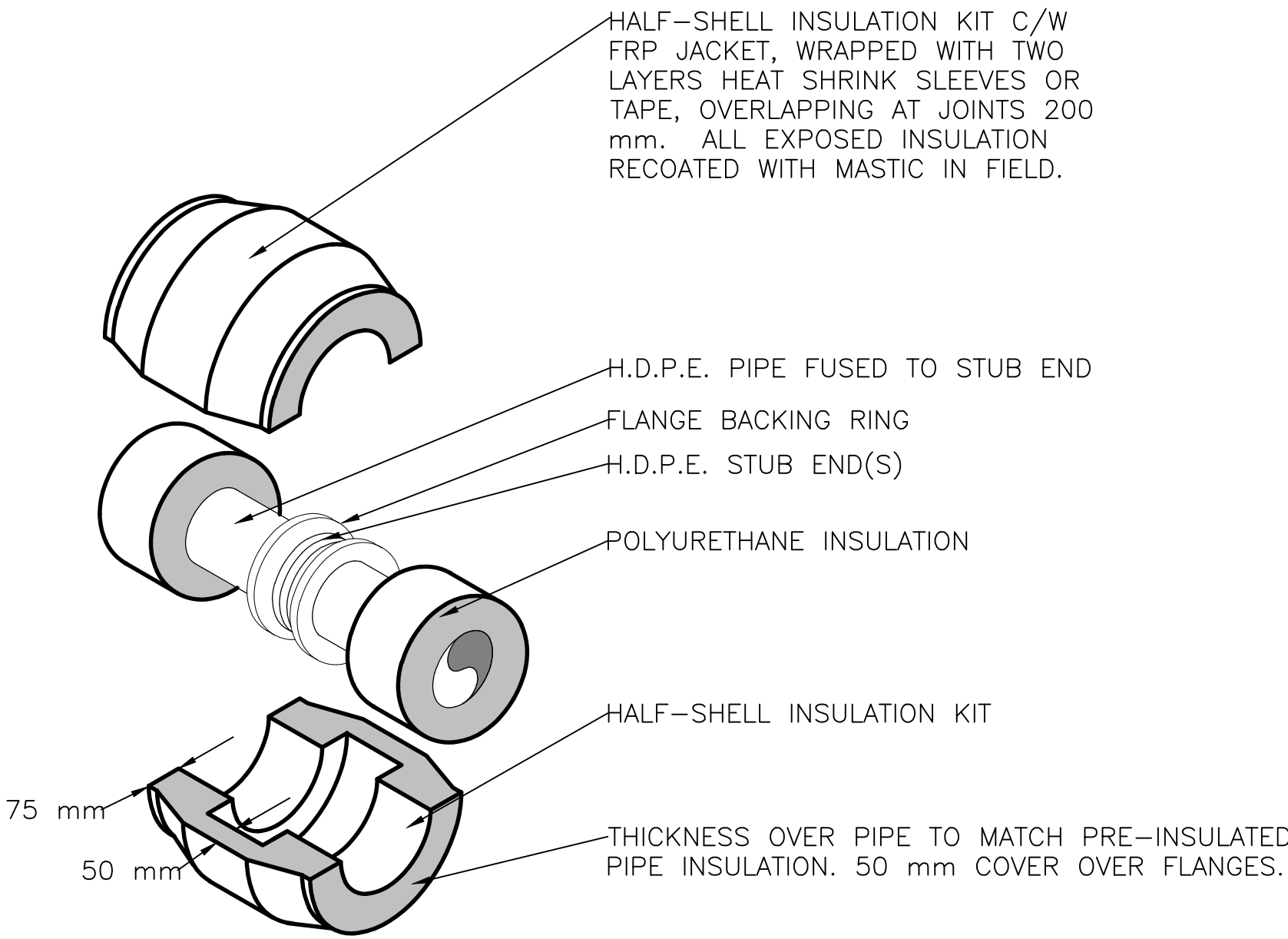
TRANSITION UNDERGROUND TO DAYLIGHT
EXISTING UTILIDOR

NOT TO SCALE



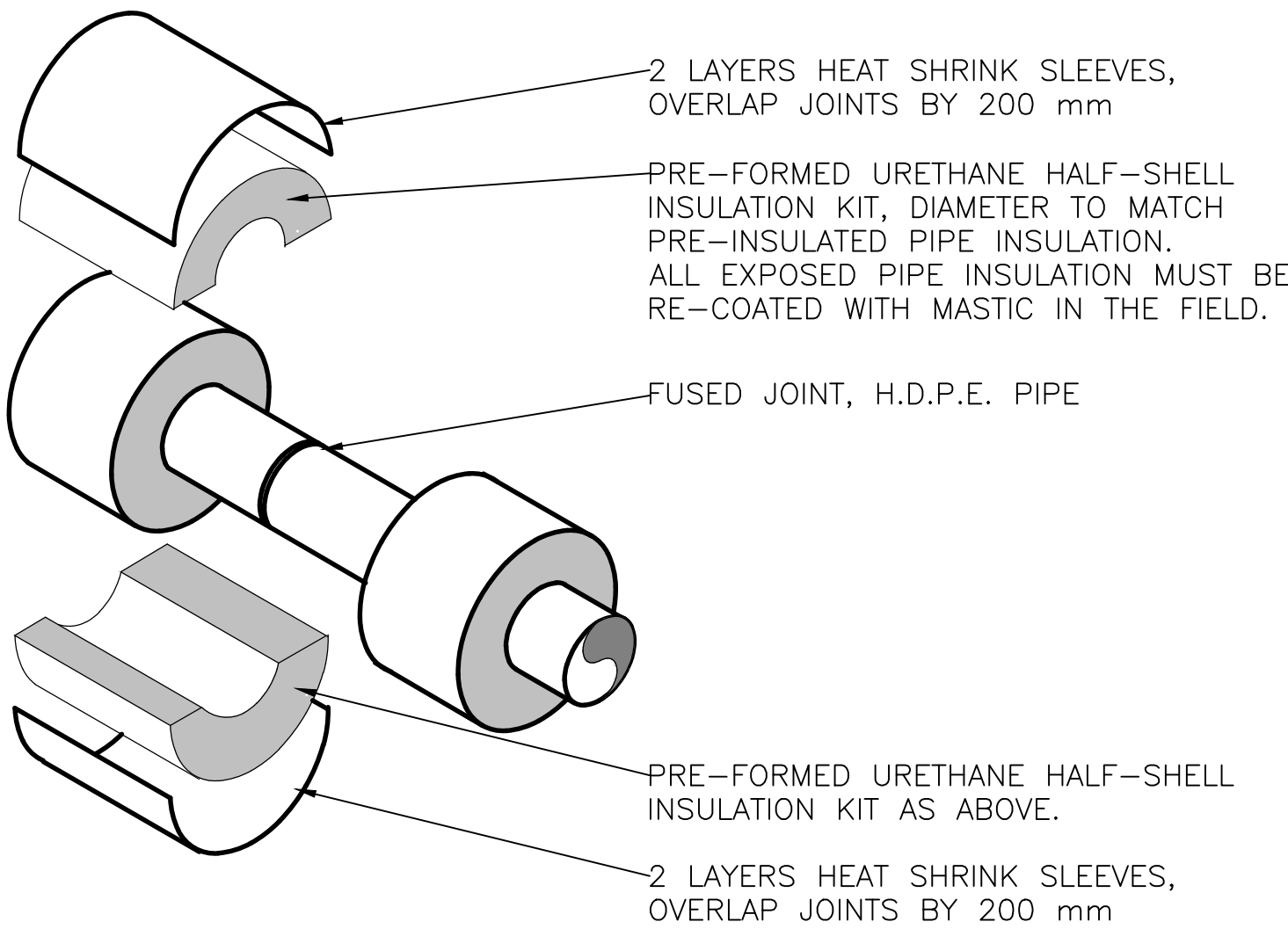
TRANSITION TO EXISTING H.D.P.E.

NOT TO SCALE



FLANGED JOINT INSULATION DETAIL

NOT TO SCALE



JOINT INSULATION DETAIL (TYPICAL)

NOT TO SCALE

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ASTRO HILL WATER RELOCATION

IQALUIT, NU

Title

CIVIL TYPICAL MISC. DETAILS

Project No.

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C-502

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ASTRO HILL WATER RELOCATION

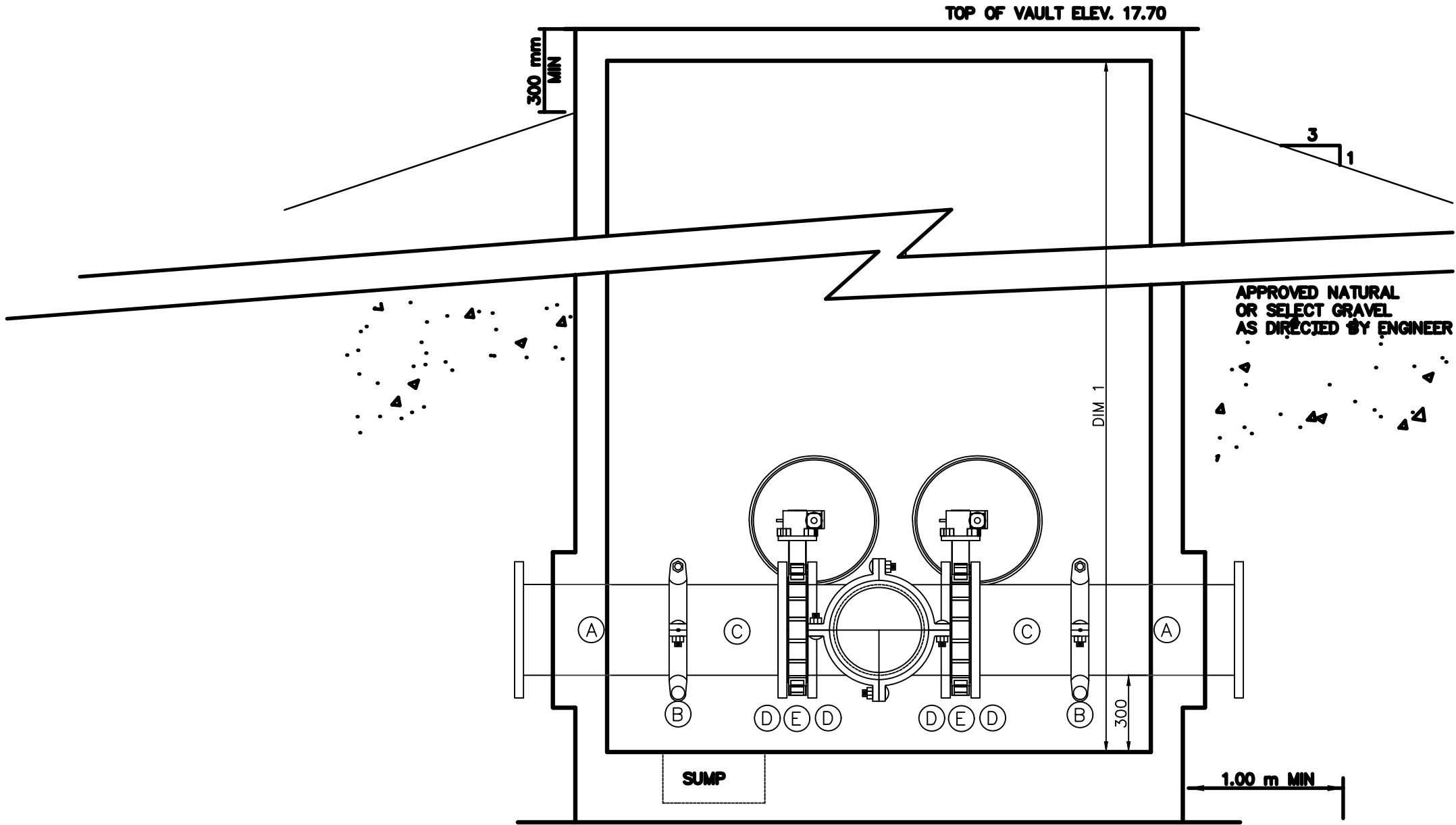
IQALUIT, NU

Title

CIVIL MH 20A & MH 20B

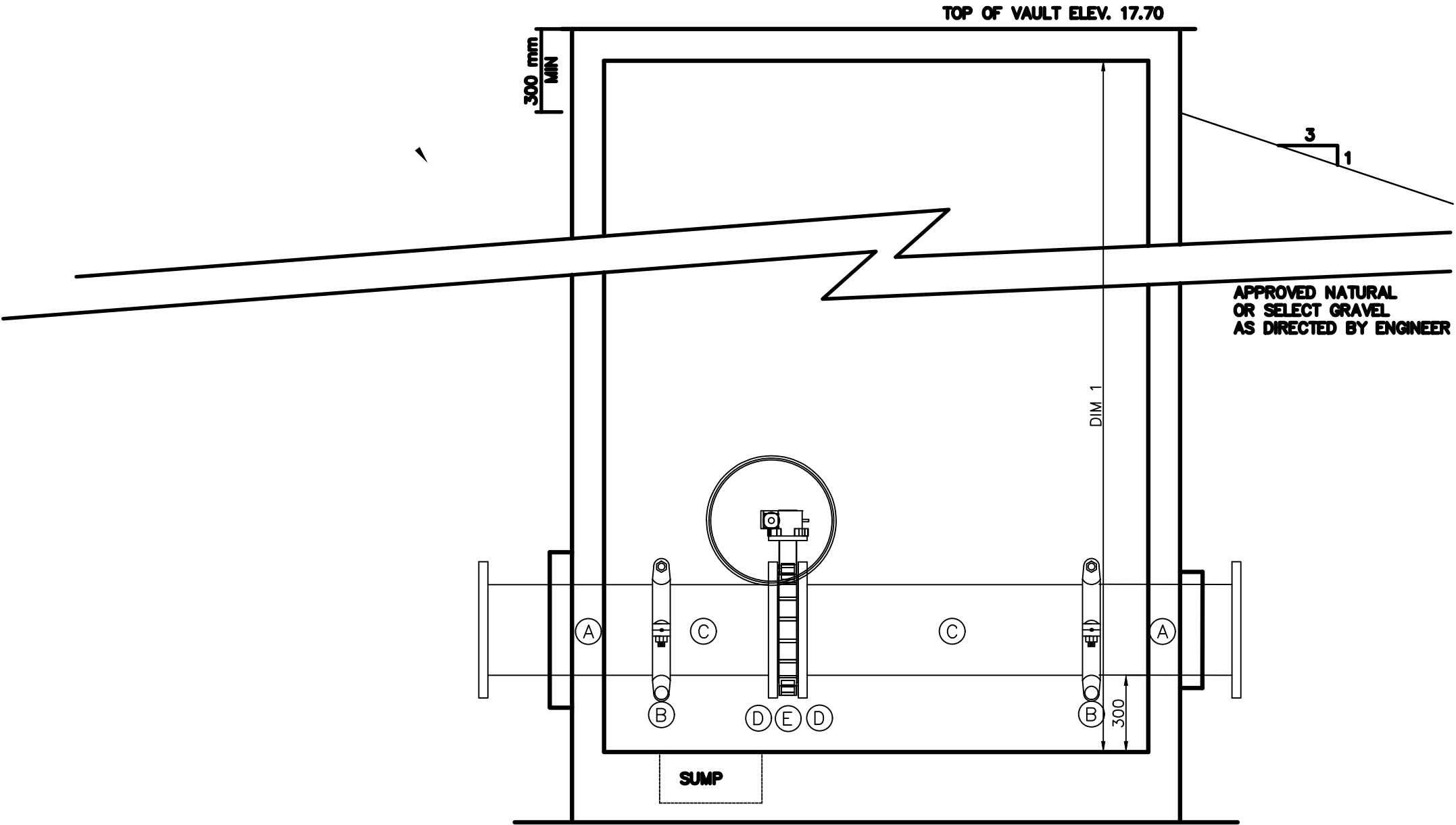
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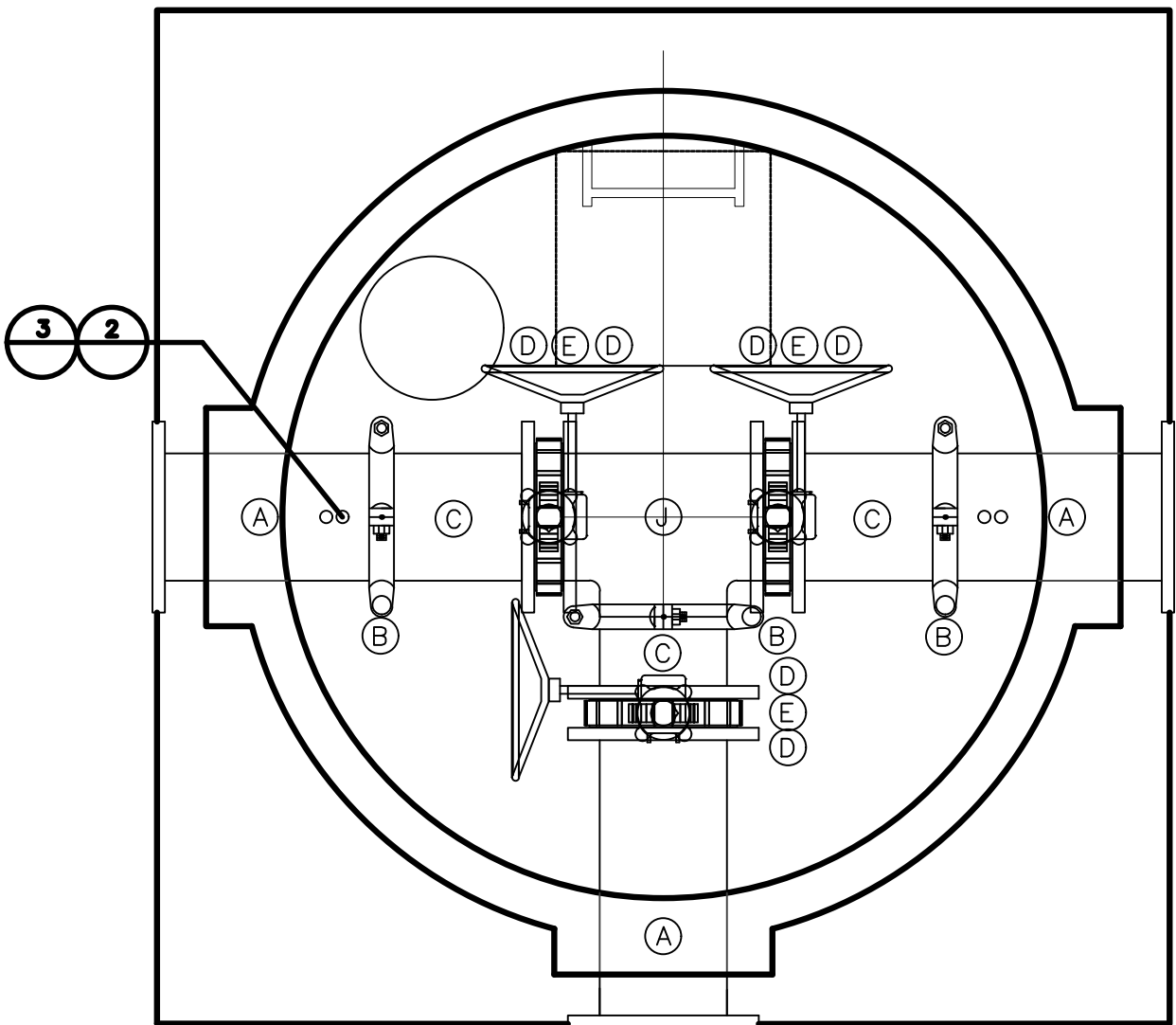
AV 20A SECTION

N.T.S. OPTIONS 1,2,3



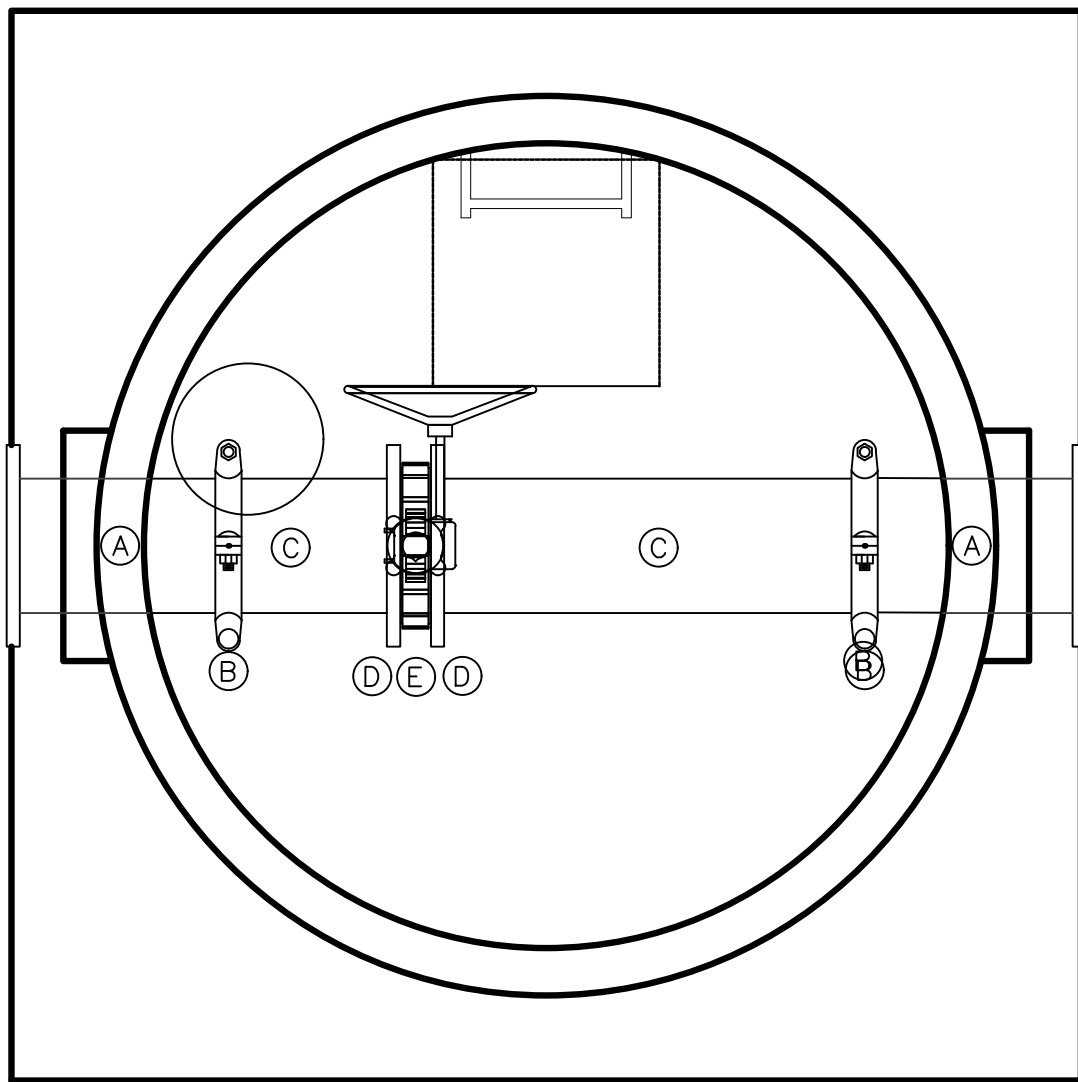
AV 20B SECTION

N.T.S. OPTIONS 1,2,3



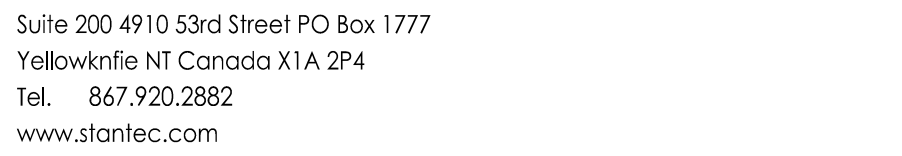
AV 20A PLAN

N.T.S. OPTIONS 1,2,3



AV 20B PLAN

N.T.S.



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N.T.S.	OPTION 1
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N.T.S.	OPTION 2
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N.T.S.



N.T.S.	OPTION 2
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Client/Project

City of Iqaluit

ASTRO HILL WATER RELOCATION

IQALUIT, NU

Title

CIVIL MH 20C & MH 20D

Project No.

Scale

144903028

AS NOTED

Drawing No.

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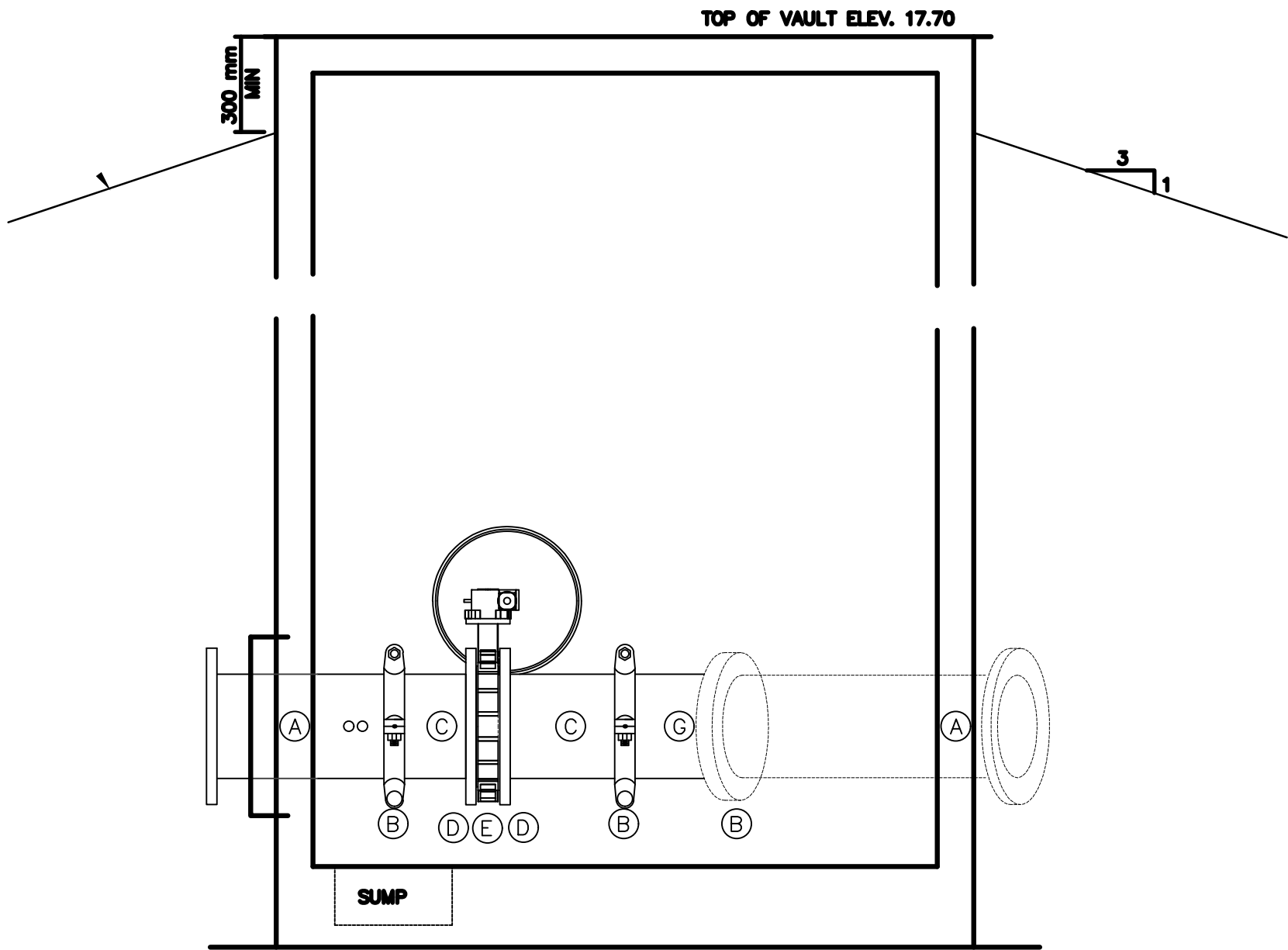
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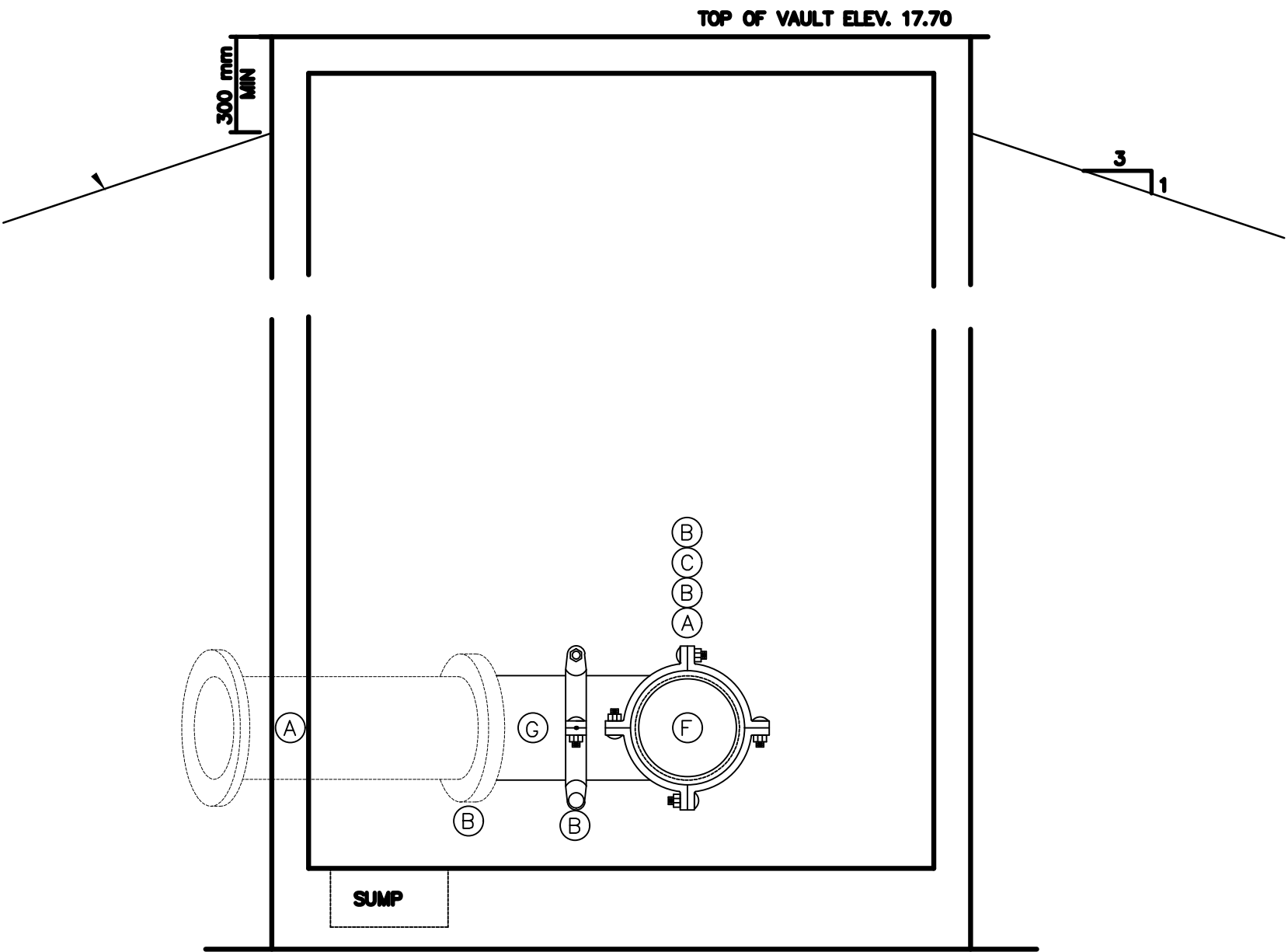
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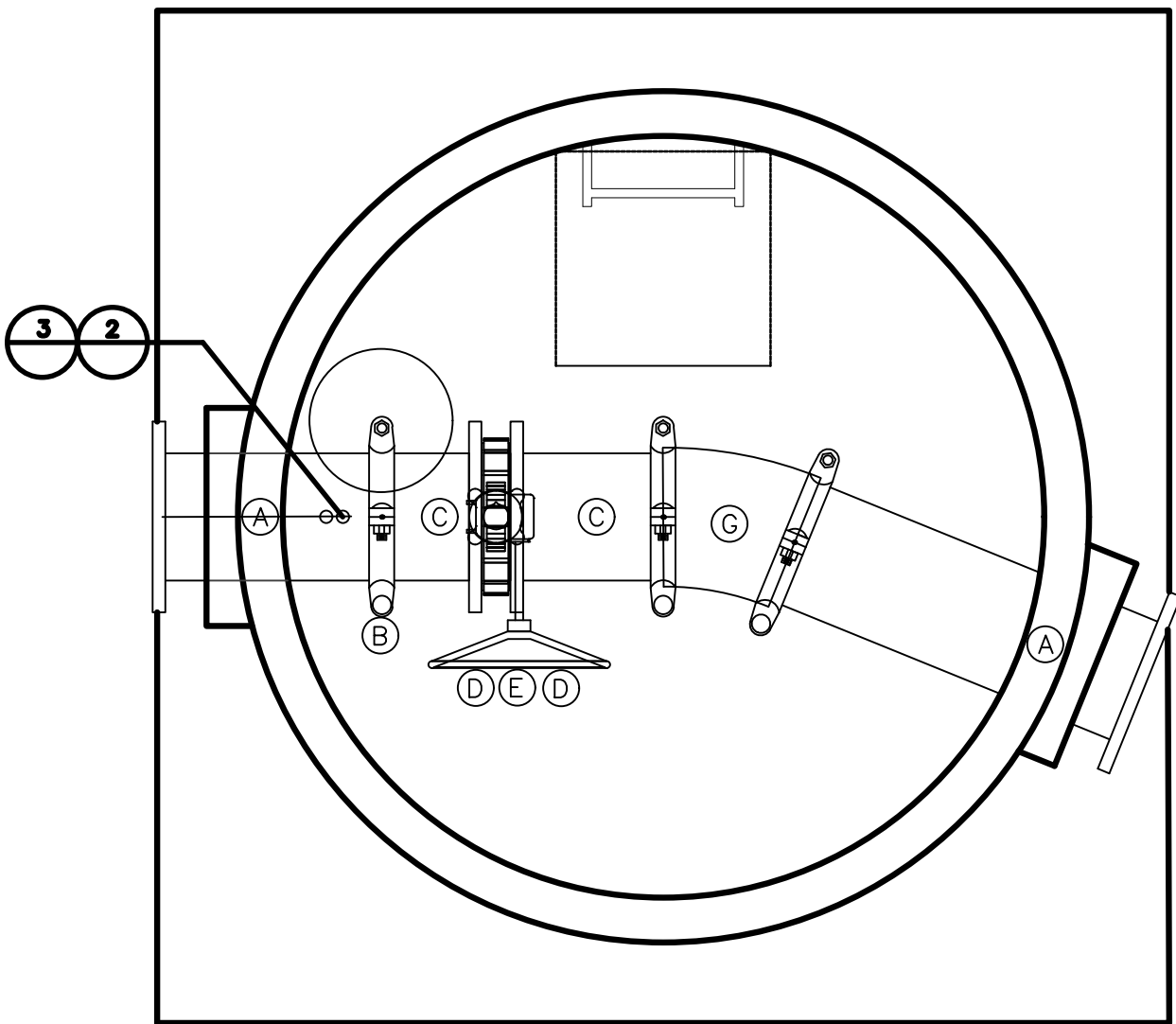
AV 20C2 SECTION

N.T.S. OPTION 2,3



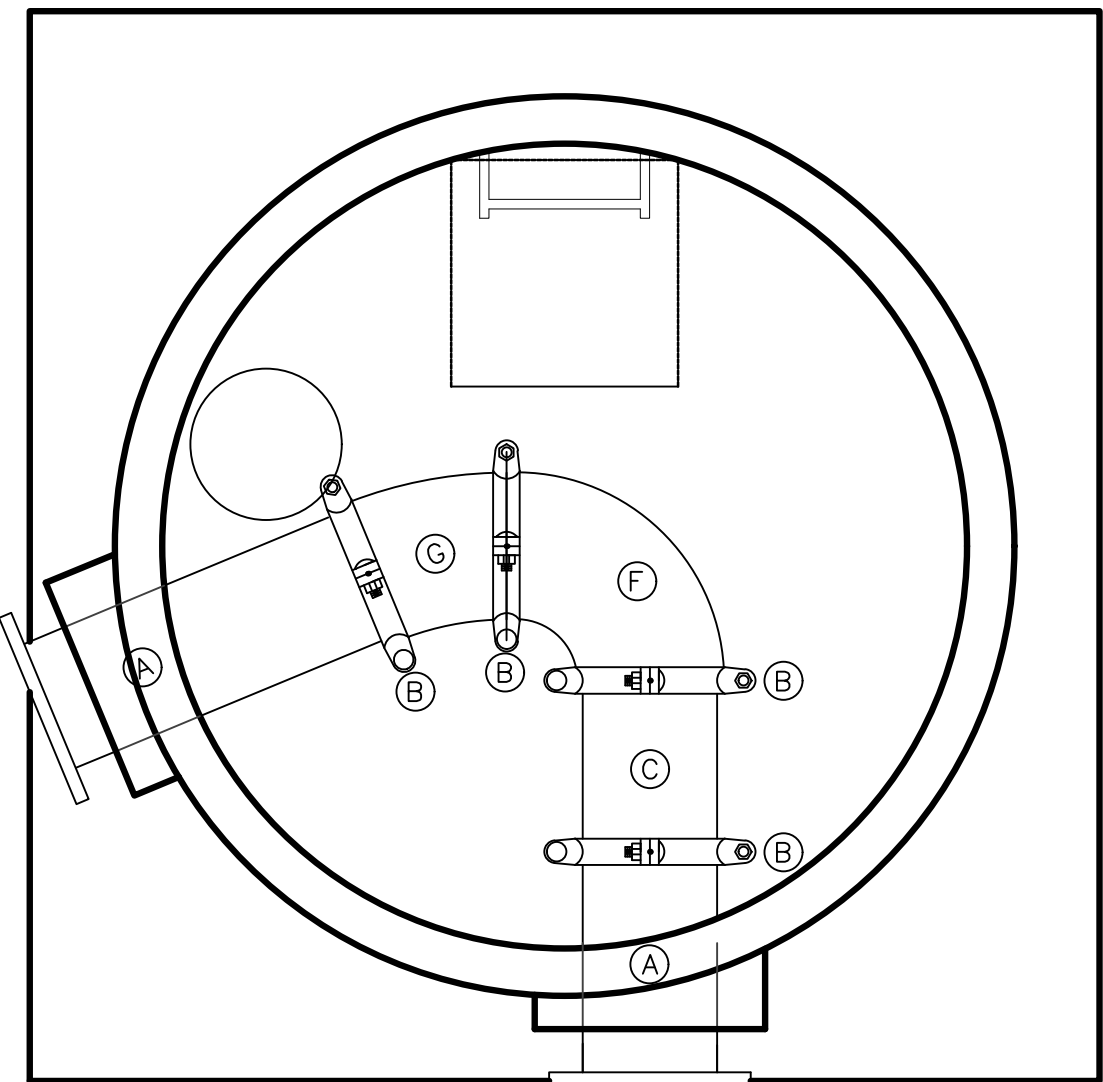
AV 20E SECTION

N.T.S. OPTION 2



AV 20C2 PLAN

N.T.S.



AV 20E PLAN

N.T.S.

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Title

CIVIL MH 20C2 & MH 20E

Project No.

144903028

Drawing No.

A/0

Scale

AS NOTED

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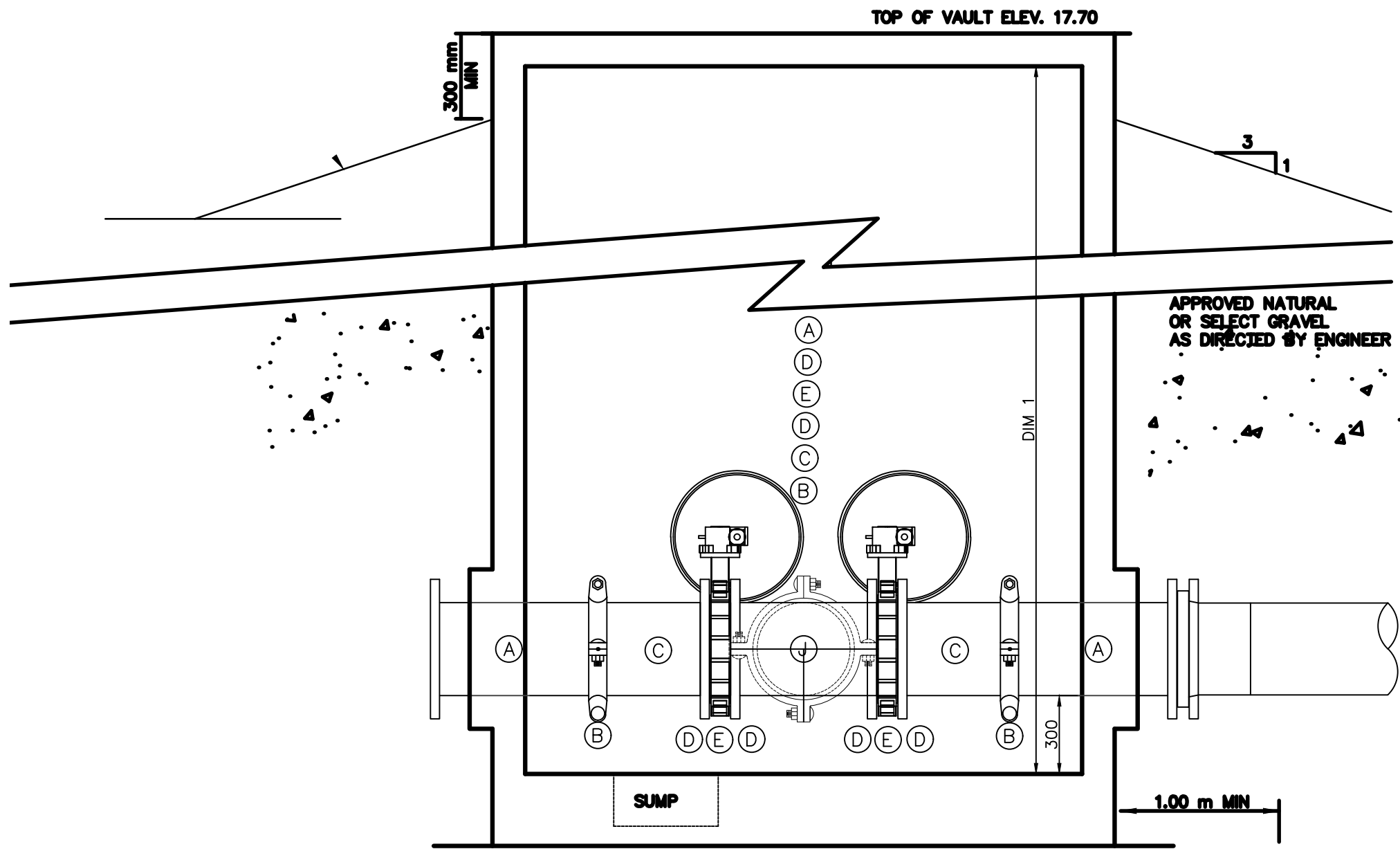
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Revision

C-505

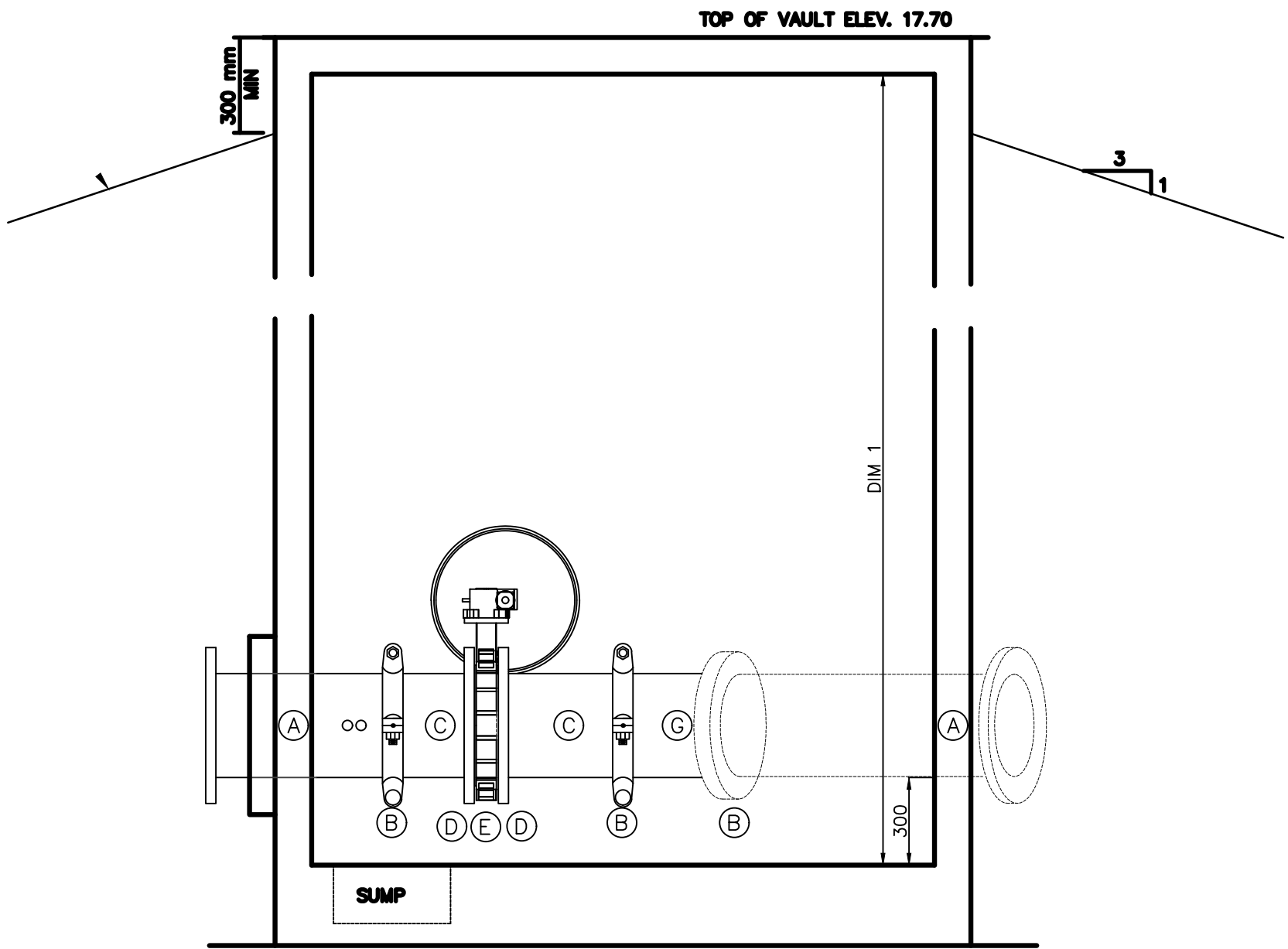
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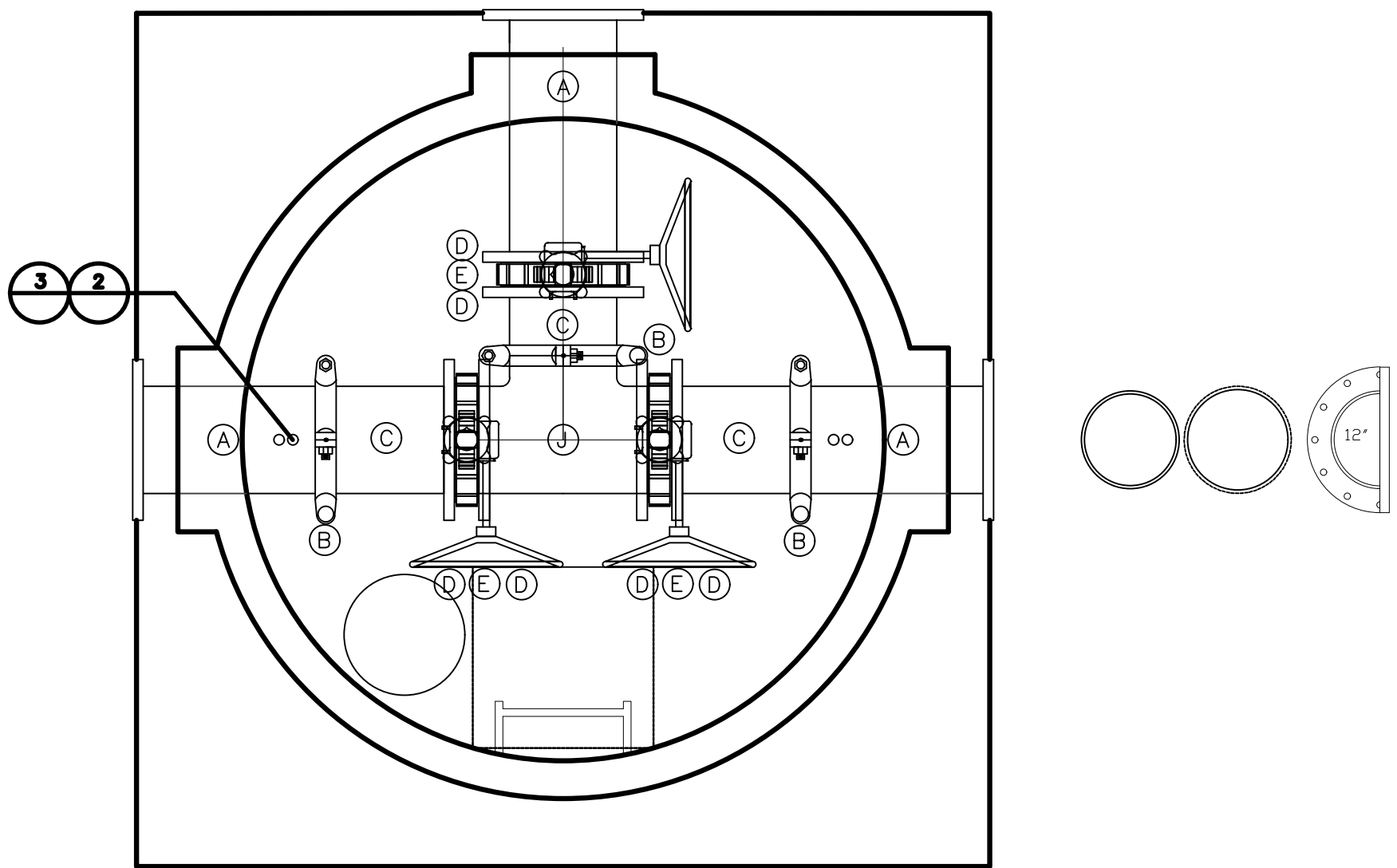
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N.T.S. OPTION 2



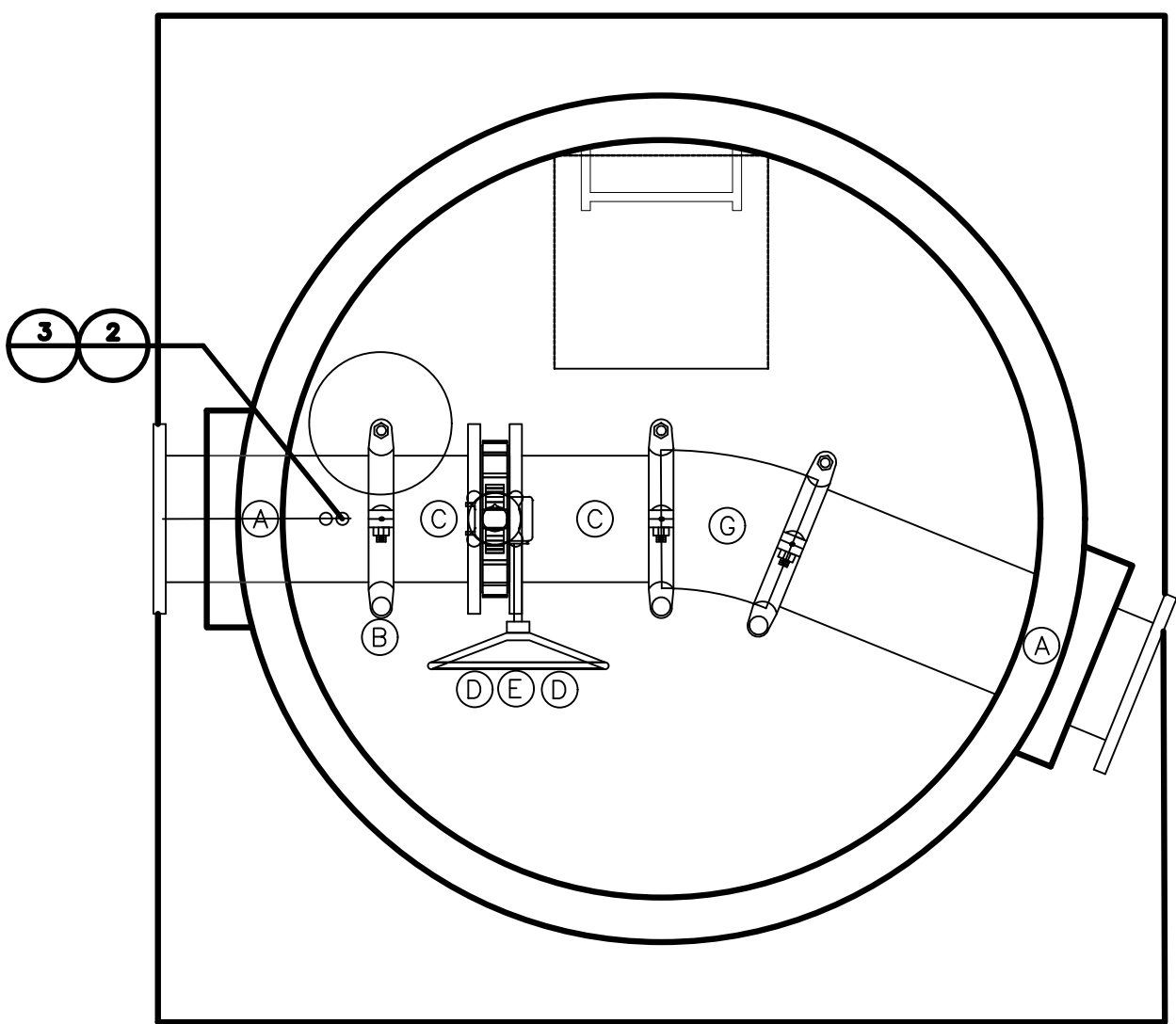
AV 20G SECTION

N.T.S. OPTION 3



AV 20F PLAN

N.T.S.



AV 20G PLAN

N.T.S.

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Title

CIVIL MH 20F & CONNECTION TO
EXISTING DETAILS

Project No.

Scale

144903028

AS NOTED

Drawing No.

Sheet

Revision

A/0

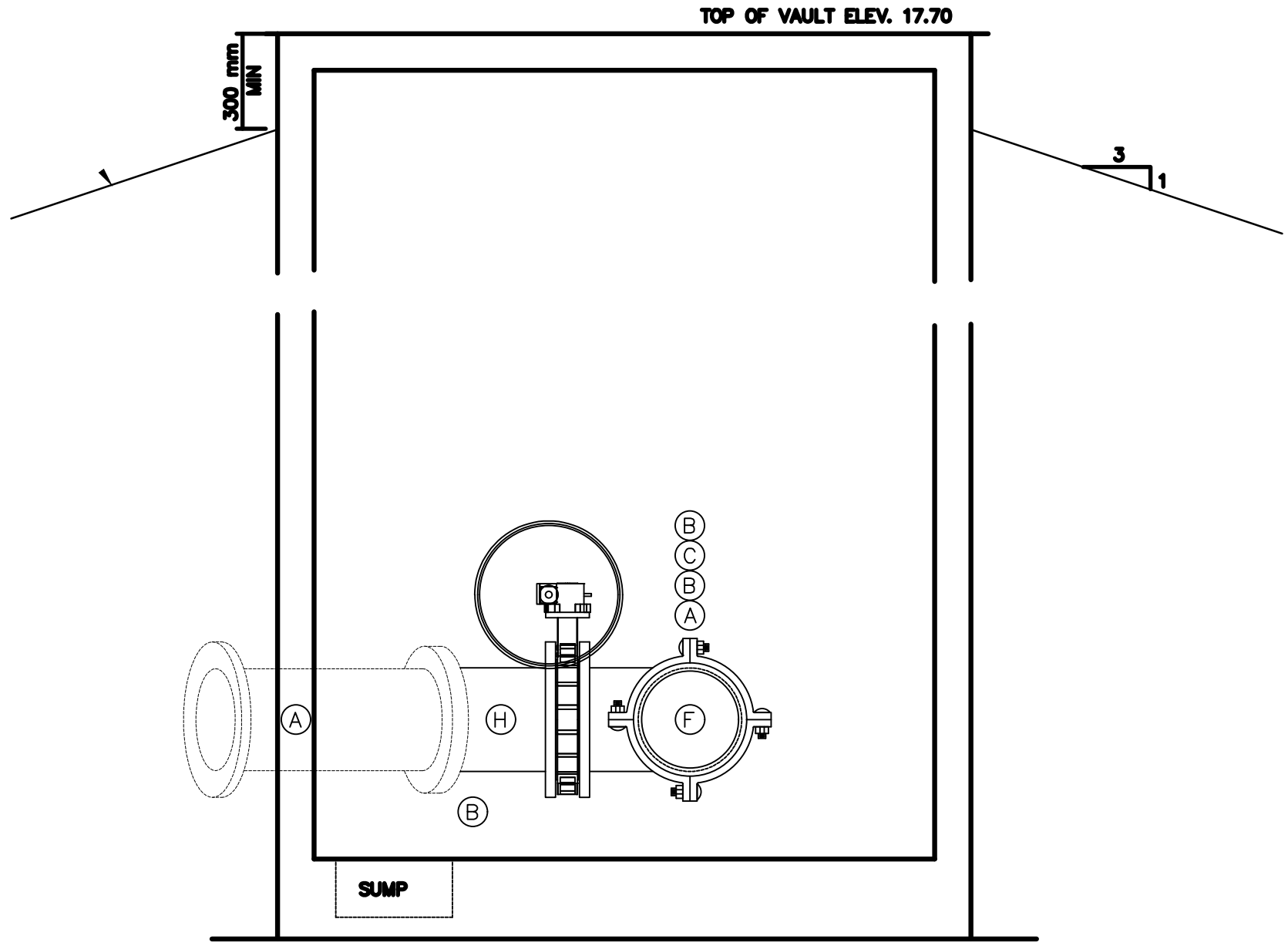
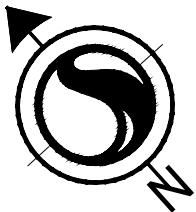
03

TBD

C-506

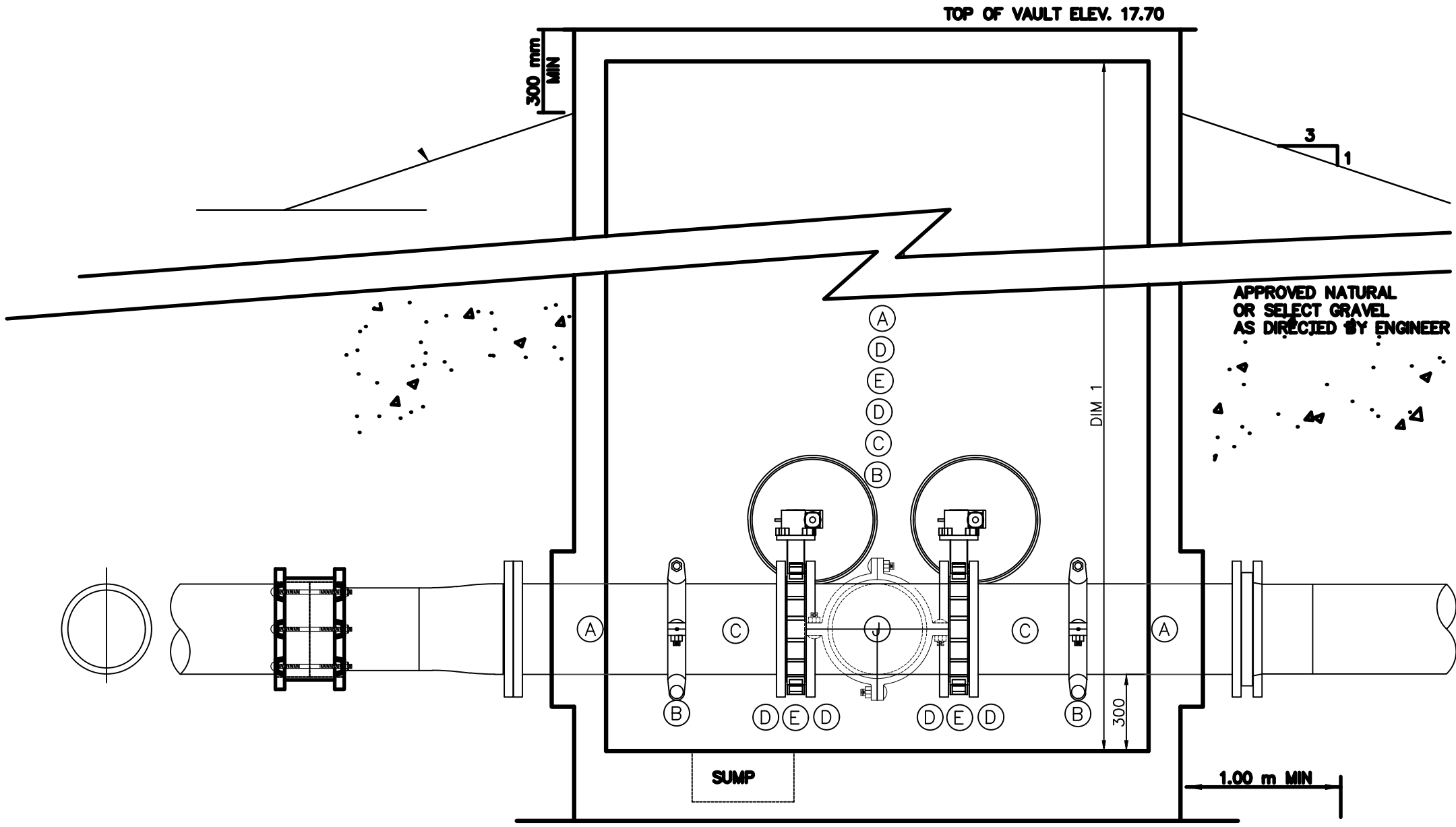
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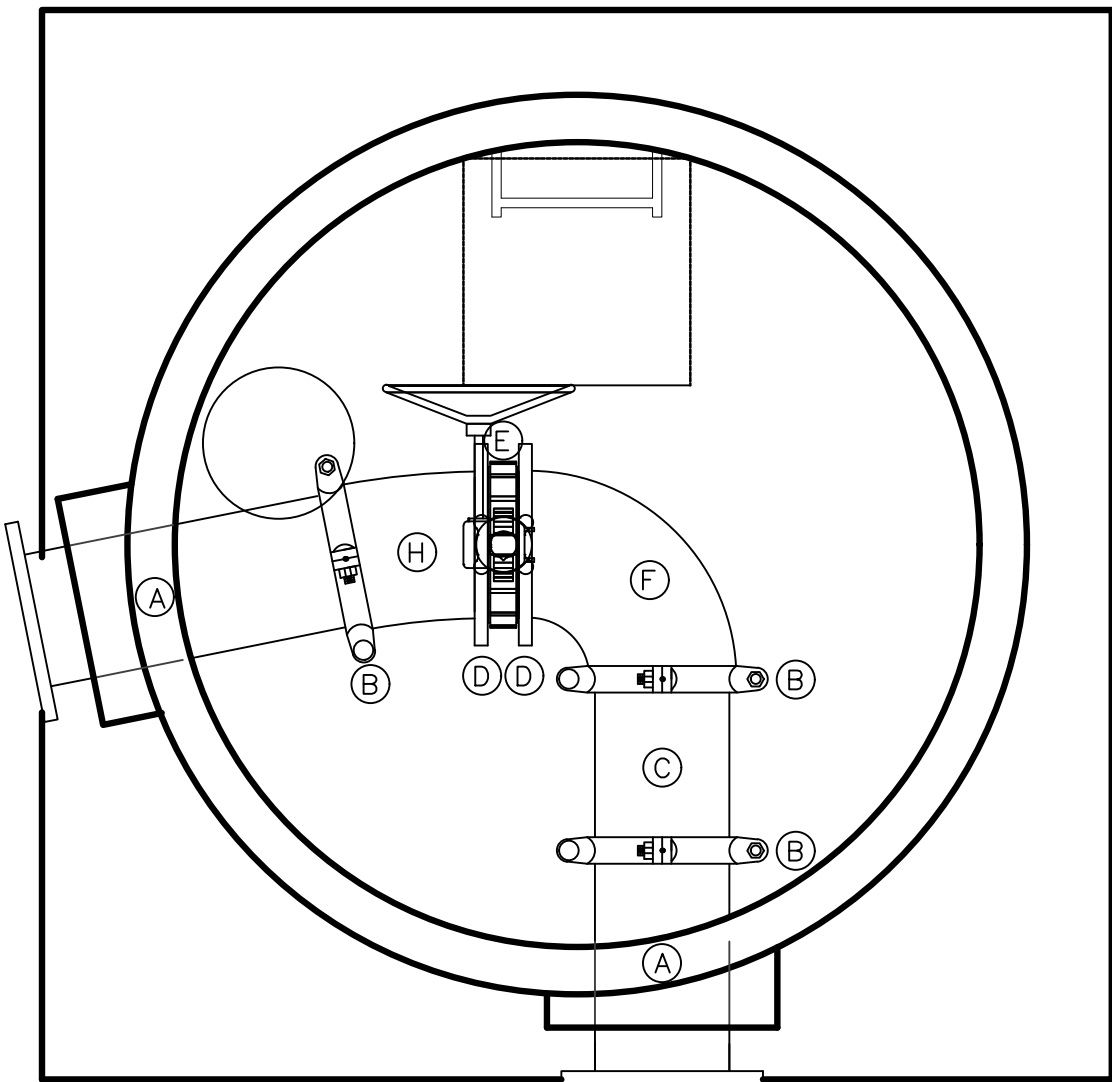
AV 20H SECTION

N.T.S. OPTION 3



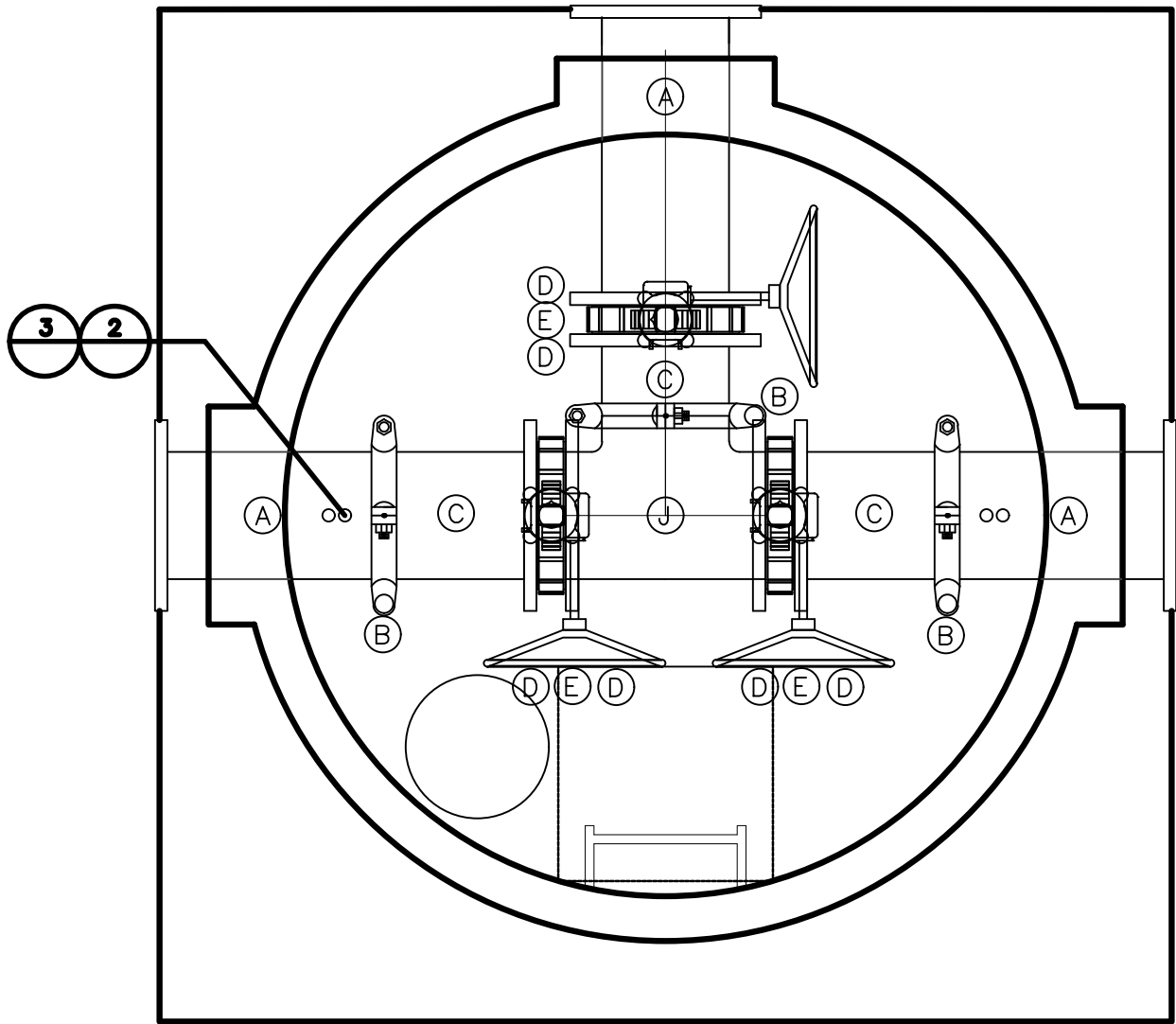
AV 20J SECTION

N.T.S. OPTION 3



AV 20H PLAN

N.T.S.



AV 20J PLAN

N.T.S.

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				21.01.26

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ASTRO HILL WATER RELOCATION

IQALUIT, NU

Title

CIVIL MH 20H & MH 20J

Project No.

144903028

Drawing No.

A/0

Scale

AS NOTED

Sheet

03

TBD

Revision

C-507

APPENDIX B

Site Photos

January 26, 2021

City of Iqaluit

Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Northwest of site near AV 304

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Crossing Lake Geraldine Discharge Channel, facing south east.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Above ground section, facing east

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Above ground utilidor, facing west

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January 26, 2021

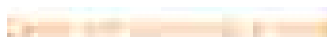
City of Iqaluit

Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Condition of utilidor, facing east (just north of WG Brown Building parking lot)

fm https://stantec-my.sharepoint.com/personal/matt_follett_stantec_com/documents/active/144903028_astrohillfeasibility/07_feasibilityreport/07_02_finalfeasibility/07_02_04_finalsubmitted/144903028_astrohill_appendixb_photos.docx



January 26, 2021

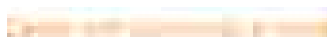
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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Poor condition of insulation and wrap

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Poor condition of utilidor protective housing

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Start of Astro Hill rerouted section. Facing south toward Frobisher Inn complex.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Facing north west at Frobisher Inn connection point. This is where we will tie into the existing line for rerouting around the Astro Hill complex.

January 26, 2021

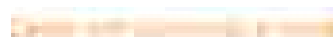
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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Path of water servicing to the Astro Hill complex. It is expected that the current watermain passes through this section into the storehouse mechanical room.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Facing north, showing pedestrian pathway from Tamativik to Astro Hill complex. Tie in point to the left of this photo.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Astro Hill complex, including Frobisher Inn Hotel, Storehouse Bar, and new Astro Hill development (movie theatre, pharmacy, etc.)

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Facing south east toward the Astro Hill bridge.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



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New Astro Hill development.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Astro Hill bridge.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



New Astro Hill complex, showing path of Pipeline Routing Option 1.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Astro Hill bridge, looking north east.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Astro Hill bridge, looking west.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Eastern edge of project site, showing path for Pipeline Routing Option 2.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Eastern side of project site, looking south west and showing area for Pipeline Routing Option 2.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Looking west toward the tie in point, just south east of the Frobisher Inn.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Above ground steam pipes.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Above ground steam pipes and above ground utilidor, looking south east toward Creekside Village.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Above ground steam pipes with utilidor access hatch.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Poor condition of steam pipe insulation.

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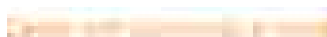
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Fuel tank and utilidor connection from Frobisher Inn.

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New Astro Hill complex development and Northwes Tel infrastructure.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



Existing Astro Hill watermain connection and sanitary connections, south east corner of the complex.

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Reference: Astro Hill Watermain Upgrades Feasibility Study _ Final



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APPENDIX C

Future Project Schedule

