City of Enderby

Shuswap River Intake Airlift Modules

Best Management Practices

Date – 2019-07-15

Emergency Airlift Module Operational Considerations

Installation Date - 2019-07-11 @2133 Z (1133 PST 2015-07-10)

Work Summary

The following is a summary of the activities leading to the decision to install of the 4 Emergency Airlift Modules onto the Shuswap River Intake protective cage assembly.

Best Management Practices

Operational and system maintenance protocols have been scheduled with noted dredging production. A trouble shooting matrix has also been included to mitigate diving intervention on the system.

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WORK SUMMARY

Decision Making

The installation of the 24" HDPE Shuswap River Intake system was completed in 1996. Since the installation date the river hydrology has changed immediately upstream of the intake structure. The influx of clean sand in front of the intake structure and overtop of the intake screen assembly has been managed through airlift dredging operations carried out by Diving Dynamics over the past two decades. During spring freshet and rain weather events the volume of sand can increase rapidly compromising the operational use of the river intake.

The river flow parameter that enabled Diver Intervention to be effective on the structure for airlift operations was possible with the flow at a volume < 125m3/second. The challenge of cleaning sand from the intake screen to below invert with a flow volume >125m3/second during freshet or a rain event exceeds the 'Health & Safety' operational guidelines for safe diving as noted in the current CSA Z275.2 Operational Code.

The installation of the 4 Emergency Airlift Modules will enable the City of Enderby operational staff to ensure that the water supply will remain uninterrupted during spring freshet, weather events and during time of high sand accumulation.

Airlift Modules

The Airlift Modules have been designed and installed by Diving Dynamics. The airlift modules have been installed to draw from just below the intake screen invert and not to impact the lowest member of the cage assembly which sits well below the dredge inlet level. This is to ensure that over-dredging will not affect the elevation of the intake screen protective cage.

Attached Drawings - Appendices

- DWG. NO. – Airlift Assembly
- DWG. NO. – Structure Assembly
- DWG. NO. – Airlift Exhaust Flap Assembly
- DWG. NO. – Intake Structure

Airlift Module Unit Identification

- Portside Single — Location: # 1 East side upstream
- Portside Double — Location: # 3 East side downstream
- Starboard Single — Location: # 2 West Side upstream
- Starboard Double — Location: # 4 West side downstream

Air Compressor Requirements

- 185cfm
- 85 – 110psig
- ¾" Chicago Fittings

Air Supply Lines

- Four Air Supply Lines have been installed to supply each of the 4 Airlift Modules
- Airline: Total of 400' of ¾" HDPE-AL-HDPE 200psi Duratec Airline Pipe Blue
- Airlines are bundled, wrapped in black heavy-duty wrap (O.50-0.63" ID)
- Each airline is terminated shoreside with a ¾" check-valve and ¾" Chicago Fitting
- Airlines shoreside are in a 6" pvc standpipe with sweep and cap assembly
- Airlines are terminated into each airlift module 10" (25cm) up from the dredge base
- The air is introduced into the airlift dredge pipe through a 90-degree elbow facing up

Operational Principle

The airlift dredge principle is based on 'Boyle's Law' – P1 x V1 = P2 x V2

- P1 = Initial Pressure
- V1 = Initial Volume
- P2 = Final Pressure
- V2 = Final Volume

Air is compressed and introduced into the airlift near the suction end of the dredge pipe. The air will then discharge up the pipe and expand within the pipe walls as it rapidly travels up through the water column. The decreasing water pressure is what allows the air to expand and in turn creates powerful suction at the dredge inlet. The digital production recordings attached to the Best Management Practices clearly shows the sand and air being discharged through the dredge caps.

During testing the dredges became operational in less than 5 seconds once air was delivered down the airlines.

Nephelometric Turbidity Units (NTU) Values During Dredging Operation

- 7m Upstream 1.77 NTU
- At Station 1.59 NTU
- 7m Downstream 1.40 NTU

*Samples drawn on July 11th, 2019 at 1400hrs at depth of 1m with a flow of 116m3/s

Production Estimates

- *Production estimate – Conducted July 11th, 2019*
- *Pre-production: Intake screen was buried to the spring line*
- *The dredging production estimates were established 2 weeks post previous dredging*
- *Intake Screen was clear to invert during dredging production 2 weeks prior*

Airlift Module	Pre Sand Depth	Run Time	Post Sand Depth	Pre-Sand Inside Dredge	Post-Sand Inside Dredge
Port Single	120cm	15	145cm	9cm	0
Port Double	115cm	15	169cm	9cm	0
Starboard Single	86cm	15	148cm	9cm	0
Starboard Double	89cm	15	105cm	9cm	0
Intake Screen	½ Buried	-	Invert Clear	-	-

- *Pre-dredge Sand Depth: sand elevation measured outside the airlift discharge diagonally down*
- *Post-dredge Sand Depth: sand elevation measured outside the airlift discharge diagonally down*
- *Run Time: Dredge Run Time (15min)*
- *Pre-Sand Inside Dredge: Sand elevation measured inside dredge*
- *Post-Sand Inside Dredge: Sand elevation measured inside dredge*

**Air outlet inside the dredge is located 26cm up inside the dredge pipe*

Operating Sequence During Production Estimate

- Port Single
- Starboard Single
- Port Single
- Port Double

Dredge Caps

- The digital recording demonstrates the caps function
- Prevent foreign material from entering the top of the dredge

Maintenance and Winterization of Airlines

Monthly

- Check pressure gauge downstream of the check valves
- Gauges should read 2psig to 3psig+
- Leak test check valves with soap
- Operate the airlift modules once per month
- **If gauges read near 0psig – Reference Trouble Shooting Matrix*

Winterization & Operations

- Maintain a positive pressure in the airlines
- 2psig+ would be ideal
- 1psig+ would still be indicative that the water in the line remains below 1m in depth

Note: If during warmer months the downstream gauges read near zero there is no risk to the system. Under these conditions it will take a little longer for the air compressor to push out the water prior to the dredge being operational.

Operating the Airlift Dredges

Ensure that all fittings are free of debris before connecting and gaskets are present.

Operating Sequence

- Portside Single – Identifier: Single wrap of red tape
- Starboard Single – Identifier: Single wrap of green tape
- Portside Double – Identifier: Double wrap of red tape
- Starboard Double – Identifier: Double wrap of green tape

Regular Season Operations

- Operate the airlift modules once a month

Freshet & Heavy Rain Events

- Operate the airlift modules twice per month
- Operate the airlift modules more frequently if river is flowing at a rate higher than considered Normal

Operating Time

First Cycle	15 Minutes
Second Cycle	20 Minutes

Reminder: The airburst during the first few minutes will normally have a higher level of sand visible in the discharge. On the second cycle the volume of sand on discharge will be reduced, however it is important to continue to operate for the full 20 minutes as this will increase the volume of removed sand below the invert of the intake screen.

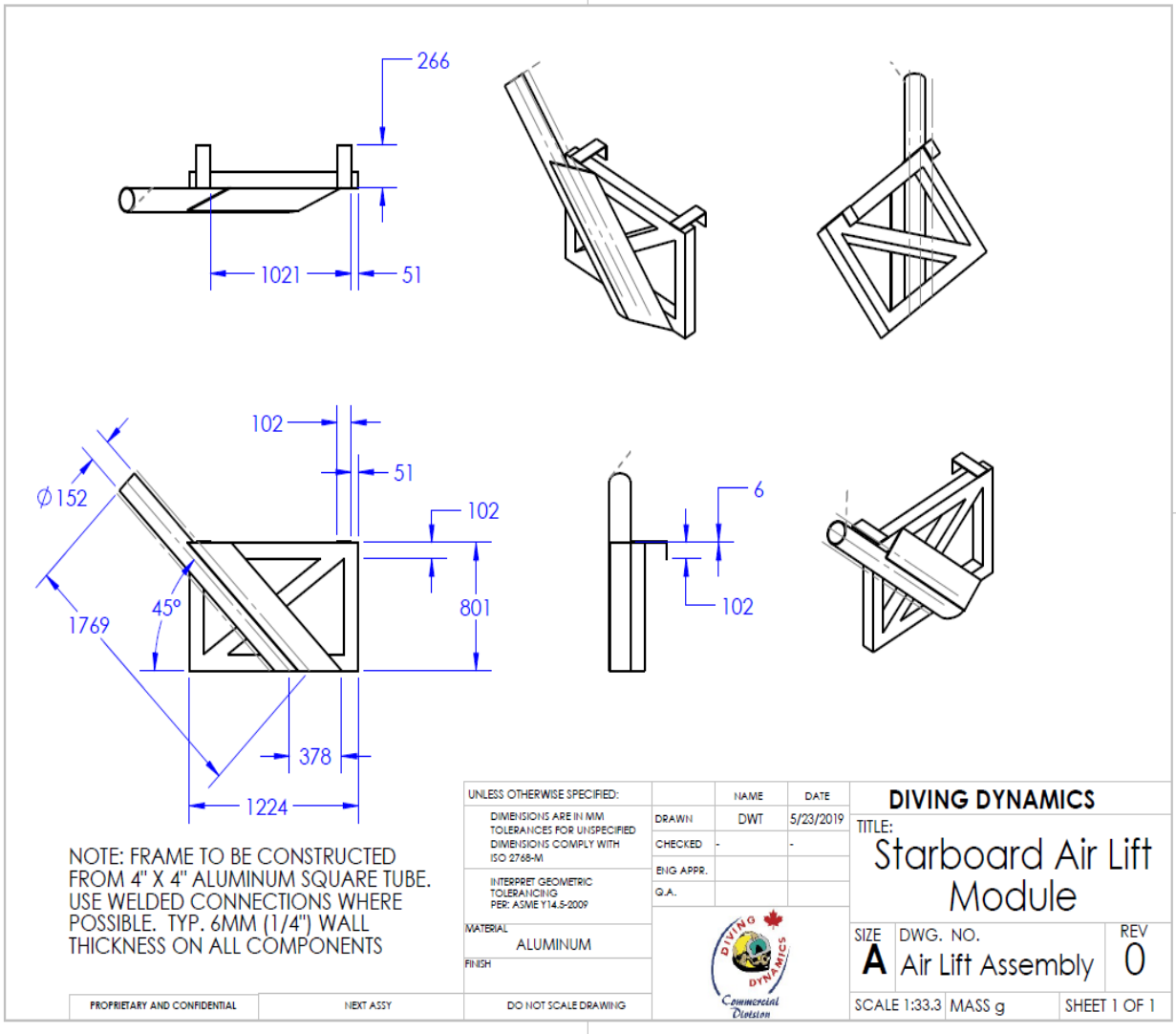
Trouble Shooting MATRIX Table

Problem	Solution
Downstream gauge at check-valve reads 0	. Run up the airline @ 185cfm at 85 – 110psig till air is coming to the surface over the intake . Run the airlift for 5 minutes . Shut off the air to the airline and check to see if the gauge is reading accurately . Leak test the check-valve . Replace check-valve if required . Replace gauge if required
Takes 3+ minutes for air to be visible offshore when the airlift is first fired up.	. Compressor had to force all the water out of the airline first prior to the dredge becoming operational . Leak test the check-valve . Check the downstream gauge . Replace as required
No air is visible at discharge on an airlift module	. Run the air compressor for 5 minutes and check for any abnormal air discharge along the airline route . Run the other 3 airlifts through the cycle sequence and then try the airlift that was not functioning properly again . If the airlift discharge remains non-functional Diver Intervention will be required . Remember that running 2 or 3 airlift modules through the operating sequence will be enough to clear the intake screen to below invert
Airlift is not operating to at full discharge and air bubbles are visible at a point along the airline route	. Possible fracture or damage to the airline supplying the airlift . Diver Intervention will be required
Airlift module is functional, but less discharge gas	. Confirm compressor size, volume and pressure

is visible	. Check the Chicago Fitting to ensure it is not leaking . Ensure the compressor valve is fully opened . Ensure the air line from compressor to the airlift standpipe is not compromised . Possibility the airline has been kinked near the air lift module *Diver Intervention Required

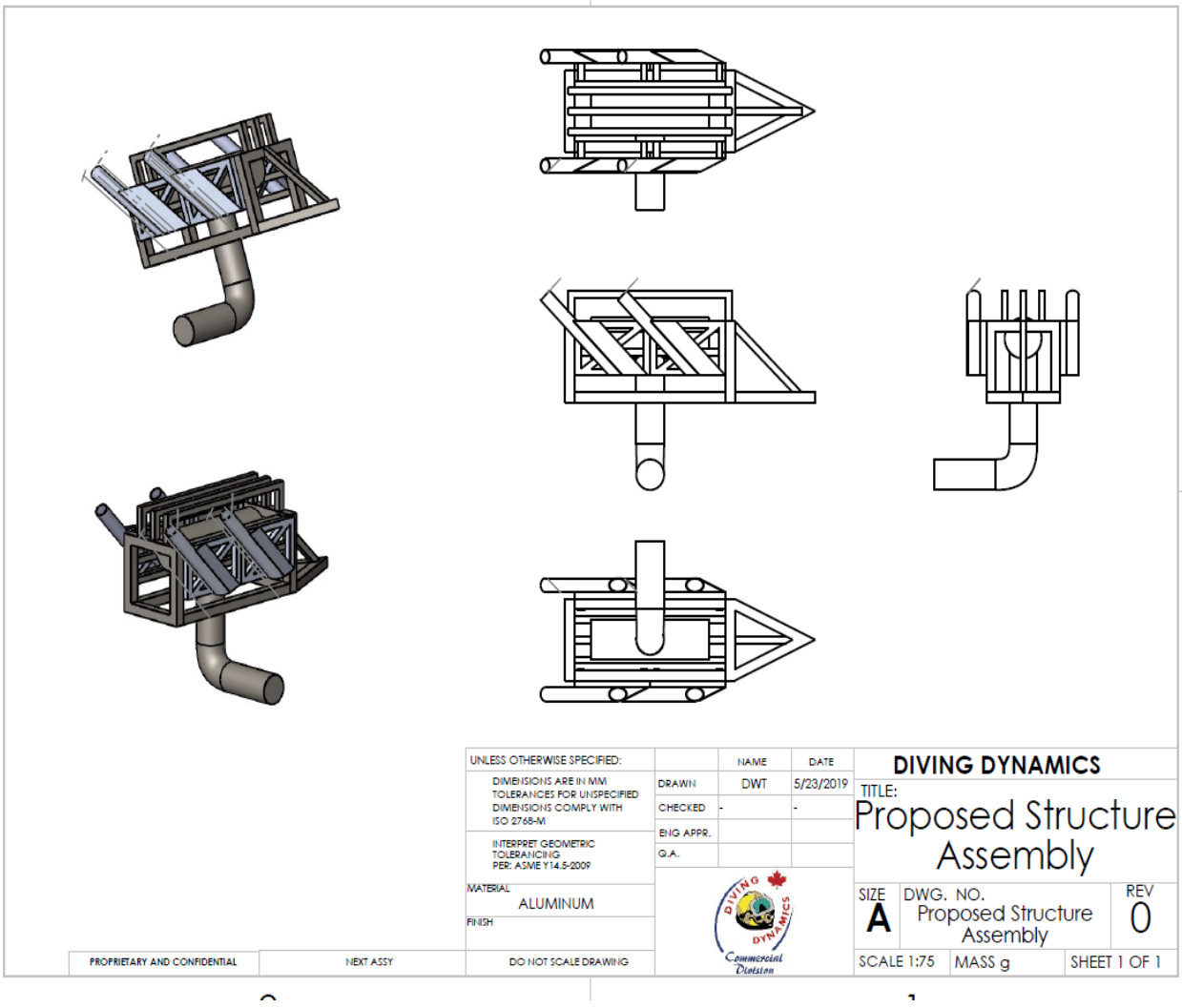
Appendices

DWG – Airlift Assembly



Appendices

DWG – Structure Assembly



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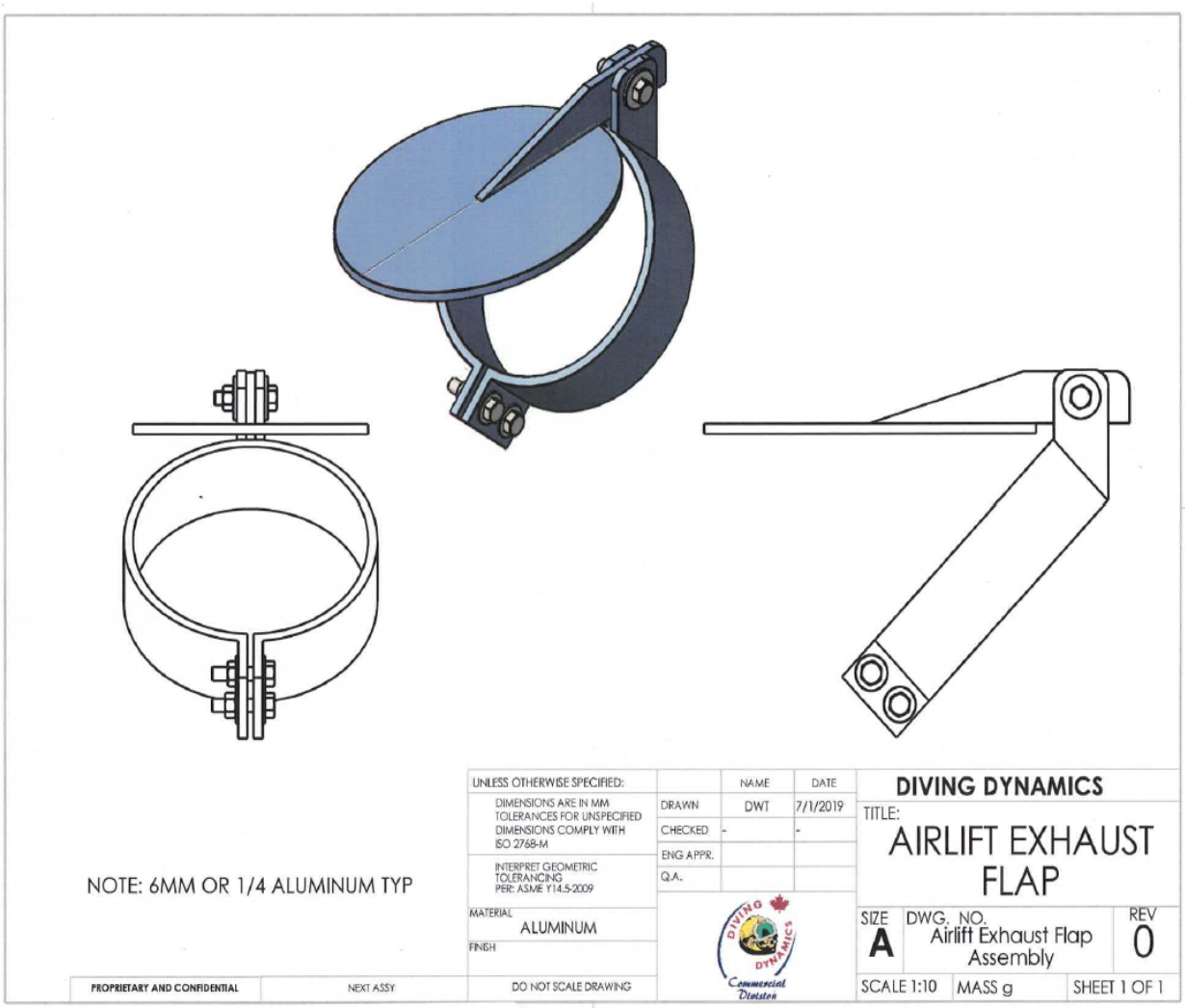
DWG – Air Exhaust Flap Assembly



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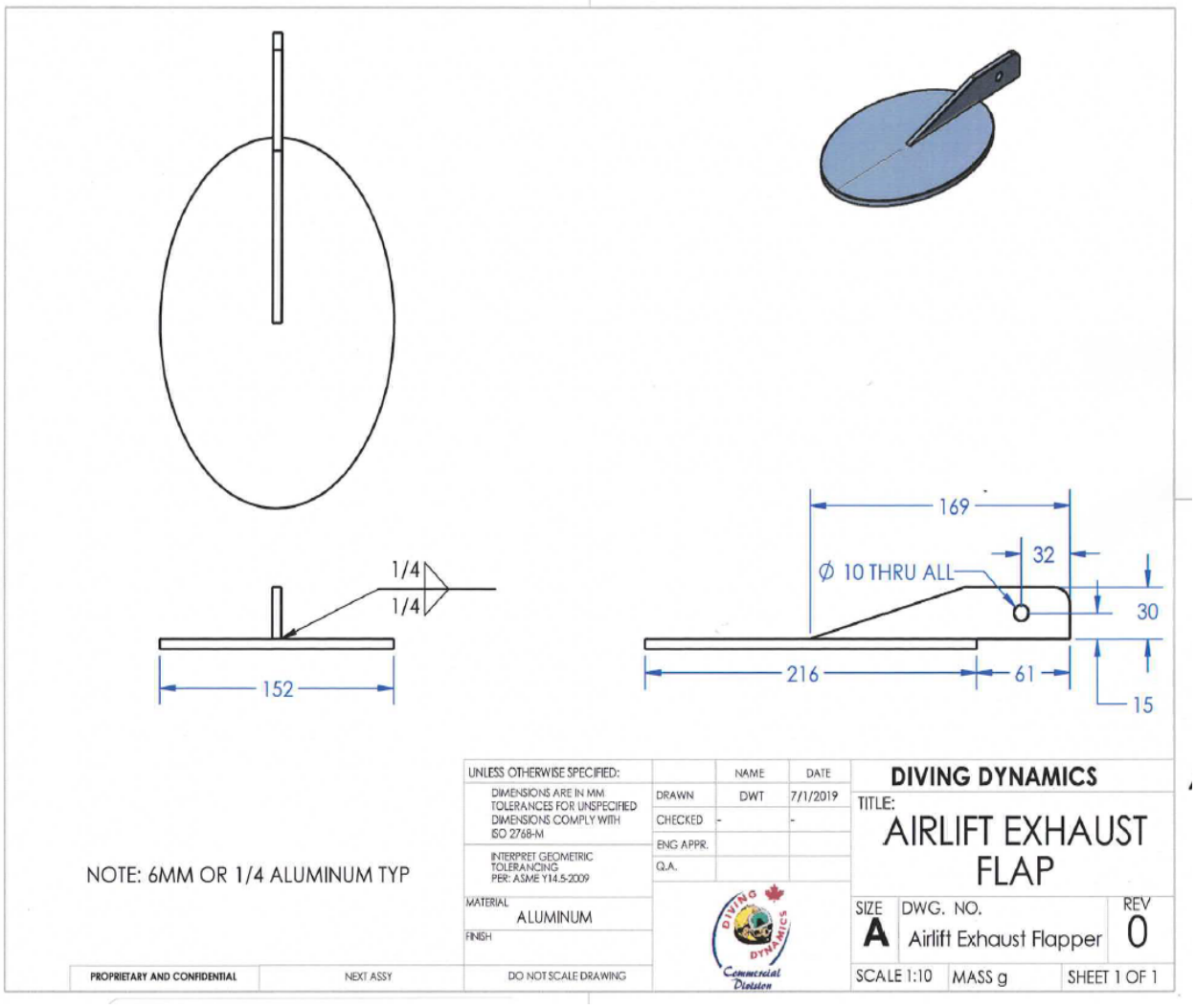
DWG – Air Flap Assembly



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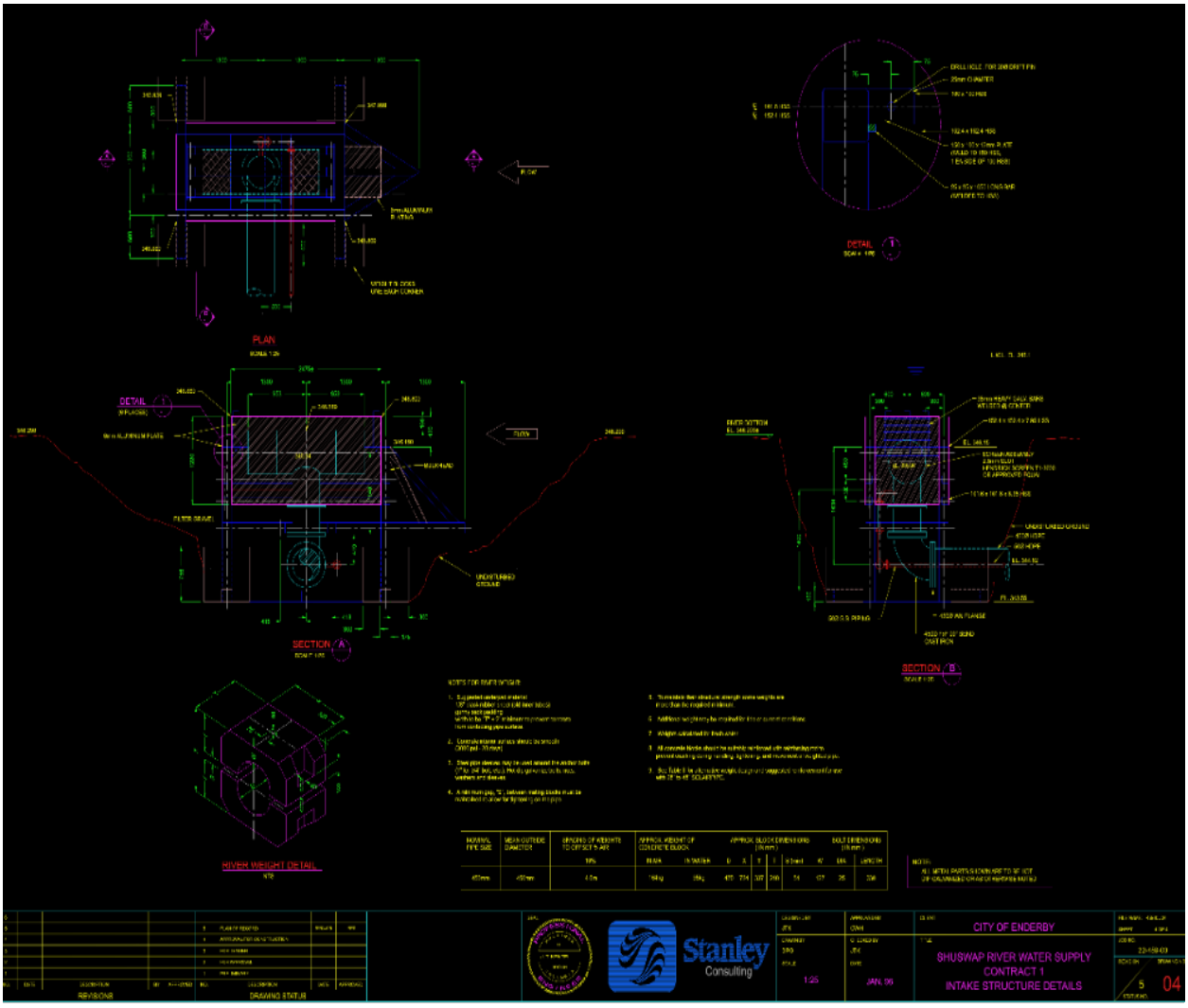
DWG – Intake Structure Assembly



Appendices

Photo 1A – Airlift Module Installation Crew

Appendices

Photo 2A – Airlift Operational

Appendices

Photo 3A – Airlift Operational

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Photo 4A – Onshore Airline Connections with Check Valves

Appendices

Photo 5A – Onshore Airline Connections Close-up