UniversalPegasus INTERNATIONAL

Pipeline Class Location Assessment

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INTRODUCTION

Pipeline class location is a geographical area classified according to its approximate population density and other characteristics that are considered when designing and pressure testing piping to be located in the area[i].

The United States (US) and Canada both require determination of class locations for pipelines. The application of this requirement is different for the two countries. The US requires the class location to be determined for pipelines covered by DOT Part 192[ii] whereas Canada requires it for all pipelines regardless of fluid service (CSA Z662[i]).

Some jurisdictions beneath the federal level may have more stringent requirements than the federal regulation. An example of this is Ontario[iii]. It is important to understand the pipeline design requirements at all levels of government.

Class locations are used to adjust the pipeline design in areas of denser population and thereby increase safety. The pipeline design pressure formula includes a design factor (DOT 192) or location factor (CSA Z662) that are determined by class location. A higher class location when compared to a lower class location (e.g., 2 instead of 1, 3 instead of 2, 4 instead of 3, etc.) has two (2) possible outcomes: a lower pressure rating or a change in design to maintain the same pressure rating (thicker pipe wall or higher strength pipe) as the lower class location.

Existing pipelines are subject to a change in class locations and subsequent change in pressure rating if the population density has changed. DOT 192 does not specify a time frame for review but rather leaves the determination up to the pipeline operator that a review is needed due to increase in population density. CSA Z662 requires an annual review of class location.

It should be noted that CSA Z662 provides more guidance on the development of the class location than does DOT 192.

This document provides a high level view of the class location study using GIS for the analysis and structure polygons obtained during data capture flight.

METHODOLOGY

Aerial Imagery and LIDAR
For the purposes of this document, it is assumed that desktop routing, ground reconnaissance, and the preliminary centerline survey for the pipeline are completed.

When the centerline is reasonably established, it is typical to fly the route to capture imagery (orthorectified) and elevation data using LIDAR. Structure type and count can also be captured and expedites the process of class location determination.

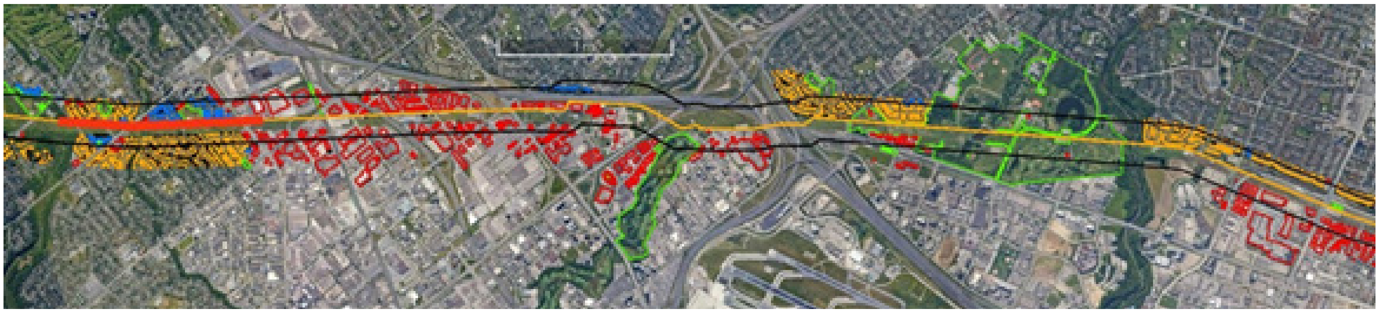
Considerations for the data capture during the flight are quality of aerial imagery to use as a background, width of corridor (collection area), and specifications for the LIDAR services.

The width of the corridor for to be captured by aerial imagery and LIDAR is dependent upon the certainty of the route. It is recommended to include allowances in the data capture for adjustments in the route. It is far easier to fly a wider route or to get higher quality data than it is to make a second flight to acquire additional information particularly if there are restrictions from a governing body such as the US Federal Aviation Authority (FAA) or Transport Canada Civil Aviation (TCCA).

The specification of the LIDAR services includes requirements for data collection and data processing/ handling. LIDAR collection parameters are highly dependent on the environment of the project area and numerous additional factors . It is recommended to have the absolute and relative vertical accuracy of the point data verified and a detailed report of the validation processes used delivered prior to development of the deliverables from the LIDAR point data.

Structure Polygons
The post flight deliverable will need to include data processing to identify structures and create polygons with attribution in GIS ready format. The polygons can identify the following types of structures as an example and as shown in the images.

- Single Family - Orange
- Multi Family - Blue
- Place of Gathering - Green
- Commercial - Red
- Unoccupied Building - Black



Analysis Passes

It is typical to perform multiple passes along the pipeline to identify the different class locations. These passes include:

Initial Pass - Apply a buffer appropriate to the width specified by the applicable code in GIS on either side of the pipeline and extend this beyond the end of the pipeline. Use a "sliding series" of polygons for the length of the route. The number of structure polygons classified as dwellings within the buffer generates the initial results of the class location assessment. This assessment should be run forwards and backwards along the route.

A second pass is a visual assessment to identify those areas that meet the higher density population. A third pass is a visual assessment to identify those areas that meet the development described in Class 4 with buildings intended for human occupancy with 4 or more stories above ground. Additional passes can be performed on a case by case basis.

GIS provides the perfect system within which to perform this work; the spatial analysis tools allow for the multiple sliding length building counts to be performed automatically, and both tabular (worksheet) and spatial outputs (kmz/shapefile) are simple to review and verify.

Reviews

It is recommended to hold reviews of the class location assessment with the project team, right-of-way, and other stakeholders as appropriate before finalizing the report.

Final Pass

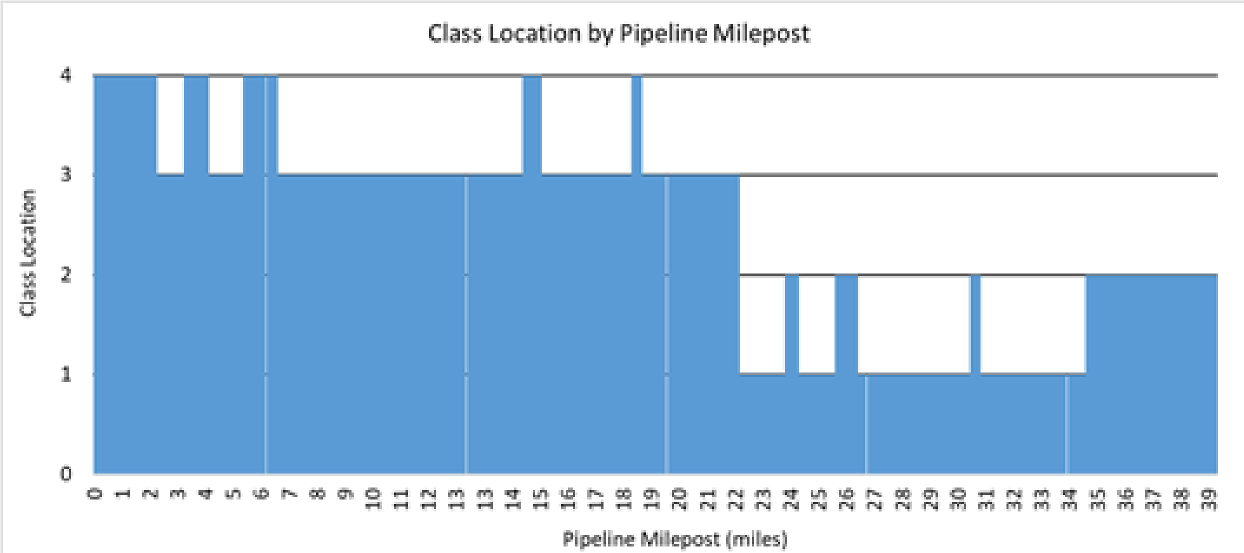
Use the input from the reviews and make a final assessment pass.

EXAMPLE

Following is an example of the application of the above process on 39 miles (62.5 kilometers) of pipeline.

The following image is an aerial representation of the class location (Green - 1, Yellow - 2, Orange - 3, Red -4).

The graph below depicts the Class Location by Pipeline Milepost.



A summary table of the analysis shows the amount of pipeline in each class location.

SUMMARY		
Class	**Length (Miles)**	**% of Length**
1	10.3	26%
2	6.3	16%
3	17.0	44%
4	5.3	14%
Total	38.9	100%

UPI CAPABILITIES

UPI offers a full complement of services for pipelines and related facilities including: conceptual design, FEED, project development, including Total Installed Costs for funding, and EPC/EPCM. Services include project management, engineering and design services, procurement services, sub contractors management, survey, laser scanning, construction management, inspection, Mobile Inspection Platform (MIP), systems integration, automation, process controls, as-built documentation, commissioning, and decommissioning.

UPI has a rich heritage of project experience for pipelines and related facilities. UPI has provided professional services (engineering, surveying, and construction management) for thousands of miles of pipeline and installed millions of horsepower of pumps and compressors.

A representative list of UPI's relevant projects include:

- 77 miles of 36-inch and 49 miles of 30-inch natural gas pipeline in Florida
- 39 miles of refined products pipeline in Ontario, Canada
- 117 miles of 42-inch natural gas pipeline in Texas
- 17 miles of 24-inch and 27 miles of 30-inch natural gas pipeline in Ohio
- 15 miles of pipeline (various diameters) near Baton Rouge, Louisiana

CLOSING

UPI looks forward to talking with you about how we can help you with your project.

[i] Oil and Gas Pipeline Systems, National Standard of Canada CAN/CSA-Z662

[ii] Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards, 49 C.F.R. § 192

[iii] Oil and Gas Pipeline Systems Code Adoption Document Amendment, Technical Standards & Safety Authority (TSSA) FS-220

[iv] 3DEP Lidar Base Specification 2020 rev. A, United States Geologic Survey, retrieved March 8, 2021 from https://www.usgs.gov/media/files/lidar-base-specification-2020-rev-a