BCIT Geographic Information Systems – GIST 8125

BCIT INDOORS - Final Report

19 May 2023

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Project – *BCIT Indoors Campus Application*

Sponsor – *Mike Burns (ESRI Canada)*

Faculty Advisor – *Josh McDougall*

ABSTRACT

The BCIT Indoors Campus Web Map Project (BCIT Indoors) was completed over 45 days under the Canadian division of the Environmental Systems Research Institute (ESRI) sponsorship. The primary intent of the project was to translate all BCIT's Burnaby campus building AutoCAD drawings to the ESRI Indoors geodatabase model, to support the creation of both an Indoors Viewer desktop application and a mobile Indoors application. The study area encompassed 16 BCIT Burnaby Campus facilities from the Northwest, Southeast and Southwest quadrants. Using the Indoors Viewer and mobile applications would allow all faculty members and students to navigate campus efficiently and plan activities surrounding the use of various rooms or the collection and maintenance of campus assets. AutoCAD data was refined to fit the import specifications of the Indoors model workflow, and a subsequent network was generated for 16 campus facilities. Future progression and collaboration between BCIT staff and students will be needed to further develop this application to its full capabilities.

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1.0 INTRODUCTION

The following document outlines the project sponsor, detailed methodology, and outcomes of the BCIT Indoors project. The project was designed to take AutoCAD drawings of every BCIT Burnaby campus building and translate them into a 3D navigation application. Version 2.9 of Esri's ArcGIS Pro mapping software was used to complete most of the project work, with initial building edits completed using Autodesk's AutoCAD drafting software. The work environment included a student-accessible computer lab (room 2980) in building SW03. A large portion of the total hours for the project was allocated towards editing and formatting building drawings, as layers for units, levels, and facility outlines had to be manually drawn, and annotations for unit ID and use type had to be added to each drawing. Additionally, each polygon had to be closed in order to be correctly imported into the Indoors Information Model.

Each drawing was georeferenced according to an orthorectified aerial image before being imported into the Esri Indoors Information Model geodatabase. Once the drawings had been imported, a network lattice was generated for each floor. Next, transitions such as stairs and elevators were created using geoprocessing. Following the creation of transitions and a preliminary network lattice, the network was thinned, generating optimal routes between units on unique floors. After creating the Indoors model, replete with a routable network, points of interest, and other relevant campus information, the ArcGIS workspace was shared as a Web Map and 3D scene to ArcGIS Online and incorporated into the Indoors Viewer application. A mobile map package was also created, enabling users to view the Indoors map using the ArcGIS Indoors mobile application.

2.0 PROJECT STATEMENT

The objective of the BCIT Indoors Project was to provide a routable platform that would allow students and staff to navigate between rooms on campus, plan daily activities, and promote awareness of various amenities and services on campus. A shift in scope allowed for other uses to be considered, including room bookings and data querying, through developing a unique Experience Builder application. The result was a suite of applications that would allow BCIT staff and students to access the full capabilities of Esri Indoors.

3.0 PROJECT SPONSOR

The project was sponsored by Mike Burns of Esri Canada. Esri is the leading-edge company for GIS solutions worldwide, with an extensive mobile and desktop GIS software suite. Their ArcGIS Online platform provides online solutions to GIS editing and data manipulation requirements. They are the creators of various industry-standard GIS software packages, including ArcGIS Pro and ArcMap. Mike Burns is a 3D GIS Analyst for Assessment Professional Services with ESRI Canada. Further contact information is contained in Appendix A.

4.0 PROJECT OBJECTIVES

4.1 Project Objectives

Due to the large volume of AutoCAD editing requirements and the wide range of possible uses for the Indoors model, the initial project scope focused on wayfinding and general reference information. The primary objective was to provide all students and staff with a campus navigation tool. These initial objectives were divided into three primary categories:

- **Navigate** – Each student or staff member would be able to easily route to their corresponding classrooms or meeting rooms based on the use type or unit number for that room.
- **Plan** - By consolidating campus data into one central repository, tasks such as room booking, timetable management, and work order assignments could all be accessed from one application, thus optimizing workflows and increasing efficiency.
- **Explore** – Students or staff members could explore essential amenities or services on campus using a Points of Interest point feature class.

As the project continued, the scope widened as buildings were imported into the Indoors model. After 16 buildings had been modelled, points feature layers containing a sampling of emergency equipment, assets and trees were created. The next series of objectives would include the following categories:

- **Emergency Response** – Students and staff would be aware of the nearest exits, fire extinguishers, and other safety equipment within their proximity in case of a fire or security threat. It would also allow campus staff to track the maintenance records of each emergency equipment asset.
- **Asset Management** - Similar to emergency response, each staff member would be able to locate assets on campus and perform checks and maintenance using a Survey123 form linked to the Indoors data.
- **Room Bookings & Space Planning** – Each staff member would be able to view classrooms and meeting rooms that would hold the required number of students or staff. Students would be able to book study rooms using the desktop application.

4.2 Project Deliverables

The primary deliverables for the project were both a mobile and desktop application, but supplemental products were also created:

Mobile Application – An Indoors mobile application was created to allow students and staff to navigate a route BCIT network and explore multiple feature categories. These categories were configured in ArcGIS and included washrooms, safety equipment points, classrooms, and all units on campus.

Desktop Application - The first focus was an interactive Indoors Viewer application that would display each room on each floor for each building on campus and provide a routable network for live navigation. Since the Indoors license was needed to display this application, it was decided that an alternative Experience Builder application would be built to share the information with BCIT campus staff and students. Attributes such as room images, unit ID, and use types were generated for each room in the Units feature class to view these statistics within the app. Various pages were created in the app, such as an asset and work order dashboard. A booking system page allows users to book study rooms within the application. A space planner page displays the various office spaces on campus and allows staff to view areas for planning meetings or managing staff placement.

Supplemental Products – Additional products, such as field map forms, were generated so campus staff could collect additional asset data using the Esri Field Maps mobile application. Other materials included the creation of a parking web map and cleaned AutoCAD drawings.

5.0 PROJECT BACKGROUND

Esri Indoors provides the tools to enable users to consolidate their indoor data into one centralized repository, creating a geospatially enabled database representing data regarding sites, buildings, rooms, and more. The suite of Esri Indoors tools allows users to visualize their indoor data in 2D and 3D in a floor-aware format. Moreover, users can share their Indoors maps through various Esri platforms, including mobile and desktop applications. Functions derived from Esri Indoors include room booking capabilities, space planning, navigation and routing, and accessibility optimization.

Currently at BCIT, there is no centralized outward-facing data access or visualization hub. Interaction with the Campus Planning and Facilities department proved less than fruitful throughout this project. The department has a page on the BCIT website with several maps available for download as PDFs and a collection of floor plans available for viewing online. Additionally, the study room booking website has links to maps that display where the bookable study rooms are, although these maps sometimes conflict with the floor plans posted by the Campus Planning and Facilities department. Overall, there needs to be more clarity between departments concerning spatial data. This highlights the need for an indoor GIS to bridge the gap between departments and facilitate the efficient sharing and dissemination of spatial data at BCIT.

Several organizations in the lower mainland are currently developing an indoor GIS. By using this technology, BCIT could position itself as a leader in adopting and developing smart campus capabilities. The City of Burnaby is currently implementing an indoor GIS for its City Hall Campus using Esri Indoors. Key functional requirements include "City building space visualization & measurement, indoor data discovery, space allocation, meeting room and hotel office booking, … photo attachments, [and] lobby kiosks for citizens" (Huntington, 2023). While the needs of the City of Burnaby and BCIT vary somewhat, there is an overlap in required functionalities between the two organizations, especially regarding space visualization and room booking. Additionally, Simon Fraser University is currently in the process of revamping its indoor GIS, although the full capabilities of its new system have yet to be revealed.

6.0 PROJECT DATA

6.1 Data Dictionary

The data produced throughout this project was organized into four datasets: Indoors, Network, PrelimNetwork, and BCIT Campus. The project participants created the BCIT Campus dataset as a repository for additional campus information collected over the project's lifespan. In contrast, the other three datasets are default datasets created by the “Create Indoors Geodatabase” geoprocessing tool.

The Indoors dataset is comprised of 10 feature classes. This includes the Details, Events, Facilities, Levels, Reservations, Sections, Sites, TrackingZones, Units and Zones feature classes. Of these, only the Details, Facilities, Levels, Sites, and Units feature classes were populated with records; the Indoors model uses the remaining feature classes for functionalities that were not within this project's scope.

- **Details** – This line feature class encompasses all the intricacies of each building, from doors to equipment. It is one of the most adaptable feature classes in that it allows any organization to customize what information they wish to “draw” within the Indoors model.

- **Units** – The units feature class is the polygon feature class that outlines the full extent of each building room. A "LEVEL_ID" field maps the units according to their level to distinguish rooms on individual floors.

- **Levels** – This polygon feature class defines the full extent of each level for every facility, acting as a boundary for the Units feature class. It allows planners to identify the total area of a facility's floor quickly.

- **Facilities** – The facilities polygon feature class outlines the full extent of the exterior walls of each building, allowing for a building footprint to be generated.

The Network dataset includes the Landmarks, Pathways, and Transitions feature classes, all generated by default when the Indoors geodatabase is created. The Landmarks feature class was not populated with records; although Landmarks are used to give directions in the mobile map package, they are optional for effective routing. Pathways and Transitions are the refined versions of the PrelimPathways and PrelimTransitions feature classes in the PrelimNetwork dataset. This dataset is the repository for the preliminary network features. The PrelimNetwork is a lattice network that covers each level according to a particular query related to which units are considered navigable and which detail lines the final route can pass through.

The BCIT Campus dataset includes all supplemental information including the Assets, Emergency Response, Work Orders, Study Rooms, and Occupants point feature classes. For the complete details on each feature class and the field data types, please refer to Appendix D.

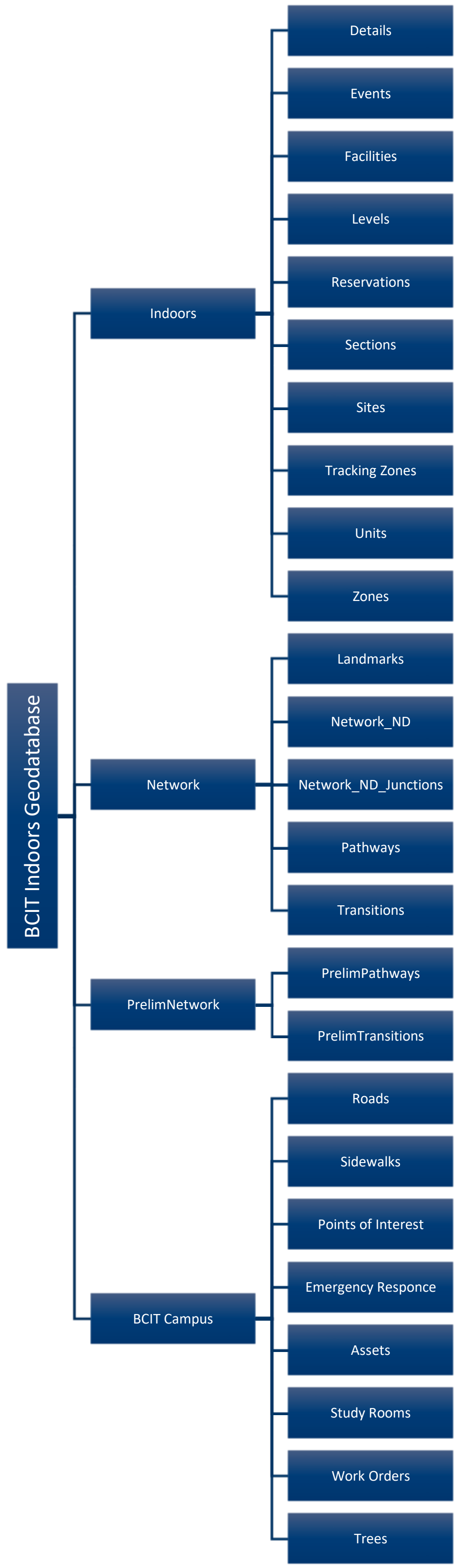

Figure 1: BCIT Indoors Data Model

6.2 Study Area

The initial study area included just two facilities: SW01 and SW03. However, as the modelling workflow became increasingly efficient, the study area was expanded to include a total of sixteen facilities (see Figure 2). Table 1 indicates which project participant completed the edits for each building within the study area.

Figure 2: Preliminary AutoCAD Data for all 16 Facilities

Building	Work Completed By	Status
SW01	Floors 1, 3, 4 (Jordan), Floor 2 (Jesse)	COMPLETE
SW02	Floor 1 (Jordan), Floor 2 + 3 (Jesse)	COMPLETE
SW03	Floor 1 + 3 (Jordan), Floor 2 (Jesse)	COMPLETE
SW05	Jesse	COMPLETE
SW09	Jordan	COMPLETE
SE02	Jesse	COMPLETE
SE04	Jordan	COMPLETE
SE06	Jordan	COMPLETE
SE08	Jordan	COMPLETE
SE10	Jesse	COMPLETE
SE12	Jesse	COMPLETE
SE14	Jordan	COMPLETE
SE16	Jordan	COMPLETE
NW04	Jesse	COMPLETE
NW05	Floor 1 (Jesse), Floor 2 (Jordan)	COMPLETE
NW06	Jesse	COMPLETE

Table 1: AutoCAD Editing Table

7.0 PROJECT METHODOLOGY

7.1 Data Manipulation

A significant undertaking involved the initial cleanup of the AutoCAD data acquired from BCIT. Drawings did not follow a standardized format, and layer names differed between drawings; some layers that should have only contained one type of feature, actually contained two. An example of this was the plumbing fixtures layer which appeared to be on both the “Plumbing” and the “Plan Fixtures” layer. The topology of the drawings varied in quality: varying degrees of connectivity, undershoots, overshoots, and overlaps were all present in most drawings. A regularly occurring example of this was wall lines overshooting door jamb endings and falsely extending into the door walkway areas. Lines with no apparent function were also regularly encountered in the drawings.

The creation of new layers to identify units and level outlines (“A-AREA-BDRY” and “A-LVL-OTLN”) was chosen as a workaround to this issue. New layers identifying the boundaries of each area with a particular use type (known as Units in the Indoors Information Model) were drawn overtop of existing lines for multiple layers within the original AutoCAD drawings. This solution reduced the hours used to find all the current mistakes in the drawing. No additional time was lost since these newly created layers were needed to import the AutoCAD drawings into ArcGIS Pro. Table 2 describes the new layers that were created for each AutoCAD drawing. Figure 3 is a screenshot of the newly created layers in AutoCAD.

LAYER NAME	TYPE	DESCRIPTION	LINE WEIGHT	COLOR
A-AREA-BDRY	Polyline	Reflects the full extent of each unit for the Indoors model upon import.	0.30	Magenta
A-AREA-TYPE	Annotation (Arial,10)	Denotes the use type of each unit.	NA	10
A-AREA-IDEN	Annotation (Arial,10)	Denotes the unit identification, usually as a number.	NA	9
A-FLOR-OTLN	Polyline	Reflects the extent of the building footprint.	0.30	Green
A-LVL-OTLN	Polyline	Indicates the extent of a particular facility floor and acts as a boundary when the network is created.	0.30	Blue

Table 2: Formatted AutoCAD Drawing Layers

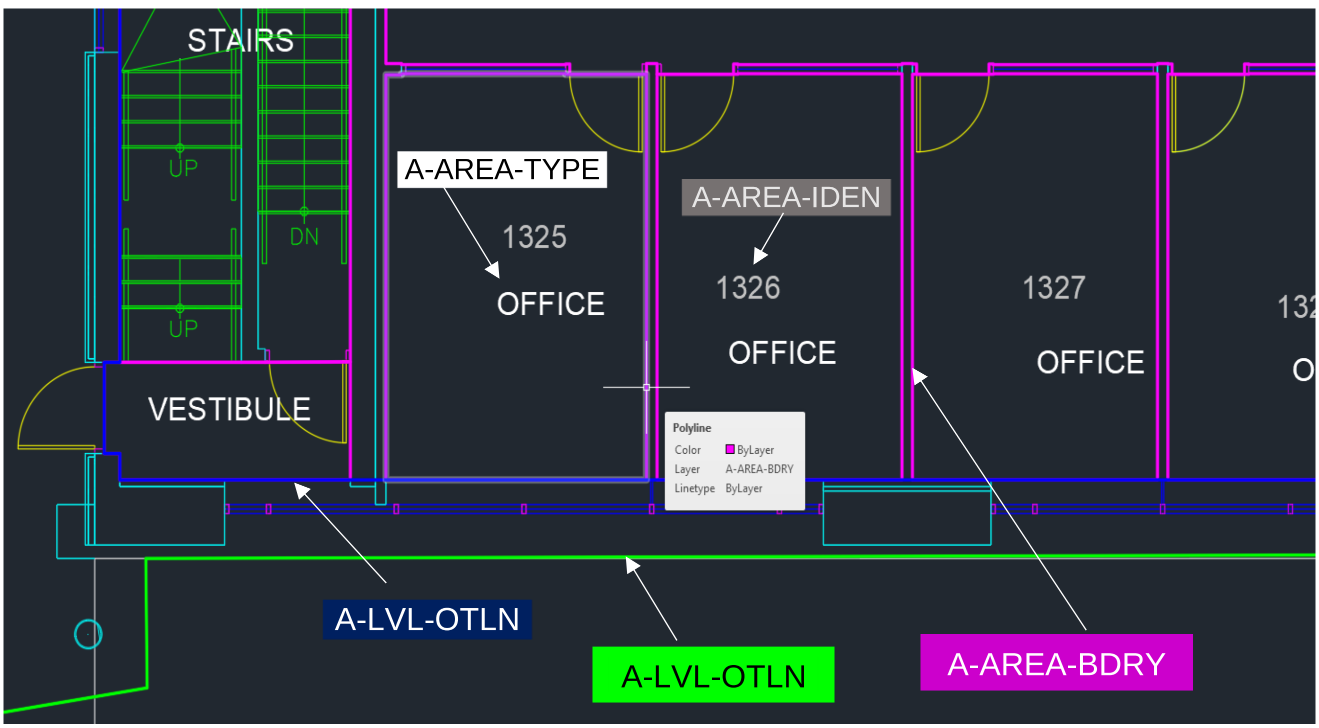

Figure 3: Newly Formatted AutoCAD Layers

Once all the drawings had been standardized, they were imported into ArcGIS Pro for georeferencing. The drawings were georeferenced against an ortho-rectified aerial photo acquired from the Campus Planning and Facilities department.

7.2 Data Translation

A transitional Excel spreadsheet translated the AutoCAD data into the Indoors Information Model. Each layer of the AutoCAD drawing was mapped to the correct feature class by specifying which layers contained each feature. Separate worksheets were used to map the A-AREA-TYPE and A-AREA-IDEN layers and specify the target feature class and fields ("Annotation to Field" sheet).

The most crucial sheet is the "Layer to Feature Class" sheet, which specifies the layers you have created in the AutoCAD drawing and maps them to the Facilities, Levels, Units, and Details feature classes:

	A	B	C	D	E	F	G	H	I	J	K	L
1	FACILITIES	FACILITY_LINES	LEVELS	LEVEL_LINES	ZONES	ZONE_LINES	SECTIONS	SECTION_LINES	UNITS	UNIT_LINES	DETAILS	OPENINGS
2	A-FLOR-OTLN		A-LVL-OTLN						A-AREA-BDRY		BARRIER	DOOR
3											EXTRAS	
4											GLAZE	
5											JAMB	
6											SILL	
7											STAIR	
8											WALL	
9											DOOR	
10											PLUMBING	
11											MILLWORK	
12											EQUIPMENT	
13											GROUNDS	
14											FURNITURE	
15											STORAGE	
16												
17												
18												
19												

Layer to Feature Class | Annotation to Field | Facility Properties | Level Properties | Source Files

Figure 4: Indoors Configuration Spreadsheet

Details includes any data that you wish to display in Indoors that provides further information, such as furniture, equipment or millwork within the facility.

7.3 Data Creation

Once the AutoCAD drawings had been imported to the Indoors Geodatabase, the network for routing had to be generated. In order to do this, a preliminary lattice was generated for each facility floor using the "Generate Preliminary Pathways" geoprocessing tool. Once the lattice had been generated, transitions had to be created for all stairwells and elevator shafts. This was done by running the "Generate Transitions" tool.

After the tool had run, additional editing was needed to ensure all transitions were accounted for. During transition editing, it is possible to edit each transition in a 3D environment to align them with the stairwells' shape accurately; this was avoided, as topological errors related to snapping the transitions to the pathways can quickly be introduced to the network during this process. After the transitions and lattice were connected, the network was thinned using the “Thin pathways” tool. The thinned pathways represent the most optimal routes from each unit to other unit center points. The final network was generated using an Esri XML template file and then built using the “Build Network” tool.

7.4 Publish Content

The last phase of the Indoors workflow involved the creation of a web map and scene that would later be incorporated within the Indoors Viewer application on ArcGIS Online. In addition to the desktop platform, a mobile map package was created from the project workspace to make the map available in the ArcGIS Indoors mobile application.

7.5 Resources Used

Upon the start of the project, both participants were enrolled in the “ArcGIS Indoors Fundamentals” learning plan through the Esri MyAcademy online learning platform. Materials included various web courses, online video content and a training seminar that gave participants background knowledge before starting the project:

Web Courses:

1. *ArcGIS Indoors: Loading Floor Plan Data*
2. *ArcGIS Indoors Basics*

Online Videos:

1. *ArcGIS Indoors: Turn Your CAD and BIM Data into Floor-Aware Maps*
2. *ArcGIS Indoors: An Introduction*

Training Seminar:

1. *Building Floor-Aware Maps with ArcGIS Indoors*

Mike Burns coordinated a series of meetings throughout the project with Esri Indoors representative Alister McDougall. Alister was fluent in the uses of ArcGIS Indoors, provided participants with expert knowledge, and answered questions on various aspects of the project.

Other online content consulted included many online documentation pages created by Esri. YouTube was consulted for other topics from other users of Indoors, including a series of videos produced by Cloudpoint Geospatial, an American geospatial solutions company (Cloudpoint Geospatial, 2020).

7.6 Project Management Techniques

In order to accurately track project progress and hours, each project participant kept a daily log of tasks completed and time spent on each task. Communication, planning, and problem-solving were conducted primarily in person in 2980; when not on-site simultaneously, Discord was used as the primary means of messaging between the project participants. Messaging with the project sponsor took place in a dedicated project Discord server. Video meetings with the project sponsor were conducted over Microsoft Teams, which enabled project participants to screen share when necessary, such as when describing an issue or giving a demonstration.

When the project went full-time, the project participants created a shared Google document where they could create daily checklists for that day's tasks. A shared Excel sheet was also created (see Figure 5), which listed each building and each task required to model that building according to the Indoors Information Model, which a checkbox in each cell. This allowed the participants to check off each step as it was completed. A second sheet contained a table detailing who was currently working on each building and a column indicating when the modelling process was complete for that building.

Data was constantly being changed throughout the project, as the two project participants made edits and created new features, which posed many challenges. A formal business workflow would incorporate an Enterprise GIS platform, wherein both individuals would be able to make simultaneous edits using versions of the database. As this option was unavailable, the project participants worked side-by-side in the computer lab and were trying to constantly communicate regarding which feature class they were editing.

In order to prevent the duplication or deletion of data, individual workspace geodatabases were appended to a centralized geodatabase. This allowed each participant to open a blank workspace, download the latest geodatabase version, and source each feature class path to the data source. This also allowed each participant to create unique maps based on the same data.

Building	Building Number for Config Sheet	Digitized	DWG Checked in Pro	Georeferenced	Imported Into Indoors Model	PrelimPathways	PrelimTransitions	Pathways Thinned	Transitions Edited
SW01	1	☑	☑	☑	☑	☑	☑	☑	☑
SW02	2	☑	☑	☑	☑	☑	☑	☑	☑
SW03	3	☑	☑	☑	☑	☑	☑	☑	☑
SW05	4	☑	☑	☑	☑	☑	☑	☑	☑
SW09	6	☑	☑	☑	☑	☑	☑	☑	☑

Table 3: Building Edits Checklist

7.7 Indoors Workflow Diagram

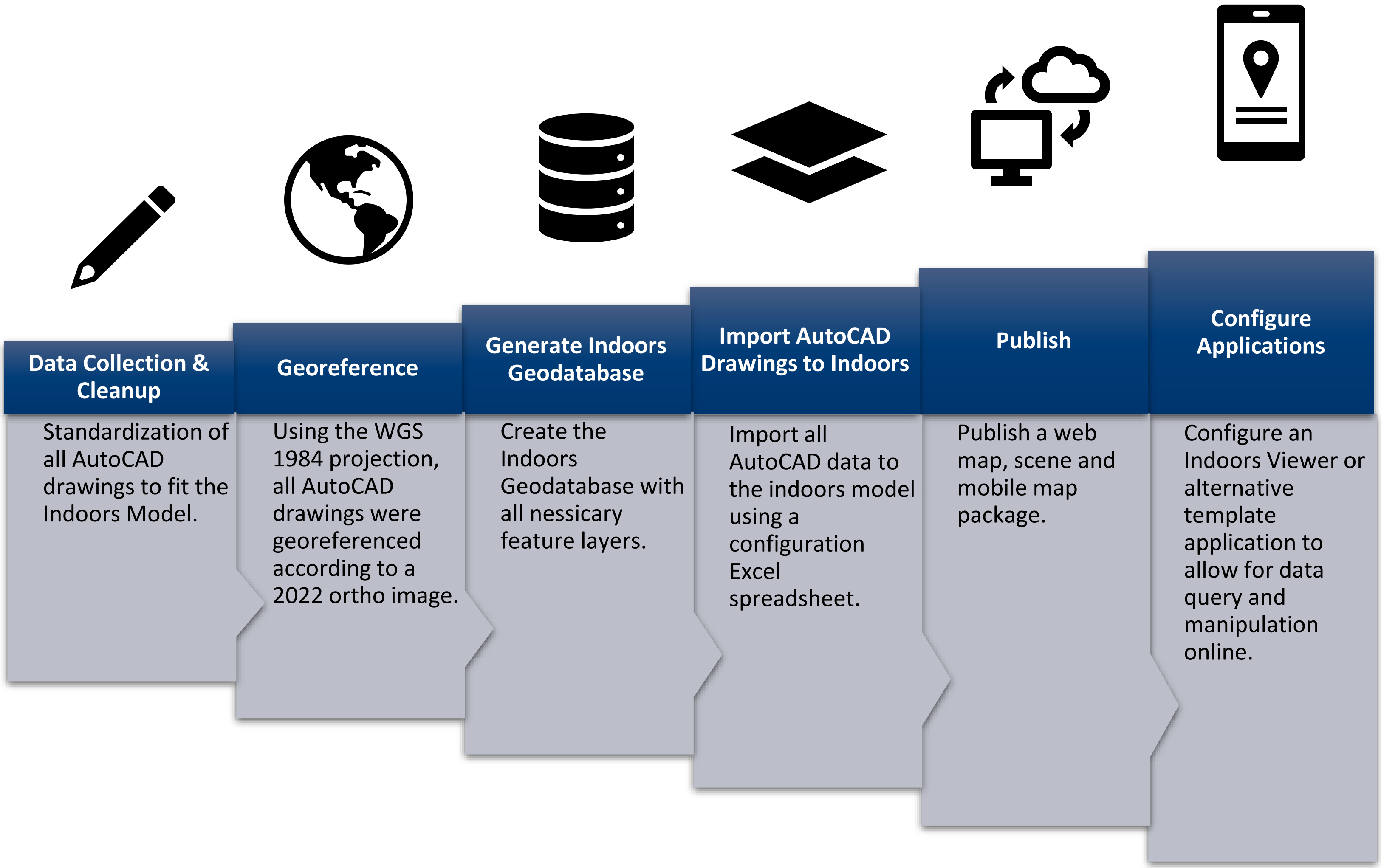

Figure 5: BCIT Indoors Workflow

8.0 DATA MANAGEMENT

8.1 Backup Strategies

Participants used cloud storage throughout the project to transfer large workspaces and centralize data. As both participants were operating on the BCIT campus, this method allowed minimal input from campus staff, who may have had to set up a network folder for both students. Microsoft OneDrive was used as the primary storage provider. Later in the project, a transition was made to Google Drive after many issues occurred syncing files to the local desktop File Explorer using the OneDrive folder link. Each participant would log in to their respective desktop units, download the latest version of the project workspace from the cloud, and work on it locally using their workstation's D:\ drive.

8.2 Naming Conventions

Naming conventions included capitalizing field names each time new fields were added to the attribute tables of various feature classes. Most feature classes and attribute tables were generated by geoprocessing tools specific to the Indoors extension (i.e. "Create Indoors Geodatabase") and retained their original schema and naming conventions. In order to avoid confusion amongst project participants, file names were created for each edited AutoCAD drawing with the editor's name and the date the drawing was updated. A series of unit use type names were formatted and pasted into each drawing, allowing the editor to maintain consistency with the names used for each unit's use type. This was especially important as the use types varied significantly between the original drawings.

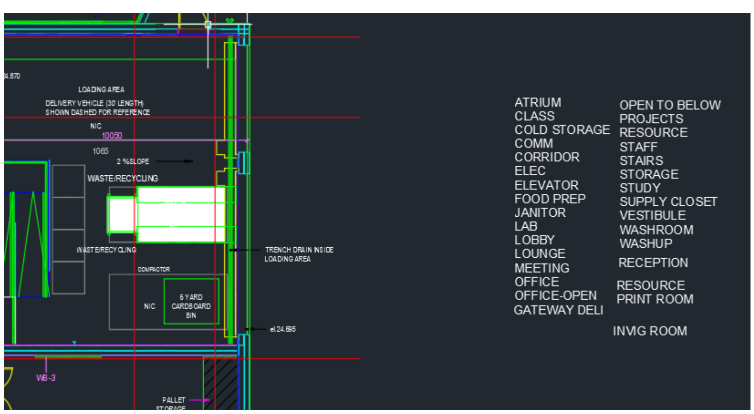

Figure 6: List of Standardized Use Types

9.0 PROJECT RESULTS & RECOMMENDATIONS

The final result of the BCIT Indoors project is an Indoors geodatabase containing information for 16 buildings on BCIT's Burnaby campus and additional campus features located outside (parking lots, trees, safety phones). Products derived from this GDB include a mobile map package which can be used for campus routing and navigation, web maps hosted on ArcGIS Online displaying campus information, and several Experience Builder applications.

The Experience Builder applications include an overview map which can be used to orient newcomers and to acquire general campus information, a study room booking application, an asset collection application, a work order dashboard, and a faculty space planning application that can be used to visualize and query office space in each building within the area of the project scope. Additional project results include AutoCAD drawings optimized for import into the Indoors Information Model and detailed documentation regarding project processes.

The project participants recommend that developing and implementing an indoor GIS at BCIT should be continued, as numerous benefits exist. For this to occur successfully, improved collaboration between relevant stakeholders and departments should be sought after. Discussions with several members from the GIS and Geomatics departments highlighted the need for more resource sharing among BCIT faculty and staff. This would have to be remedied should an indoor GIS be further pursued. By fostering stakeholder collaboration, BCIT could position itself as a leader in the smart campus movement, a goal already stated in its Smart Campus Initiative.

10.0 CONCLUSION

The BCIT Indoors project allowed both participants to adapt and problem-solve as challenges arose with data storage and editing to a centralized location. It also allowed each student to understand the Indoors workflow and master this process for use in the future. Drawing edits took up most of the project timeline as many errors were discovered. Drawings were then translated, and a network was created so that a new mobile map could support routing between all rooms on the BCIT Campus. From raw AutoCAD data to an interactive campus map, integrating a new centralized geodatabase will help form the foundations of a centralized BCIT GIS. The BCIT Indoors mobile application will be a massive step towards a smart campus, as Mike Hill, BCIT's GIS program head, mentioned. This application will provide an interactive user experience for all new students and give BCIT a leading edge for taking on new students and resources. The conceptualization of a virtual campus has begun, and more functionalities can be incorporated and adapted as BCIT staff get further involved.

11.0 REFERENCES

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12.0 APPENDICES

Appendix A: Contact Details

Mike Burns, ESRI CANADA

1130 W Pender St #610, V6E 4A4, Vancouver, BC

Email: mburns@esri.ca

Appendix B: Accounted Time

Task #	Description	Final Report Hours		Total Hours	
		Jesse	Jordan	Jesse	Jordan
1.0	**1.0 Data Collection**				
1.1	Collect AutoCAD Drawings (dwg)	0.00	0.00	0.00	0.00
1.2	Collect Transitional (xlxs) Data	0.00	0.00	0.00	0.00
1.3	Collect Campus Asset Information	7.03	2.50	7.38	2.50
1.4	Collect All Photos For Each Room	0.00	0.00	0.00	0.50
1.5 – (NEW)	Data Additions and Cleanup	10.73	0.00	10.73	0.00
2.0	**Build ESRI Indoors Geodatabase**				
2.1	Create Indoors Database	1.32	3.50	1.75	5.25
3.0	**Create 3D Floorplan**				
3.1	Format AutoCAD Drawings to AIA Standards	13.42	2.50	105.09	80.25
3.2	Add Edited AutoCAD File to ArcGIS Pro and Georeference	13.13	14.25	29.12	32.00
3.3	Fill in Transitional Data for Each Floor	1.45	2.00	4.63	4.00
4.0	**Build Indoor Network**				
4.1	Generate Preliminary Pathways	1.78	5.00	17.93	11.50
4.2	Generate Preliminary Transitions	4.02	4.75	7.84	12.25
4.3	Thin Pathways	0.65	1.25	3.37	6.75
4.4	Create Landmarks & Points of Interest	2.18	0.00	2.18	0.00
4.5	Classifying Pathways	0.00	0.00	0.00	0.00
4.6	Add Pathways Between Facilities	7.37	4.00	7.37	4.00
4.7	Identify Points of Interest	0.00	0.00	0.00	0.00
5.0	**Production**				
5.1	Finalize Symbology and Formatting of Floor Aware Map	6.07	14.25	6.07	14.25
5.2	Share Online Web Map with ESRI Online	8.28	8.00	23.48	20.00
5.3	Create Mobile Map Package	2.23	7.50	4.96	11.25
5.4 – (NEW)	Configure Field Map Survey	7.32	0.00	7.32	0.00
5.5 – (NEW)	Configure Experience Builder App	27.47	22.50	27.47	22.50
6.0	**Communication & Documentation**				
6.1	Sponsor Meetings	4.32	4.75	12.42	11.25
6.2	Planning & Communications	26.37	24	36.32	29.25
6.3	Orientation & Research	2.43	1.5	14.83	8.50
6.4	Documentation	24.75	24.25	43.07	38.25
6.5 – (NEW)	Problem-Solving	4.12	3.75	4.12	3.75
TOTALS		176.44	150.25	377.45	318.00

Appendix C: List of Primary Authors

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5.0 - *PROJECT BACKGROUND* – Jordan Lineker

6.0 - *PROJECT DATA* – Jesse Streight

6.1 - *DATA DICTIONARY* – Jordan Lineker

6.2 - *STUDY AREA* – Jesse Streight

7.0 - *PROJECT METHODOLOGY* – Jesse Streight

7.1 - *DATA MANIPULATION* – Jesse Streight

7.2 - *DATA TRANSLATION* – Jesse Streight

7.3 - *DATA CREATION* – Jesse Streight

7.4 - *PUBLISH CONTENT* – Jesse Streight

7.5 - *RESOURCES USED* – Jesse Streight

7.6 - *PROJECT MANAGEMENT TECHNIQUES* – Jordan Lineker

7.7 - *INDOORS WORKFLOW DIAGRAM* – Jesse Streight

8.0 - *DATA MANAGEMENT* – Jesse Streight

8.1 - *BACKUP STRATEGIES* – Jordan Lineker

8.2 - *NAMING CONVENTIONS* – Jordan Lineker

9.0 - *PROJECT RESULTS & RECOMMENDATIONS* – Jordan Lineker

10.0 - *CONCLUSION* – Jesse Streight

12.0 - *APPENDICES* – Jesse Streight

APPENDIX D: *DATA DICTIONARY* – Jesse Streight

Appendix D: Data Dictionary

Note: All features have a projected coordinated system of WGS 1984 Web Mercator (auxiliary sphere) and a vertical coordinate system of WGS 1984.

BCIT Indoors Geodatabase					
Feature Dataset	**Feature Class**	**Geometry Type**	**Field Names**	**Data Type**	**Description**
Indoors	Details	Line	DETAIL_ID	Text	A unique ID for the detail.
			HEIGHT_RELATIVE	Double	The relative height value.
			LEVEL_ID	Text	Identifies the feature's level.
			USE_TYPE	Text	The feature's use type (“Class” or “Lab”).
	Events	Point	DATE_END	Date	An event’s end date.
			DATE_START	Date	An event’s start date.
			DESCRIPTION	Text	A description of the event.
			EVENT_ID	Text	A unique ID assigned to the event.
			IMAGE_URL	Text	An internet link to the images for the event.
			LEVEL_ID	Text	Identifies the feature's level.
			NAME	Text	The short name of the event.
			NAME LONG	Text	The long name of the event.
			NAME_SUBTITLE	Text	The subtitle for the event.
			UNIT_ID	Text	The unique ID for the unit in which the event will be held.
			USE_TYPE	Text	The use type of the room in which the event will be held.
	Facilities	Polygon	FACILITY_ID	Text	The unique ID for the facility.
			HEIGHT_RELATIVE	Double	The relative height of the facility.
			LEVELS_ABOVE_GROUND	Long	The count of the number of levels above the ground the facility contains.
			NAME	Text	The short name of the facility.
			NAME LONG	Text	The long name of the facility.
			SITE_ID	Text	A unique ID assigned to the site.
	Levels	Polygon	AREA_GROSS	Double	The gross area for the entire level.

			FACILITY_ID	Text	A unique ID assigned to the level.
			HEIGHT_RELATIVE	Double	The relative height of the level.
			LEVEL_ID	Text	Identifies the feature's level.
			LEVEL_NUMBER	Long	The number corresponding to the level.
			NAME	Text	The long name of the level.
			NAME_SHORT	Text	The short name of the level.
			VERTICAL_ORDER	Long	The vertical order value for the level.
	Reservations	Polygon	ALL_DAY	Long	An attribute identifying if the reservation will be held for the entire day.
			CHECK_IN_TIME	Date	The reservation check-in time.
			CHECK_OUT_TIME	Date	The reservation check-out time.
			DESCRIPTION	Text	A description of the reservation.
			END_TIME	Date	The end time for the reservation.
			LEVEL_ID	Text	Identifies the feature's level.
			RESERVED_FOR_FULL_NAME	Text	The full name of the reservation holder.
			RESERVED_FOR_USERNAME	Text	The user name of the reservation holder.
			START_TIME	Date	The start time for the reservation.
			STATE	Long	The reservation state.
			TITLE	Text	The reservation title.
			UNIT_ID	Text	The unit ID of the room upon which the reservation was held.
			UNIT_NAME	Text	The unit name of the room upon which the reservation was held.
	Sections	Polygon	AREA_GROSS	Double	The gross area of the section.
			HEIGHT_RELATIVE	Double	The relative height of the section.
			LEVEL_ID	Text	Identifies the feature's level.
			NAME	Text	The short name of the section.
			NAME_LONG	Text	The long name for the section.
			SECTION_ID	Text	A unique ID for the section.
	Sites	Polygon	NAME	Text	The short name of the site.

			NAME_LONG	Text	The long name for the site.
			SITE_ID	Text	A unique site ID.
	Tracking Zones	Polygon	DESCRIPTION	Text	A brief description of the tracking zone.
			LEVEL_ID	Text	Identifies the feature's level.
			TRACK_TYPE	Long	Identifies areas in which mobile location is tracked. WGS 1984
			TRACKING_ZONE_ID	Text	A unique ID for the tracking zone.
	Units	Polygon	AREA_GROSS	Double	The gross area in meters squared for a particular unit.
			AREA_ID	Text	A unique ID for the area zone.
			ASSIGNMENT_TYPE	Text	Used to identify specific booking features of the unit.
			CAPACITY	Long	The people capacity of each room.
			HEIGHT_RELATIVE	Double	The relative height of the room.
			LEVEL_ID	Text	Identifies the feature's level.
			NAME	Text	The short name of the unit. This is the room number.
			NAME_LONG	Text	The long name of the unit which includes the building and room number.
			RESERVATION_METHOD	Long	The method by which the room can be reserved.
			SCHEDULE_EMAIL	Text	The email used by Microsoft 365 to book the room.
			UNIT_ID	Text	A unique ID for the room.
			USE_TYPE	Text	The use type of the room (“Class” or “Lab”).
	Zones	Polygon	AREA_GROSS	Double	The gross area of the zone.
			HEIGHT_RELATIVE	Double	The relative height of the zone.
			LEVEL_ID	Text	Identifies the feature's level.
			NAME	Text	The short name of the zone.
			NAME_LONG	Text	The long name for the zone.
			ZONE_ID	Text	A unique ID for the zone.

Network	Landmarks	Point	DESCRIPTION	Text	A short description of the landmark.
			LEVEL_ID	Text	Identifies the feature's level.
			VERTICAL_ORDER	Long	The vertical order number for the landmark.
	Pathways	Line	DELAY	Long	The time upon which it takes to use an elevator or stairway.
			FACILITY_ID	Text	A unique ID for the facility.
			FACILITY_NAME	Text	The long name of the facility.
			LENGTH_3D	Double	The 3D length of a network line.
			LEVEL_NAME_FROM	Text	The level name upon which a feature starts.
			LEVEL_NAME_TO	Text	The level name upon which a feature ends.
			PATHWAY_RANK	Long	The rank of a pathway which determines the path of travel.
			PATHWAY_TYPE	Long	The type of pathway.
			TRAVEL_DIRECTION	Long	The direction of travel permitted along the pathway line.
			VERTICAL_ORDER	Long	The vertical order of the pathway.
	Transitions	Line	FACILITY_ID	Text	The facility ID upon which the transition is located.
			FACILITY_NAME	Text	The facility name upon which the transition is located.
			HEIGHT_FROM	Double	The height upon which a feature starts.
			HEIGHT_TO	Double	The height upon which a feature ends.
			LENGTH_3D	Double	The 3D length of a transition line.
			LEVEL_NAME_FROM	Text	The name of the level upon which a feature starts.
			LEVEL_NAME_TO	Text	The name of the level upon which a feature ends.
			TRANSITION_RANK	Long	The rank of a transition which determines the path of travel.
			TRANSITION_TYPE	Long	The type of transition.
			TRAVEL_DIRECTION	Long	The direction of travel permitted along the transition line.

			VERTICAL_ORDER_FROM	Long	The vertical order number upon which a feature starts.
			VERTICAL_ORDER_TO	Long	The vertical order number upon which a feature ends.
PrelimNetwork	PrelimPathways	Line	ANGLE	Long	The preliminary pathways rotation angle.
			DELAY	Long	The time upon which it takes to use an elevator or stairway.
			FACILITY_ID	Text	A unique ID for the facility.
			FACILITY_NAME	Text	The long name of the facility.
			LENGTH_3D	Double	The 3D length of a network line.
			LEVEL_NAME_FROM	Text	The level name upon which a feature starts.
			LEVEL_NAME_TO	Text	The level name upon which a feature ends.
			PATH_EDGE_DISTANCE	Double	The distance of the pathway edges.
			PATHWAY_RANK	Long	The rank of a pathway which determines the path of travel.
			PATHWAY_TYPE	Long	The type of pathway.
			TRAVEL_DIRECTION	Long	The direction of travel permitted along the pathway line.
			VERTICAL_ORDER	Long	The vertical order of the pathway.
	PrelimTransitions	Line	FACILITY_ID	Text	The facility ID upon which the transition is located.
			FACILITY_NAME	Text	The facility name upon which the transition is located.
			HEIGHT_FROM	Double	The height upon which a feature starts.
			HEIGHT_TO	Double	The height upon which a feature ends.
			LENGTH_3D	Double	The 3D length of a transition line.
			LEVEL_NAME_FROM	Text	The name of the level upon which a feature starts.
			LEVEL_NAME_TO	Text	The name of the level upon which a feature ends.

			PATH_EDGE_DISTANCE	Double	The distance of the transition path edges.
			TRANSITION_RANK	Long	The rank of a transition which determines the path of travel.
			TRANSITION_TYPE	Long	The type of transition.
			TRAVEL_DIRECTION	Long	The direction of travel permitted along the transition line.
			VERTICAL_ORDER_FROM	Long	The vertical order number upon which a feature starts.
			VERTICAL_ORDER_TO	Long	The vertical order number upon which a feature ends.
Tables	Areas	NA	AREA_ID	Text	A unique ID for the area.
			AREA_TYPE	Text	Signifies the type of area.
			AREA_NAME	Text	The name of the area.
			RESTRICTED	Long	Signifies if the area is restricted.
	IndoorsConfig	NA	CONFIG_KEY	Text	The configuration key specific to Indoors.
			CONFIG_VALUE	Text	The configuration value specific to Indoors.
BCIT Campus	Assets	Point	OBJECTID	Object ID	The object ID for a particular asset.
			SHAPE	Geometry	The geometry for a particular asset.
			LEVEL_ID	Text	Identifies the feature's level.
			RELATIVE_HEIGHT	Float	The relative height of the asset.
			Z	Double	The z value for the asset.
			CATEGORY	Text	The category for the asset.
	Emergency_Response	Point	OBJECTID	Object ID	The object ID for a particular emergency point.
			SHAPE	Geometry	The geometry for an emergency point.
			LEVEL_ID	Text	Identifies the feature's level.
			RELATIVE_HEIGHT	Float	The relative height of the emergency point.
			Z	Double	The z value for the emergency point.
			CATEGORY	Text	The category for the emergency point.
	Occupants	Point	UNIT_ID	Text	The unit ID in which the occupant is located.

			LEVEL_ID	Text	Identifies the feature's level.
			EMAIL	Text	The email of the occupant.
			AREA_ID	Text	The area ID in which the occupant is located.
			HEIGHT_RELATIVE	Double	The relative height of the occupant point.
			KNOWNAS	Text	The name of the occupant.
			OCCUPANT_ID	Text	The ID of the occupant.
			OCCUPIED	Text	Signifies if the unit is occupied.
			JOB_TITLE	Text	The job title of the occupant.
	Parking_Lots	Polygon	OBJECTID	Object ID	The object ID for a particular parking lot.
			SHAPE	Geometry	The geometry of the parking lot.
			LOT_NUMBER	Long	The lot number.
			NAME	Text	The name of the parking lot.
			TYPE	Text	The access type of the parking lot.
			SHAPE_LENGTH	Double	The length of the parking lot shape.
			SHAPE_AREA	Double	The area of the parking lot shape.
	Points_of_Interest	Point	OBJECTID	String	The object ID for a particular point of interest.
			LEVEL_ID	Single	Identifies the feature's level.
			HEIGHT_RELATIVE	Double	The relative height of the point of interest.
			Z	String	The z value for the point of interest.
			CATEGORY	String	The category for the point of interest.
	Roads	Polygon	OBJECTID	Object ID	The object ID for a particular road.
			SHAPE	Geometry	The geometry of the road.
			SHAPE_LENGTH	Double	The length of the road shape.
			SHAPE_AREA	Double	The area of the road shape.
			NAME	Text	The name of the road.
	Sidewalks	Polygon	OBJECTID	Object ID	The object ID for a particular sidewalk.
			SHAPE	Geometry	The geometry of the sidewalk.
			SHAPE_LENGTH	Double	The length of the sidewalk shape.
			SHAPE_AREA	Double	The area of the sidewalk shape.
			NAME	Text	The name of the sidewalk.

	Study_Rooms	Point	OBJECTID	Object ID	The object ID for a particular study room.
			SHAPE	Geometry	The geometry of the study room.
			BOOKING_LINK	Text	The link to the BCIT study room booking system.
			UNIT_ID	Text	The unit ID of the study room.
			LEVEL_ID	Text	Identifies the feature's level.
	Trees	Point	OBJECTID	Object ID	The object ID for a particular tree.
			SHAPE	Geometry	The geometry of the tree.
			COMMON_NAME	Text	The common species name for the tree.
	Work_Orders	Point	OBJECTID	Object ID	The object ID for a particular work order.
			SHAPE	Geometry	The geometry of the work order.
			CATEGORY	Text	The category for the work order.
			INCIDENT_DATE	Date	The date upon which the incident for the generated work order occurred.
			LEVEL_ID	Text	Identifies the feature's level.
			RESOLVED_DATE	Date	The date upon which the work order was resolved.
			DESCRIPTION	Text	The description for the work order.
			STATUS	Text	The completion status of the work order.
			WORK_ORDER_NUM	Double	The work order number.