C124273 – Taking a New Road: InfraWorks for Public Engagement

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City of Vancouver

Learning Objectives

- Benefit from real-life successes (and stumbles) in the application of InfraWorks for public engagement
- Learn how to adapt strategies for introducing InfraWorks into existing workflows, and learn how to overcome resistance to change
- Learn how to optimize models for best delivery through the web and VR
- Learn how to choose effective third-party tools to enhance InfraWorks models

Description

InfraWorks software facilitates engineers, planners, and architects in the making of complex decisions. Of equal importance is the role it can play in explaining the complexities of the decision-making process to a less technical audience, making the “why,” “how,” and “what” accessible and engaging. As part of a new plan for its central core, the City of Vancouver is replacing a viaduct system, the only remnant of a proposed freeway, with a more resilient and connected street network. Public engagement is a key component of the process—and with extensive changes being proposed to the street system and the public realm, the challenge has been to present the future state and how things are being phased/changed in a clear, accurate, and interesting manner. This class will show how an interdepartmental team is collaborating to use the full palette of InfraWorks software's capabilities—including web maps, ground-based LIDAR (light detection and ranging), and virtual reality—to make the public an informed and engaged partner in the process.

Speaker

Dan Campbell is a Systems Analyst with the City of Vancouver, responsible for coordinating 3D visualization and analysis activities, and managing the City's 3D model. He has a background in architecture, planning, urban design and GIS which he is able to apply in the context city modeling. Dan has spoken at conferences including Autodesk University, Map Asia, GeoWeb, GeoTec, URISA, RTC BIM Forum, Pitney Bowes Insight, Geospatial World Forum Rotterdam, Middle East Geospatial Forum, India Geospatial Forum, and the ITEA 3 Smart City Workshop-Istanbul, focusing on the role of 3D as it relates to design, smart cities and public engagement. Dan has had articles published by Vector1 Media, GeoWorld, and Geospatial World. In 2012, Dan was the recipient of the Pitney Bowes Meridian Award for Technical Achievement.

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Intent

In the following three public engagement programs at the City of Vancouver, InfraWorks played a key role. Each of engagements was unique, and highlighted specific applications of InfraWorks functionality. As well, the different compositions of the teams and departments involved offers insight on the challenges of both a technical and organization structural nature.

What is Public Engagement?

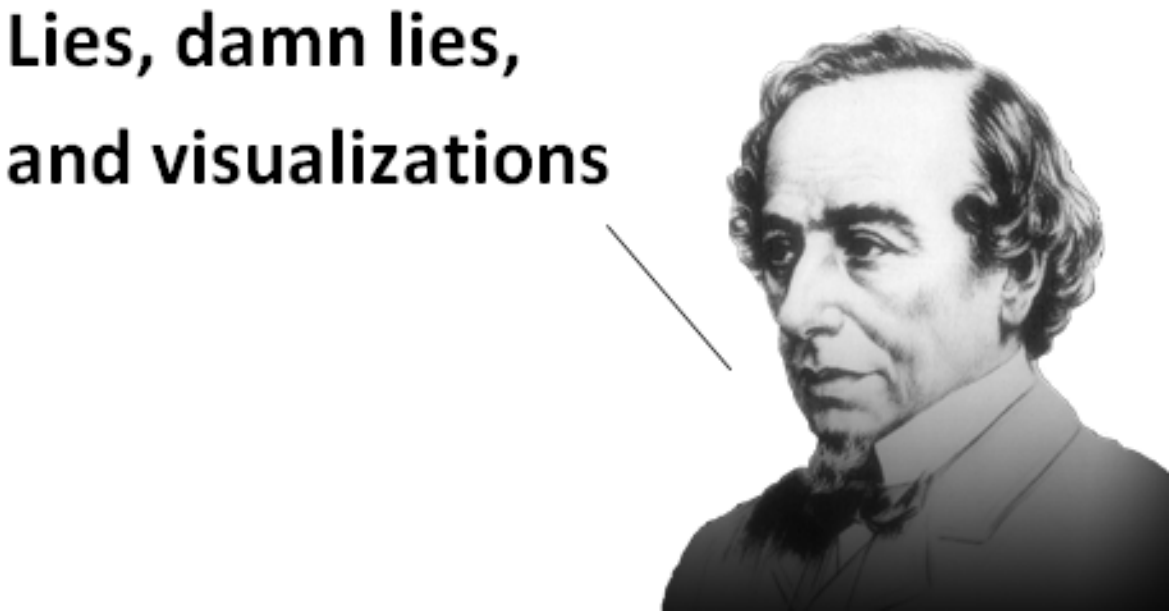
A good starting definition: Public engagement is a term to describe "the involvement of specialists listening to, developing their understanding of, and interacting with, non-specialists" *(as defined by England's university funding agency, HEFCE, in 2006). – Wikipedia*

There isn't a specific methodology that is able to facilitate all manner of public engagement. As much as we wish there was a one size fits all solution, effective participation depends on each unique case evolving from a combination of participants, tools and objectives. The examples that follow all fall under the umbrella of local government projects. There are many lists available that outline the principles of the ideal principles of public participation. Some key principles, that are relevant to this presentation, and that we have tried to follow include:

1. There should be an opportunity for the perspectives of those participants who lack specialist knowledge of the area concerned to engage in a two-way exchange with participants (City staff in our case) possessing specialist knowledge. At the very least provide enough supporting information to ensure a basic understanding of complex or highly technical issues).
2. There should be transparency of the data resources involved and any activities carried out within the process to those both inside and outside it. Participants should be able to audit what is being presented.
3. The process of engagement should try not to be exclusionary. For example, VR might be a very good way to present a complex project, but if only a small number of participants have access to VR viewing devices the process will fail.
4. The line between one way communication and public participation can be fuzzy. Know what you are trying to achieve and don't confuse one with the other. They are complementary processes. The process should offer opportunities for new ideas, asking questions, sharing of information and observations, and of course, engagement.
5.

THE ENGAGEMENT RING

6. Engagement is not seduction. Be careful about not just emulating commercial architectural visualization. The objective should be to inform and engage, not sell. Consider the slight rephrasing of Benjamin Disraeli's famous quote:



My experience working on a range of projects is that while we always tried to maintain the intent of these principles, complexity, time constraints, budget, and resources often limited the extent of their application. As well, a common problem with public engagement is that if all involved and not, well,

engaged, public engagement can seem like a chore. We need to be careful not to see public engagement like this, the dental floss of local government:

PUBLIC ENGAGEMENT: THE DENTAL FLOSS OF LOCAL GOVERNMENT.

We know that like flossing, public engagement is beneficial, provides great results, and keeps big problems from popping up later. However, like flossing, we don't do it frequently enough, are not always really committed to it, and often do it only because we are told to. Public engagement can be time consuming and expensive. Given these issues, any tools that can make the public engagement process easier and achievable are most welcome. This is especially true for local government. This is why InfraWorks has is beginning to play a larger role in processes.

With the majority of our projects we have tried to accomplish as much as possible using InfraWorks out of the box and minimizing incorporating other tools into the production pipeline. This is not always feasible, but as we try to expand the number of InfraWorks users we know that we will have more success getting staff being productive if we can focus on one product. Staffs leading the public engagement processes are planners and engineers, not GIS or visualization specialists. Having to become a competent in Photoshop, 3ds Max, SketchUp, Navisworks, Stingray, FME and Premiere Pro is simply too much.

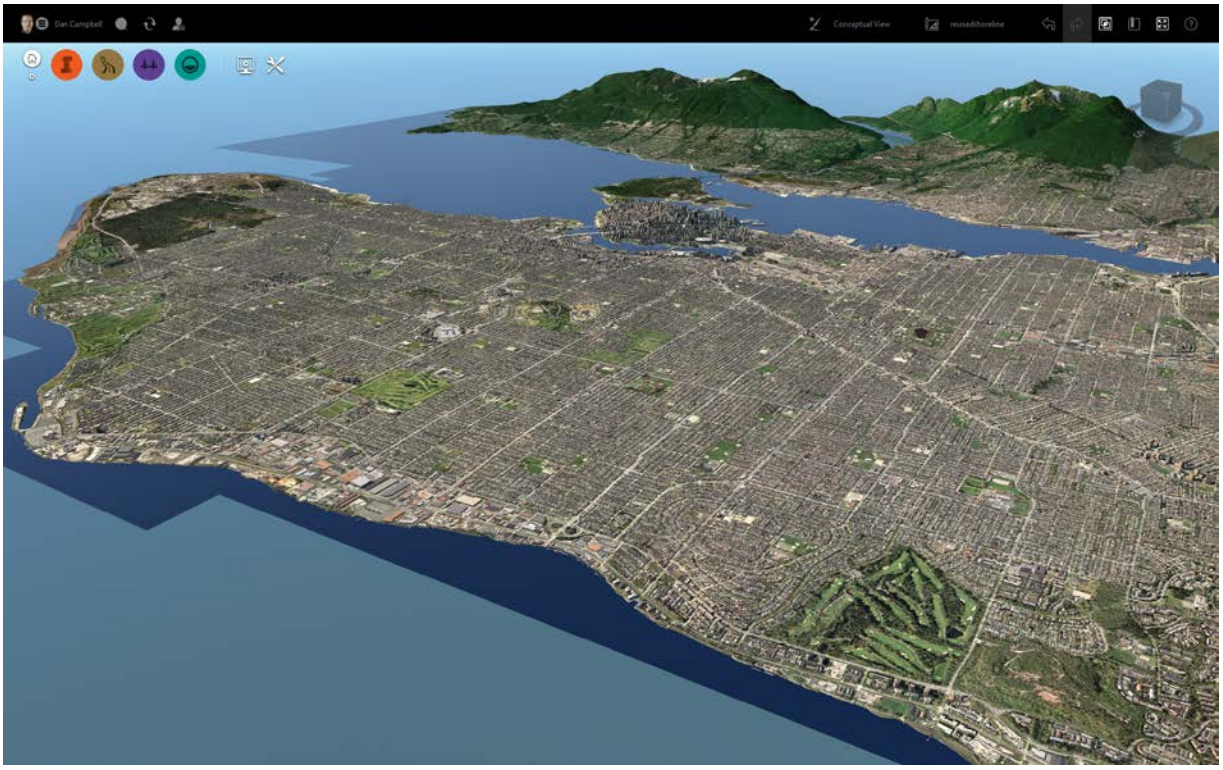
The following three project examples illustrates how InfraWorks has been used in different ways by the City of Vancouver to assist in explaining the complexities of decision-making, and to ensure that the public are involved in the all phases of the projects from the outset. The projects are presented in chronological order to highlight our growing understanding of the role of InfraWorks.

InfraWorks at the City of Vancouver

A very small number of us in the GIS/CAD Support Group have been working with InfraWorks from the time when it was LandXplorer, It is only recently that is use has expanded into other departments, notably our Engineering and Urban Design Groups.

Our full City model is constructed from the key following ingredients:

- Aerial LiDAR (2013)
- Ground Based LiDAR (only specific areas) 2017
- 2.5D Building Footprints (with height, elevation and roof slope data) 2009
- Textured Pictometry 3D Buildings (downtown core only) 2016
- GIS Data (street trees, street centre-lines, street lights and such)
- SketchUp and 3ds Max 3d models (as needed)
- InfraWorks Model Builder (outside the City context – Northshore mountains)



EXTENT OF THE CURRENT CITY MODEL

LEVEL OF DETAIL OF THE CURRENT CITY MODEL

Northeast False Creek Redevelopment

Northeast False Creek (NEFC) represents approximately 58 hectares of mostly undeveloped land along downtown's False Creek waterfront. This is equivalent to approximately 10% of the downtown peninsula (not including Stanley Park).

In 2015, City Council chose to move forward with a plan to replace the viaducts (the only built part of a Vancouver freeway that never was) with a more resilient and connected street network. Replacing the viaducts is a self-funding solution with many public benefits including a larger Creekside Park and an improved transportation network that replaces vulnerable infrastructure.

Earlier I attempted to define "public-engagement". Now it is worthwhile to try and define "public". For those of us doing very specialized work, our public is not just ordinary people in general, or the community, but also our project co-workers who do not share our same technical skills.

Organizations can have set ways of doing things, and introducing new tools and processes is often difficult. This is especially true when technology is involved, and the fear that the tools might not perform as expected must be addressed at an early stage. To engage the public, one must first engage the gate-keepers of the public processes. For a major project like Northeast False creek that includes staff from our Digital Services Group, and our Corporate Communications Group. Starting small is an effective way to begin, experimenting.

While public engagement was the primary objective for involving InfraWorks, it was also an opportunity to get in a foot in the door to expose other ways it could be used. In our case, most of the preliminary roadway design had already occurred before InfraWorks was introduced. Even so, as other staff became more familiar with what could be accomplished with InfraWorks as an actual design tool, they recognized it could play a key role complementing the traditional use of Civil3D. Given the scale of the project it was immediately clear that we in our GIS/CAD support group could not deliver what was needed for a successful public engagement. It was necessary for the multi-disciplinary Northeast False Creek staff to also become proficient in working with InfraWorks, with our group proving in-house orientation, training and support. This was the first project to explicitly expand the number of InfraWorks users and licenses.

The initial objective was to clearly present the proposed road alignment changes to the public. Not only was what was being proposed complex, but it was very controversial as well. An informed public would understand all the issues involved and be able to give more consideration to the decisions as they are made. The traditional set of tools would not be adequate.

We had precise and detailed Civil 3D drawings that where indecipherable by anyone other than an engineer on one end of the spectrum. At the other end were loose, conceptual sketches of how things might look which were highly subjective and easily misunderstood. Our hope was that InfraWorks might be able to bridge these two extremes and find a sweet spot for communication and engagement.

FINDING THE SWEET SPOT BETWEEN TWO EXTREMES

InfraWorks provided the capability of producing visually appealing imagery that because of the fidelity of detail provided immediate orientation to the viewer. Our existing model provided adequate built form context and allowed the team to focus on generating additional content related to the proposal. The additional content was being sourced from two distinct sub-projects. The first sub-project was generating the new road alignment that would replace the viaducts. Because of the removal of the viaducts and the revised road system, new development sites were being opened. The second team was working with the development community to begin generating responsive building massing options. As well, park opportunities were being explored.

The new road alignment was still being developed when InfraWorks was introduced to the teams. That meant that InfraWorks played more of visualization role rather than as a design tool. Rather than waiting until every detail was finalized, Engineering staff began creating the new roads in InfraWorks rather than waiting to import Civil 3D files.

Concurrent with the Engineering work, Planning staff were getting up to speed with InfraWorks, mostly working on importing SketchUp and 3ds Max models, and becoming familiar with the Storyboard features. This was also the first time that we had multiple City staff working on the same model.

The Pictometry textured models provided familiarity and made the model much more accessible for public not familiar with the project. The photo-skins made individual buildings immediately recognizable and the model more immersive. To further enhance this familiarity, we worked on creating models of unique Vancouver lighting and street banners.

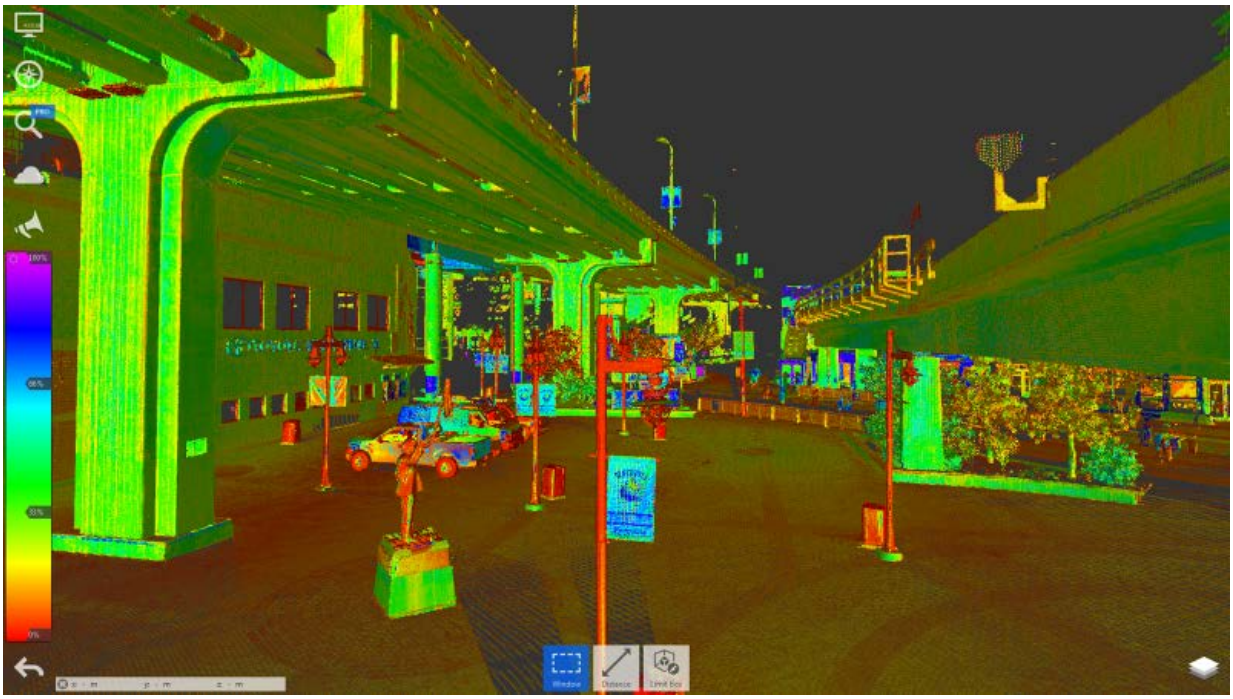
LOCAL CONTENT PROVIDES ORIENTATION AND MAKES THING MORE IMMERSIVE

Exactly replicating the proposed road alignment was not always possible. Modelling complex intersections and access ramps was difficult. Vancouver is a City strongly committed to encouraging to encouraging cycling with the new road system even including a bicycle specific bridge to deal with a substantial elevation change from the water's edge to the downtown. For most of the road system, the bike paths follow the alignment. There are some situations where the bike path diverges from the road to take advantage of parks and other open spaces. These could not be modelled as part of a component road system. While we were able finally create bike paths that had good visual fidelity, we were disappointed at not being able to maintain their intelligence as part of a system.

The priority for the team was to produce a video that showed the before and after of the road system, highlighting the phasing of all the changes. We created good, individual before and after videos using the storyboard tools, but to switch back from the before and after views required us to export the video and to do the final edits in Premiere Pro.

We are still working with our Digital Services and Corporate Communications Groups on how to integrate the web maps and panoramas into the City web pages.

Finally, the Northeast False Creek Project gave us our first opportunity to work with ground based LiDAR, and we have had good initial success working with it directly in InfraWorks. We see opportunities for the LiDAR to provide greater levels of detail, making the model more immersive and engaging. We will certainly be exploring the feature extraction capabilities.



THE CITY'S FIRST GROUND BASED LIDAR

THE FINAL PROPOSED ROAD SYSTEM AND NEW DEVELOPMENT

NORTHEAST FALSE CREEK WEB MAP

What worked well

- Using photo-textured building models (Pictometry). Provided immediate orientation for the public.
- Creating some actual local content provides orientation and familiarity.
- Learning curve for staff new to InfraWorks was easier than anticipated.
- Staff quickly became proficient working with basic storyboard functionality.
- The precision of the data reassured all involved in the project.

What was challenging

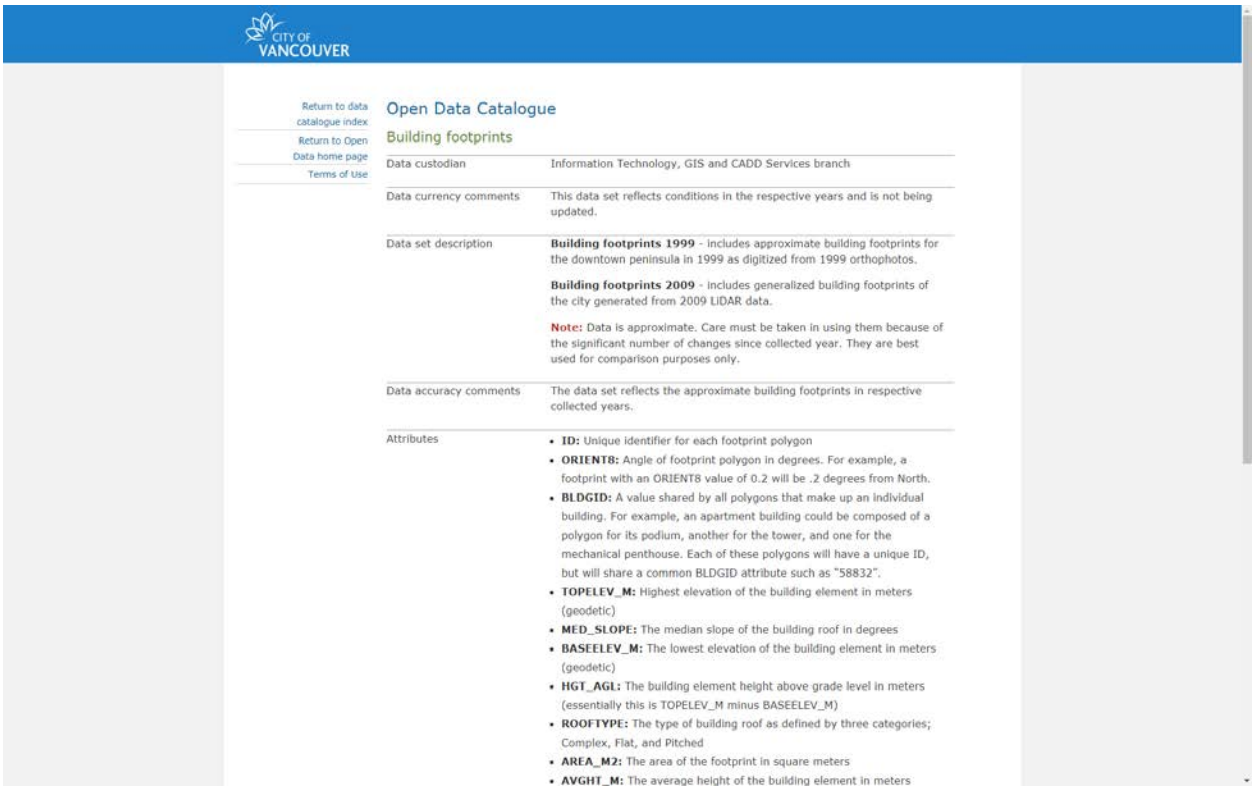
- Some intersection conditions are difficult to model in InfraWorks.
- Modelling bike-lanes that diverge from the street network could not be successfully achieved.
- To create the video, 8 different proposals were created, and keeping track of what proposal needed to be active for which video clip was difficult.
- Shifting the mindset that a detailed InfraWorks model looked too finished and would give the impression that all the decisions had already been made, and that a rough sketch would be more appropriate. My response was that most of the public is familiar enough with technology and 3D not to believe that this was the case.

What we would like to see

- Ability to create video that can incorporate content from different proposals.
- The ability to have elements diverge, but remain part of, a component road.

What we learned

- Using IMX files allowed successful sharing of road networks between models.
- One can never have a powerful enough GPU. Over the course of the work we have used 2GB, 4GB, 8GB and 11 GB cards. Some staff did not have adequate hardware to fully exploit the visual quality of InfraWorks.
- To provide an auditing function, we should consider making some of the design data most of the data should also be available through our Open Data site. This would allow the public to review what was being proposed using tools they are familiar with and to verify the accuracy of the data.



CITY OF VANCOUVER

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Open Data Catalogue

Building footprints

Data custodian	Information Technology, GIS and CADD Services branch
Data currency comments	This data set reflects conditions in the respective years and is not being updated.
Data set description	**Building footprints 1999** - includes approximate building footprints for the downtown peninsula in 1999 as digitized from 1999 orthophotos. **Building footprints 2009** - includes generalized building footprints of the city generated from 2009 LiDAR data. **Note:** Data is approximate. Care must be taken in using them because of the significant number of changes since collected year. They are best used for comparison purposes only.
Data accuracy comments	The data set reflects the approximate building footprints in respective collected years.
Attributes	• **ID:** Unique identifier for each footprint polygon • **ORIENT8:** Angle of footprint polygon in degrees. For example, a footprint with an ORIENT8 value of 0.2 will be .2 degrees from North. • **BLDGID:** A value shared by all polygons that make up an individual building. For example, an apartment building could be composed of a polygon for its podium, another for the tower, and one for the mechanical penthouse. Each of these polygons will have a unique ID, but will share a common BLDGID attribute such as "58832". • **TOPELEV_M:** Highest elevation of the building element in meters (geodetic) • **MED_SLOPE:** The median slope of the building roof in degrees • **BASEELEV_M:** The lowest elevation of the building element in meters (geodetic) • **HGT_AGL:** The building element height above grade level in meters (essentially this is TOPELEV_M minus BASEELEV_M) • **ROOFTYPE:** The type of building roof as defined by three categories; Complex, Flat, and Pitched • **AREA_M2:** The area of the footprint in square meters • **AVGHT_M:** The average height of the building element in meters

CITY'S OPEN DATA SITE

Next Steps

- Redo model with slightly larger context, including North Shore mountains.

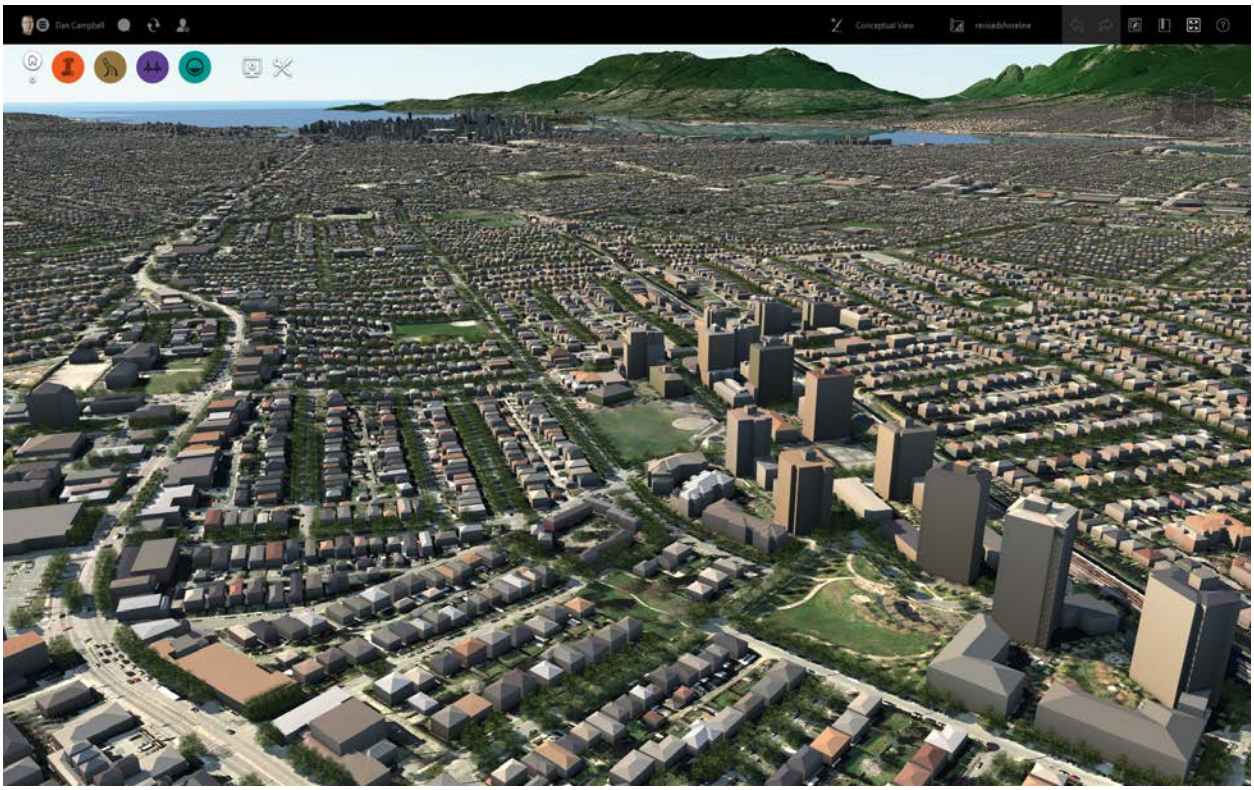
Joyce-Collingwood Redevelopment: (focus on 3d printing)

In 2016, The City of Vancouver initiated a review the area around Joyce-Collingwood Rapid Transit Station to:

- Update policies adopted in 1987 as part of the Joyce Station Area Plan
- Consider changes to the area's sidewalk, road, and cycling networks that respond to upgrades at the SkyTrain station and bus exchange

As part of the review, staff began a detailed review focusing on:

- Land use, density, and building forms
- Transportation - improved safety and connections for people walking, cycling, driving, and taking transit
- Improved public spaces
- Amenities needed to support additional population

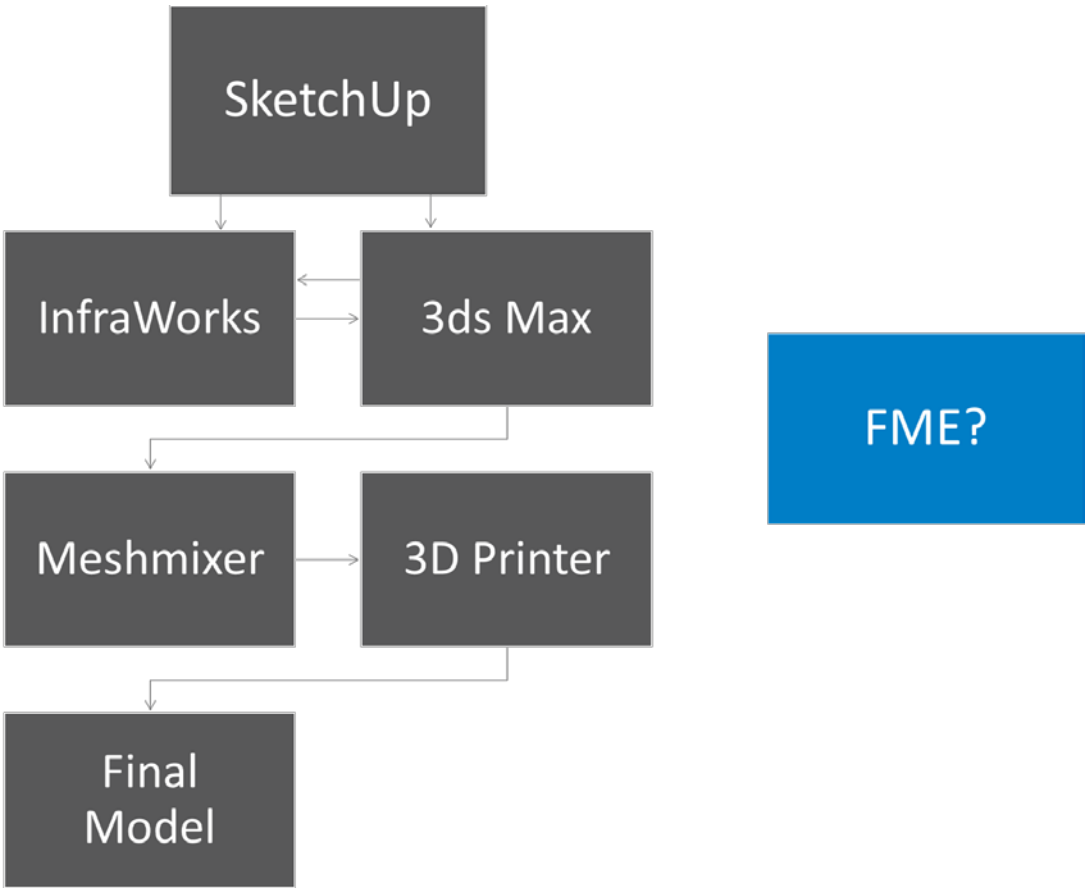


JOYCE-COLLINGWOOD AREA

While our team had been assisting the planners by extracting content from the City model for them to work with in SketchUp, there hadn't been any consideration of using InfraWorks fully on the project. This was mainly due to lack of familiarity with the product. However, I was approached about an idea to create essentially a 6' x 4' physical model of the study area. This seemed like a good test for InfraWorks, and ready for a challenge I agreed to take on the project. Having no experience working with 3D printers I didn't really realize how challenging this would turn out to be.

The idea was to have the full Joyce-Collingwood area as fixed context, and to produce a series of massing options that could be physically swapped out as needed. I worked on tidying up the neighbourhood context, and the planners began generating the massing options in SketchUp.

By trial and error, we developed a workflow as noted in the diagram below:

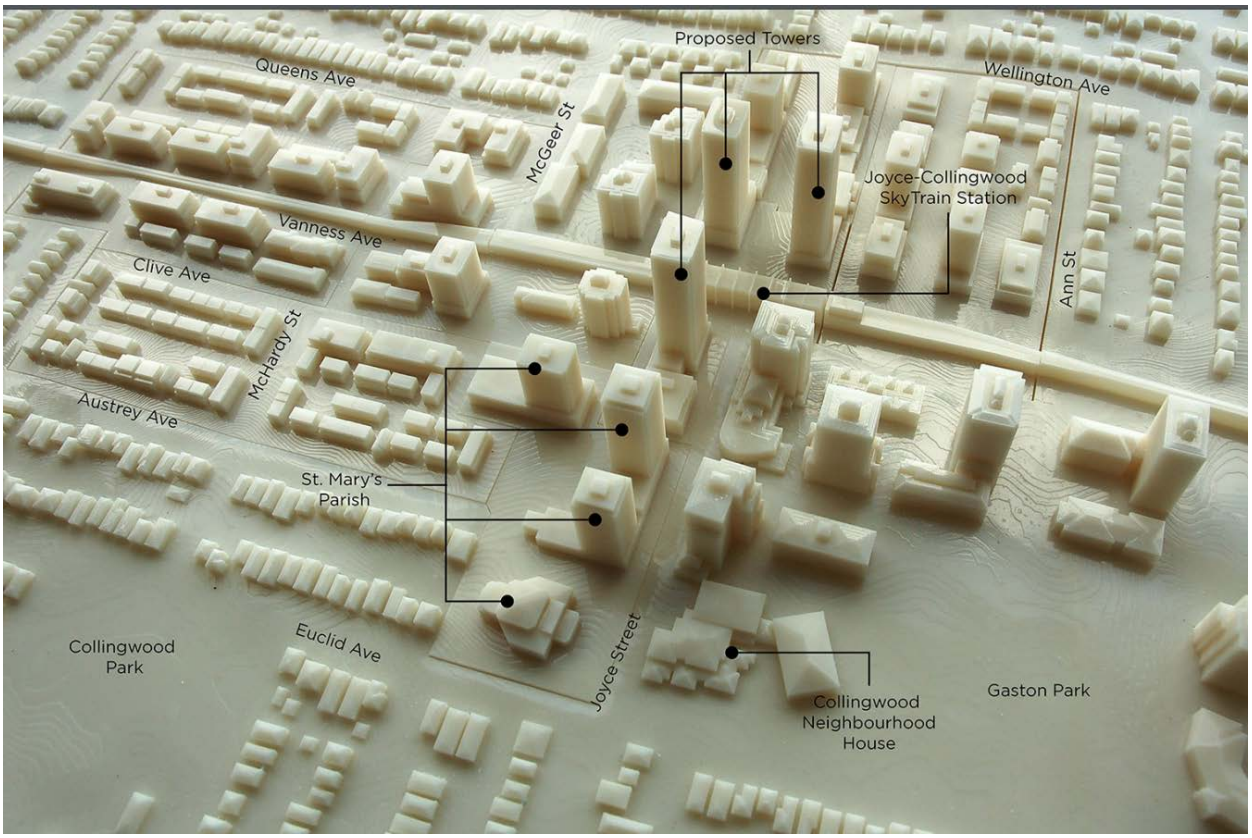


INFRAWORKS TO 3D PRINTER WORKFLOW

My first stumbling block was recognizing that the terrain generated from LiDAR in InfraWorks was far too dense for 3ds Max to work with efficiently. So, I explored both substituting the LiDAR terrain with terrain generated from InfraWork's Model Builder tool. That generated an acceptable mesh, but was not accurate enough. The solution was to use the optimization tools with 3ds Max to generate a mesh that hit the sweet spot between size and accuracy.

The next problem was SketchUp. For better, and in my case, worse, SketchUp is very forgiving of slopping modelling technique. Importing the SketchUp buildings into InfraWorks revealed multiple reversed faces that had to be repaired in either 3ds Max or back in SketchUp.

What was most frustrating was realizing how important clean topology is for 3D printing. The extruded building footprints looked good when viewed in InfraWorks, but the original GIS files did not have properly snapped vertices, so any attempt to generate a file that would be acceptable for 3D printing ended in failure. To deal with this issue required a complete export in FBX format from InfraWorks into 3ds Max and finally into Meshmixer to prepare the final file. It took a lot of back and forth file transfers to get everything working perfectly.



FINAL 3D PRINTED MODEL

What worked well

- InfraWorks was a good aggregating environment for the model.
- Using InfraWorks Proposal function to keep track of all the different massing options was very efficient.

What was challenging

- Dealing with recent technology – 3D printing.
- Dealing with new software – Meshmixer.
- GIS 2.5D data topology issues.

What we would like to see

- Nothing to suggest, most of the issues were outside of InfraWorks.

What we learned

- InfraWorks can provide reliable source content for 3D printing.

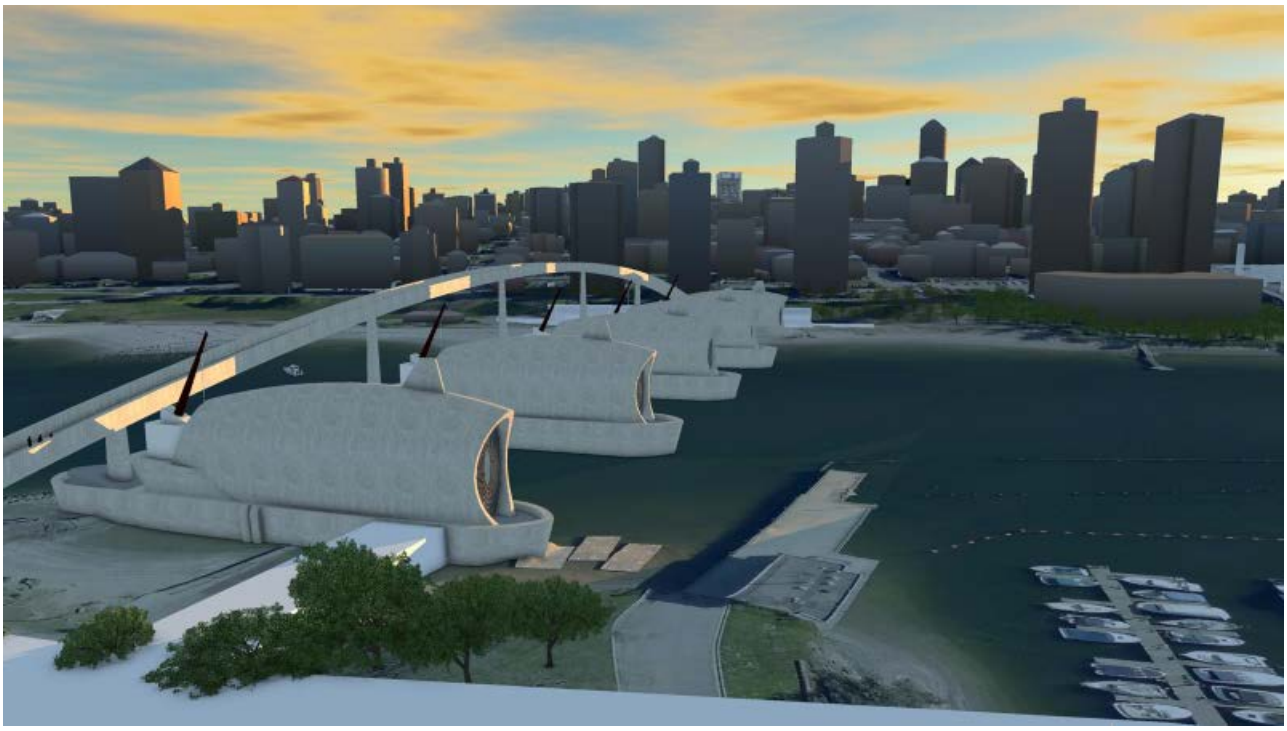
Sea Level Rise

SEA LEVEL RISE WORK 2013

The City of Vancouver first terrestrial LiDAR capture was to support sea level rise analysis. Initially InfraWorks played only a supporting role. We imported our bare-earth raster that was derived from the LiDAR into InfraWorks and searched for any anomalies that would need to be corrected. We could easily locate elements like large piles of gravel or excavation for construction sites and correct them in the source files as needed.

Once some of the early GIS files noting the future extent of flooding became available we pulled them into InfraWorks for visualization. The initial response to these was sort of an anti-public-engagement. We were told “don’t show these to anyone”. The worry was that the visualizations were too frightening. The ability to create near photo-real images can be a stumbling block.

Since then, we have produced a series of before and after sea level rise animations for various spots around the City, generated concepts for potential mitigation projects, and are now actively exploring using VR technology in conjunction with InfraWorks as a public engagement tool.



POTENTIAL SEA LEVEL RISE MITIGATION

What worked well

- Easy production of individual before and after videos using InfraWork's built in tools
- Strong visualization (almost too good).
- Whiles somewhat rough, working with VR directly in InfraWorks can be beneficial

What was/is challenging

- What is the best VR workflow
- What final environment to use (Unity, Stingray, Unreal).
- Desktop based VR, or mobile based VR
- Difficult to estimate actual cost of VR for public engagement

What we would like to see

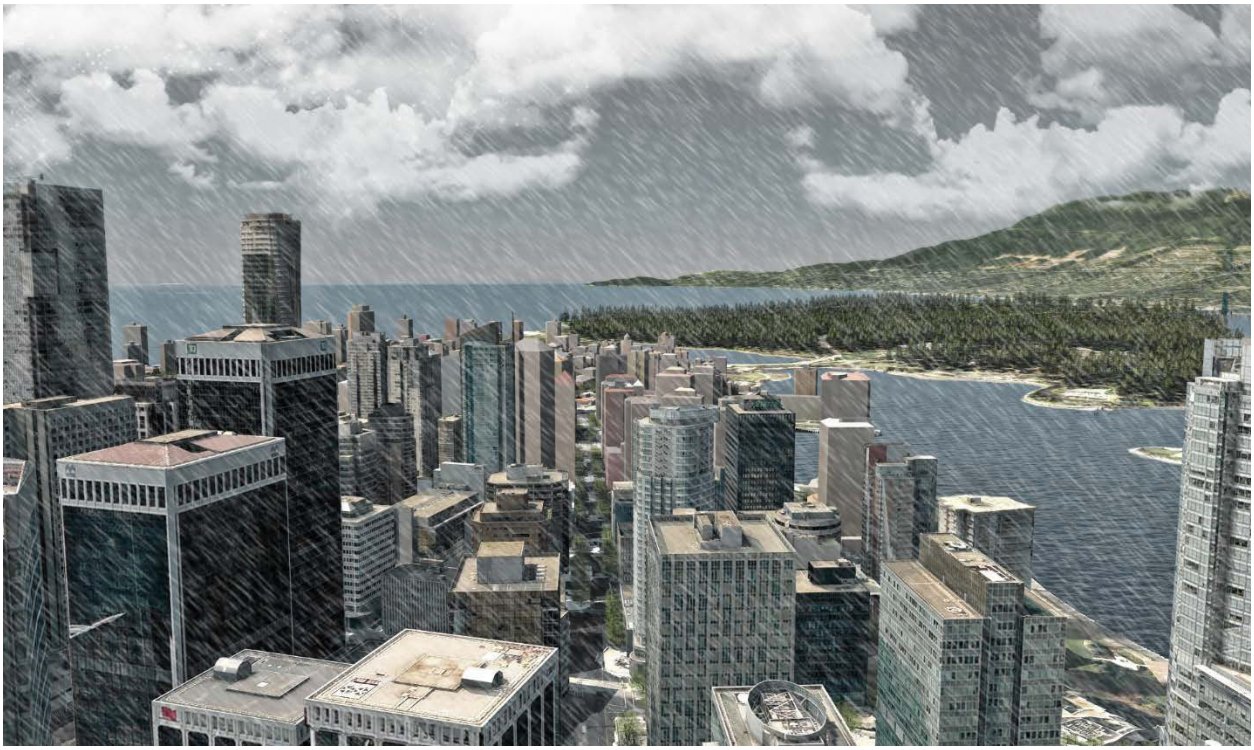
- Better direct support of VR by InfraWorks
- More control over water colour – Vancouver's water is not Mediterranean blue.

What we learned

- We have a lot to learn about VR

Overall Observations on Using InfraWorks for Public Engagement

1. Each public engagement is unique
2. Everyone is trying to assimilate a tremendous amount of new technology all at once
3. One model cannot meet all needs (for example, the level of detail needed for a good ground level VR experience would not be suitable for 3d printing
4. It is worth the effort to make your InfraWorks model visually unique. If there is a visual limitation to InfraWorks it is that models can look very much alike. The same constant road finishes, common street furniture elements, and water treatment can make even a detailed model seem generic.
5. For some of the web and cloud tools we need to address Provincial legislation that prohibits private data from being stored on servers in the U.S.



SLIGHT ENHANCEMENT OF AN INFRAWORKS SCREENSHOT IN PHOTOSHOP. IT RAINS THAT MUCH IN VANCOUVER