Completion Report for the Centre for Sustainability Excellence Feasibility Study
Waterloo, ON

GMF number	**15117**
Name of lead applicant (municipality or other partner)	**City of Waterloo**
Name, title, full address, phone, fax and e-mail address of lead technical contact for this study	**Allan Taylor** **329B-121 Charles St W** **Kitchener, ON** **N2G 1H6**
Date of the report	**March 1, 2017**

1. Introduction

a. Who was involved in doing the Feasibility Study, and what are their affiliations? Please include name, title and contact information. Those involved could include municipal staff, engineers and other consultants, a representative from a non-governmental organization, and others.

This feasibility study was undertaken by the City of Waterloo, in partnership with Sustainable Waterloo Region to determine the potential of building a financially feasible and replicable, regenerative multi-tenant office building. Engaged in the process were also the Cora Group (developer), the David Johnston Research + Technology Park (land owner), EY Canada (anchor tenant), Stantec (engineering & architecture consultant), and a team of academic researchers from Wilfrid Laurier University (WLU - focused on the Citizen Engagement Strategy). The teams from each of these organizations, along with all of their relevant information are listed below. The project also included a significant community engagement component and associated Technical Advisory Group (TAG) who informed the process and design (process described below in Section 2).

Organization	Name	Title	Contact
City of Waterloo	Justin McFadden	Executive Director – Economic Development	justin.mcfadden@waterloo.ca
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David Johnston Research + Technology Park	Carol Stewart	Manager	carol.stewart@uwaterloo.ca
EY Canada	Greg McCauley	Managing Partner	Greg.J.McCauley@ca.ey.com
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WLU	Dr. Manuel Riemer	Associate Professor of Community Psychology and Sustainability Science Director, Centre for Community Research, Learning and Action (CCRLA)	mriemer@wlu.ca

2. The Feasibility Study

a. Describe the process that you undertook to make this feasibility study a reality, from concept, to council approval, to RFP, to final deliverable.

The concept for this project, now named Evolv (previously the Centre for Sustainability Excellence), emerged from a community consultation process that was being undertaken as a part of Sustainable Waterloo Region's (SWR) strategic planning process in 2013. Through SWR's programming and local leadership from public and private sector representation, Waterloo Region has shown significant leadership in sustainability and there was a push to take on something bigger, a grand vision for a physical home for sustainability. Wilfrid Laurier provided funds to create a preliminary Business Case (http://www.sustainablewaterlooregion.ca/wp-content/uploads/2017/01/140505-CSE-Business-Case-Full-Draft.pdf). Sustainable Waterloo Region was encouraged to play a leadership role moving this initiative forward and received seed funding from the Ontario Trillium Foundation.

Ongoing community consultation, in large group settings and smaller 1:1 sessions, led to the conclusion that finding land was the first step. With support from local leaders in the development industry a Request for Expressions of Interest (informally a 'Call for Land') was issued (http://www.sustainablewaterlooregion.ca/wp-content/uploads/2017/01/SWR-CSE-RFEOI-Final.pdf). This Call for Land asked the community to put forward potential sites, visions, and partnerships aligning with the vision set out. Five responses were received, and while they are all held confidential, it is worth noting that each was very strong in its own right. The decision to move forward with a partnership proposal – that provided land (in the David Johnston Research + Technology Park at the University of Waterloo) and a partnership with a leading local developer (the Cora Group) who was ready to build – was made based on having the ability to realize the vision to its fullest extent, on the most feasible timeline. Adding EY Canada's local office, a member of SWR's Regional Sustainability Initiative interested in locating in the building, filled out the Leadership Team – a combination of developer, land owner, anchor tenant, and vision holder that enabled the community to take the first step toward this project becoming a reality.

Together, the Leadership Team defined the project's next steps through a Memorandum of Understanding, as well as more community consultation. Three independent, though heavily interrelated, parts of the project emerged: Architecture & Engineering – the physically building; Citizen Engagement – the role occupants play in achieving project goals; and, Innovation Hub – creating a space for ongoing sustainable innovation in the building.

In partnership with the City of Waterloo, the decision was made to take on the Feasibility Study. For this, SWR engaged a technical team at Stantec and built a partnership with Dr. Manuel Riemer at WLU to begin addressing the technical and non-technical challenges to building a net-positive building. The Innovation Hub took on a separate process in partnership with the Accelerator Centre and both local universities, which is still ongoing.

The teams at the City of Waterloo, SWR, and Stantec, in consultation with the FCM team, prepared the Green Municipal Fund application, confirmed other funding sources, and sought approval from the corporate leadership and council at the City of Waterloo. The objectives and process for the Feasibility Study were then negotiated (which took form as a Memorandum of Understanding and a Notice to Proceed).

b. What were the objectives of the Feasibility Study (what was it seeking to determine)?

The team undertook this Feasibility Study to assess the technical feasibility of constructing a leading-edge 'net-positive' building – a 100-120,000 sq. ft. multi-tenant commercial building that maintains a regenerative relationship with its environment. Our vision was that the building design manifests itself in the four following areas:

- Net-positive energy: The building will generate more energy than it uses. For example, the CIRS building at UBC has accomplished this by designing a structure that minimizes heat loss and energy waste, and harvesting energy on-site from the ground (geothermal), the sun (solar PV & evacuated tube water heater), and an adjacent building (heat recovery) to provide air and water heating/cooling (http://cirs.ubc.ca/building).
- Net-zero water: All water for use on site will be harvested from rainwater and all waste water will be treated on-site and used for irrigation, allowing it to infiltrate back into the groundwater. For example, the Bullitt Centre in Seattle achieves this by using rainwater harvesting to gather water, foam flush and composting toilets to decrease water use and transform physical waste, and a greywater/constructed wetland system to store, clean, and infiltrate waste water (http://www.bullittcenter.org/building/building-features/).
- Net-positive air quality: Air inside the building will be of a quality at least as good as the external air, effectively filtering air as it moves through the building. This will be accomplished by carefully selecting construction materials, finishes, and products used in the building, encouraging fresh air exchange using passive (operable windows and heat chimney) and active (heat-recovery ventilator) methods, and sophisticated filtration systems (living and mechanical). An encouraging new example can be found in Dutch designer Daan Roosegaarde's Smog Free Project (https://www.studioroosegaarde.net/project/smog-free-project/stories/#878).
- Net-zero waste: No operational waste will be sent to landfill. This will require consideration of a management structure that encourages behaviour change alongside effective diversion systems for recycling and organic waste. Both Dupont (http://www2.dupont.com/Building_and_Construction/en_US/sustainable_building.html) and the City of Vancouver (http://vancouver.ca/green-vancouver/zero-waste.aspx) provide leading examples and have made significant progress toward zero-waste goals.

Throughout the visioning process, we identified additional aspirations that are still under consideration, but warrant mentioning here to show the breadth of impact we were interested in exploring. These include:

- Net-zero transportation emissions: Over the long-term, occupant organizations would contribute zero greenhouse gas emissions to our atmosphere from commuting or business travel. For example, Google has seen significant success by providing alternatives in both of these areas, promoting cycling to and within their campus, offering 'clean diesel' shuttles to work, and providing the largest corporate car sharing program in the United States – Gfleet, with hybrid and electric cars.
- Net-positive occupant well-being: This building will also seek to maximize the productivity, health, and happiness of its occupants through a progressive management model and physical design that encourage a culture of belonging, active community involvement, and collaborative engagement between tenants of the building and the surrounding area.

As a community project, it was our desire to approach the design of this building collaboratively. Engaging local experts and stakeholders ensures we develop a structure that is truly leading-edge, and establishes conduits for learning that help to seed future sustainable developments across Waterloo Region and beyond. The material output of this phase was a feasibility study that includes at minimum (a) comparison and identification of building systems, (b) preliminary site plan(s), and (c) architectural concept design to achieve the following outcomes:

- Affirmation of the technical feasibility to build to a ‘net-positive’ level, achieving the goals of our vision (above) and identifying the systems that will be used to measure/report on relevant indicators;
- Financial analysis that shows:
    - the cost of building Evolv to different performance levels: net-positive, building code (energy-only), and LEED Platinum; and
    - financing options/cost-recovery analysis

In alignment with our aspirational considerations mentioned above, we were also encouraged to consider:

- Assessment of building and tenant management risks, opportunities, potential structures, and phasing to enable the goals of:
    - long-term sustainability and ongoing improvement; and
    - a workplace culture of collaboration, innovation, and belonging.
- Opportunities to explore long-term strategies to reduce emissions from commuting and business travel.

c. What approach (or methodology) was used in the Feasibility Study to meet these objectives?

For the Evolv Feasibility Study, the team developed a progressive methodology that was supportive of the need for an “Innovation Funnel” to move the project forward in a timely manner. For this we used a four step process characterized as an INITIATION, followed by QUESTION, DISCOVER, and INNOVATE.

INITIATION

Project initiation began with a kick-off meeting which took the form of a charrette. The purpose of the charrette was to prepare for the project and ensure that all stakeholders have a mutual, confirmed understanding of roles, responsibilities and expectations.

During this time, the project objectives were discussed and a work plan was developed (Appendix A). This work plan incorporated past project efforts completed to date, and ultimately aimed to meet all stakeholders’ needs.

QUESTION

Through a concise programming process, the actual needs were defined around the use of the building. This included opportunities for more advanced workplace design, potential shared spaces, opportunities for exterior program uses, and other ideas such as the actual functionality of the innovation hub space. This helped inform the layering of program spaces and ideal floor plate configurations for a supportive and interactive workplace. Fundamental to this was the definition of how and when the building could possibly be used with a 24/7 viewpoint, ranging from traditional tenant use to broader community use. It was important to identify the range of tenant types that will be attracted to this space in order to optimally design a building that meets their needs. This overall use plan directly influenced the building modeling work, as well as the discussion of potential system types and capacities.

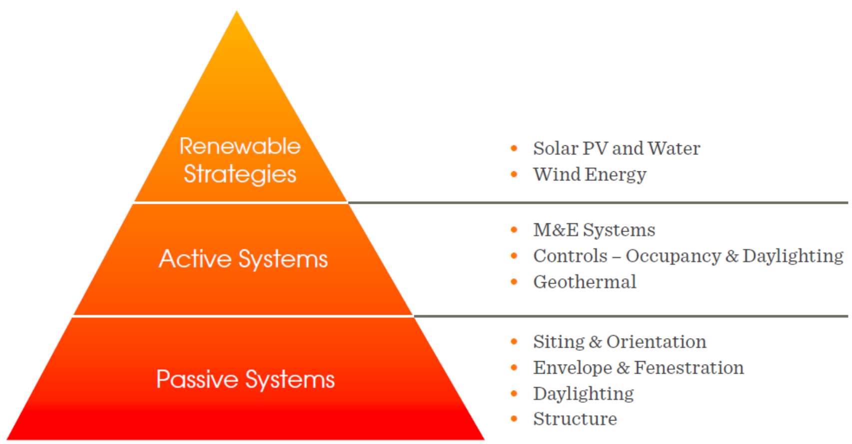
Key aspects of this were helping to uncover the program spaces that would most effectively support an innovation environment, identifying overlaps for potential shared spaces with other tenants, and usability by the larger community. For example, larger meeting spaces can support corporate tenant use, incubator use, and be available to community use after traditional business hours; and developed outdoor spaces can support engagement for seasonal use.

Another outcome of the programming was a better understanding of the intent for this facility to be a “living lab” to educate the development industry on leading sustainable opportunities and what is achievable today in sustainable development.

DISCOVER

The first step for this part of the process was to capture the range of ideas already present from the work to-date, and develop further options in concert with our range of specialists. These were then subject to careful analysis, modeling, life cycle analysis and ongoing engagement with the client team. The result of which produced an agreed matrix of integrated solutions for incorporation into the building. As part of the analysis, we always looked to the effectiveness of the “sustainable pyramid”. The intent is to focus on the passive strategies first, as these have longevity, minimal operating costs, and significant energy avoidance.

The next step was to investigate active systems such as the ventilation systems, lighting, and heating and cooling. Having initially reduced demand, more advanced systems became more possible. Finally at the top of the pyramid are renewable strategies – renewables are only applied to a significantly reduced energy demand, allowing them to be much more cost effective in the entire building ecosystem.



INNOVATE

We then developed a design concept that includes integrated solutions at all scales – from site to desktop – in an innovative and iconic “architecture” for both site and building. The concept design integrates the specific program elements from the QUESTION phase and the strategies in the DISCOVER phase, bringing them together in an innovative architectural solution.
This solution builds in the synergies of integration, while at the same time rendering the final design in an iconic architectural expression.

d. Please describe any public consultations conducted as part of the Feasibility Study and their impact on the Study.

Building on the strong public consultation and public outreach culture embedded in Sustainable Waterloo Region’s organizational model, the feasibility study for Evolv commenced with three key workshop sessions that the Stantec design team facilitated. Participants came from a wide breadth of professional experience related to the local building and sustainability communities.

Inspired by the project requirements which state that Evolv "is the manifestation of a community vision for a physical location to connect those that care about bringing the benefits of a healthy environment to Waterloo Region and beyond," there were several key questions to ask the community around what they felt were the sustainable initiatives that this building should embrace. The intent was to provide more thoughtful and far-reaching discussion on aspects of the project.

The purpose of these workshop sessions was to engage the broader sustainability sector in the region to participate in brainstorming sessions. The results helped serve as markers and baseline expectations of the community. As with many public consultation processes, the results were quite varied and included diverse perspectives based on each participant's background. A compilation of the onsite notes and comments can be found in the Feasibility Study's Appendix H. However, in all three sessions the following five themes were focused on through a series of question and discussion periods:

Theme 1: Site Circulation and Parking
The purpose for this stream of questions was to help establish an overall context of the site and to understand some of the limiting factors. A key example was the car centric work culture that exists in our current economic reality. The reality of the current market for the developer is that tenants need 4 cars for every 1000 sq.ft. of rentable space as a minimum, and in some cases can rise to 6 cars for every 1000 sq.ft. With this as a design question to be answered eventually by the design process, the question was opened to the community to see what "out of the box" and culturally acceptable solutions would be plausible for Evolv. Of high interest was the current construction of the LRT station within close proximity of the site, and the desire to capitalize on this new infrastructure.

Theme 2: Horizontal Occupation
In this theme the participants were asked to envision a productive use of all horizontal spaces such as roof tops and surface parking. Evident solutions such as photo voltaic arrays and green roofs were at the root of this theme; however, it was evident that a desire to optimize the occupancy of these spaces was a common baseline expectation for all participants. It was not enough to leave the traditional use of these spaces as status quo.

Theme 3: Behavior and "Nudges"
The source of this theme of questions was to discuss past examples of how participants can help building occupants adopt a more sustainable way of living in a space. A large portion of building energy is spent meeting occupant comfort levels. With varying ways of reducing this energy through sustainable initiatives, it becomes important to understand the psychology of the building's citizens and provide incentives to change their habits.

Theme 4: Shared Spaces
Waterloo Region is known to be a very community oriented region with a strong culture in collaboration and cooperative initiatives. This theme is a natural outcome of the location and context of the building, and was meant to help build on the already strong traditions of "barn-raising" precedents in the area. Several additional initiatives could easily be encapsulated in Evolv's future programming.

Theme 5: System Strategies
This last theme was intended to identify some of the priority systems that the community expected and would mark as being successful as a net positive building. With the wide range of sustainable systems available in the market today, it becomes more and more critical to help identify, in the early stages of the design process, the direction that systems engineering will hone in on for overall building performance.

Overall, these sessions were an incredibly rich source of conversation and brought forward thought provoking ideas that helped us understand and appreciate the site, context and community in which Evolv will be built.

3. Feasibility Study Findings and Recommendations

a. What were the environmental findings related to the options explored in the Feasibility Study? Please provide quantitative results and summary tables of these results (or the page numbers from the Feasibility Study report).

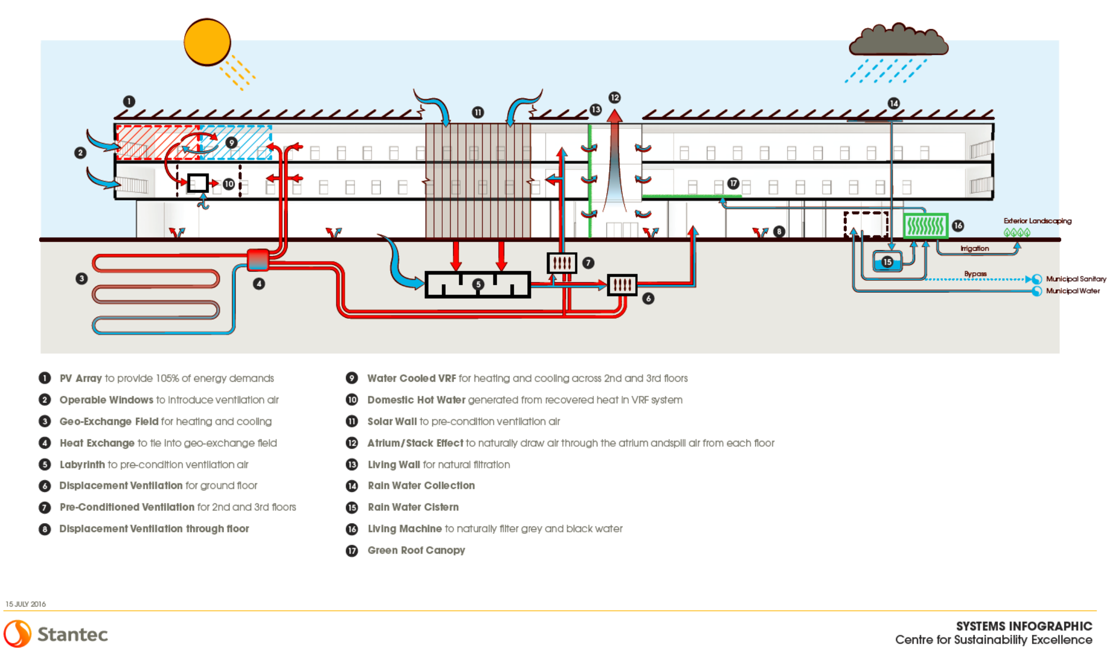
b. What were the financial findings related to the options explored in the Feasibility Study (for example, results of a cost-benefit analysis, financial savings identified, and so on)? Please provide quantitative results and summary tables of these results (or the page numbers from the Feasibility Study report).

c. Based on the environmental and financial findings above, what does the Feasibility Study recommend?

Green buildings within the construction market are becoming increasingly common. Non-residential green buildings represented 2% of the total market in 2005, 12% in 2008, and 35% in 2010. As LEED certified building become commonplace, there is a need for building owners to move beyond LEED in order to achieve greater levels of sustainable and resilient design.

The WELL building Standard and Living Building Challenge (LBC) are two more of the most widely used standards in the new construction building industry. The WELL building standard is a performance based system for certifying and monitoring features that impact health and wellbeing. It focuses more on the interior of the building and how the building reacts with the occupants. The LBC is the most stringent performance standard for building design looking more holistically at projects and how they operate cleanly, beautifully, and efficiently as nature's architecture.

To construct a Net-positive building using the LBC requirements entails exceptional energy conservation and renewable on-site energy generation. Beyond energy we've applied the Net-positive thinking to Waste, Water, and Air. The feasibility study outlines the path to achieving a Net-positive building design in a commercially viable sense. A detailed analysis in section 3 describes the Net-positive approach and describes the objectives, criteria, and process of achieving these stringent standards.
Although this study illustrates an approach for achieving increasingly stringent sustainability goals through Net-positive building design, a brief description of a LEED Platinum building (treated as a



baseline building for simple comparison) allows for a comparison to a more well understood building type. To most effectively design a LEED building this would require a much different approach to what we've done in this study in terms of a sustainability target, however this table of description (Table A – Sustainable Strategy Comparison, also in Feasibility Study p.vi) can be used as a reference to see where this projects goes above and beyond the criteria for a LEED Platinum building. The metrics and cost premiums associated with some of these measures can also be seen below (Table B – Green Municipal Fund Metrics, also in Feasibility Study p.viii). Based on the costs and calculated ROIs, the feasibility study suggests adoption of the technologies/strategies laid out throughout the Feasibility Study report, summarized in the Net-positive columns of the two tables below, and displayed graphically in the following systems diagram.

Table A – Sustainable Strategy Comparison

	LEED PLATINUM	NET POSITIVE	REFERENCE
WASTE			
Construction Waste	75% Waste Diversion Rate specified and to be tracked and implemented during building construction	90-99% Waste Diversion Rate Specified and to be tracked and implemented during building construction	3.4 Waste - 3.4.2 Objectives (page 113)
Operational Composting	Not required	100% Composing On-Site using organic composters	3.4 Waste - 3.4.2 Objectives (page 113)
Materials Selection	Selection of construction materials that are sourced locally and able to be recycled locally	Same as LEED Platinum & promoting the use of building materials that are not listed on LBC Red List	3.4 Waste - 3.4.4 Process (page 114)
WATER			
Plumbing Fixtures	High Efficiency Plumbing Fixtures	Same as LEED Platinum	3.2 Water - 3.2.4 Process (page 103)
Water Metering	Whole building water meter	Advanced sub-metering for water end uses. This is a much more granular level of water metering to understand major water use areas.	3.2 Water - 3.2.4 Process (page 103)
Water Efficient Landscape Design	Selection of native and adaptive plant species that are drought tolerant. No permanent irrigation system to be installed onsite.	Same as LEED Platinum	3.2 Water - 3.2.4 Process (page 103)
On-site Wastewater Treatment	Not required	Treat 100% of waste water generated onsite. Proposing the use of Waterloo Biofilter or EcoMachine	3.2 Water - 3.2.5 Impact (page 104)
Rainwater Harvesting	Sized to meet capacity of LEED stormwater requirements (Manage stormwater peak discharge rates for 1 and 2 year 24-hour design storms, & minimum 90% of annual rainfall eliminated) & building demand for urinal and toilet flushing	Sized to meet the capacity of LBC stormwater requirements (100% of annual rainfall eliminated) & total potable water demand for the building.	3.2 Water - 3.2.5 Impact (page 104)
Permeable Pavers	-	Implemented throughout the hardscape parking lot area to achieve increased infiltration to meet the stormwater management needs of the site	3.2 Water - 3.2.5 Impact (page 104)
AIR			
Ventilation Design	Meeting ASHRAE 62.1-2007	Same as LEED Platinum	3.3 Air - 3.3.4 Process (page 108)
Air Filtration Media	Installation of MERV 13 Filters	Same as LEED Platinum	3.3. Air - 3.3.4 Process (page 108)
Materials Emissions	"100% of composite wood products to have No Added Urea Formaldehyde (NAUF) 100% of adhesives, sealants, paints and coatings to meet low VOC criteria (South Coast Air Quality Management District Rule 1168 & 1113 & Green Seal Standard 03 & 11)"	Same as LEED Platinum	3.3 Air - 3.3.4 Process (page 108)
IAQ Management During Construction	"Implementation of Indoor Air Quality Management plan during construction. Building flush-out post-construction and conduct IAQ testing pre-occupancy."	Same as LEED Platinum	3.3 Air - 3.3.4 Process (page 108)
Living Wall	-	Install green wall system that uses biofiltration media to filter and purify indoor air reducing CO2	3.3 Air - 3.3.4 Impact (page 108)
TRASPORTATION			
Electric Vehicle Charging Stations	3% of Total Parking Spaces (10 Spaces)	Same as LEED Platinum	1.5 Preliminary Research - Transport (page 18)
Bicycle Racks	5% of Total Building Occupants (27 Bicycle Racks)	Same as LEED Platinum	1.5 Preliminary Research - Transport (page 18)
On-Site Electric Vehicle Car Sharing	-	EV car sharing program that meets the needs of building occupants	1.5 Preliminary Research - Transport (page 18)
Corporate Transit Pass Program	-	Discounted transit passes for all building occupants	1.5 Preliminary Research - Transport (page 18)
ENERGY			
Envelope:	Walls R-25, Roof R-35, Glazing U-0.2, WWR 30%	Walls R-30, Roof R-40, Glazing U-0.2, WWR 30%	
Heating System	Electric Boiler, Perimeter Convectors	Ground floor VAV w/ reheat served by geoexchange central heatpumps (COP=4), 2nd & 3rd Floor served by VRF heatpumps with connection to geoexchange field	
Cooling System	DX Cooling (EER 23)	Same as Heating above	
Air System	DOAS, 70% Heat Recovery, DCV, Oversized ducting	DOAS, 70% Heat Recovery, DCV	
Lighting:	PoE, LED lighting, hybrid (DC/AC) outdoor lighting	PoE, LED lighting, hybrid (DC/AC) outdoor lighting	
Measurement and Verification	Metering strategy in place that meets the IPMVP standards. Metering at an end use level (heating, cooling, fans, pumps, lights, plugs)	More granular level of metering that allows for signicant building diagnostics to understand energy end use. Includes individual equipment monitoring.	
Solar Wall	-	"Vertical wall cladding system that uses the Sun's solar energy to heat ventilation air before entering the building"	
Photovoltaic Panels	-	Combination of roof mounted ballasted PV panels and ground mounted solar car ports	
Controls		"Additional Controls for features added above: Ceiling mount Occupancy sensors Wall mount Occupancy sensors Typical Ceiling mount Daylight sensors 40% of the façade with automated shades controlled by daylight sensors and integrated to BMS Centralized photocell Outdoor control by switching and timers/photocells"	

Table B – Green Municipal Fund Metrics

Environmental Performance Indicator	GMF Indicator Metric	LEED Platinum Building	Proposed CSE Net Positive Building	Reference Location	Rationale	Approximate Cost Premium	Simple Payback (years)
Energy Consumption	GJ	70.5 kWh/m^2 654,966 kWh/year 2358 GJ/year	67.9 kWh/m^2 630,791 kWh/year 2271 GJ/year	**Section 3.1 Energy - 3.16 (page 97)** Table: Comparison of Energy Model Scenario's, Option 4: Net Positive Design with PV Field	Reported in Energy Use Intensity (EUI) for simple comparison against other buildings. Additional Metering recommended for Net Positive design to diagnose energy issues regularly Conversion to GJ is as follows: 1 GJ = 2.77.7 kWh	$2.3M Energy Upgrades $100,000 Metering Upgrades	26.8 Energy Upgrades
On-Site Renewable Energy Generation	GJ	0 kWh/year 0 GJ/year	688,745 kWh/year 2479 GJ/year	**Section 3.1 Energy - 3.16 (page 96)** Photovoltaic Options Considered, Option 2 R1+G2.	Energy generated from Photovoltaics presented in kWh. Conversion to GJ is as follows: 1 GJ = 2.77.7 kWh	$2M	24.5
Greenhouse Gas Emissions	CO2	"Energy Used = 71.51 tonnes CO2"	Material Components = 5,720,000 kg CO2e Energy Used = 113.55 tonnes CO2 Energy Generation = - 118.7 tonnes CO2 (reduction)	**Appendix G (pages 25-38)** **Section 3.1 Energy**	Material Components: Embodied GHG emissions reported for building structure and envelope components. CO2e presented in kg CO2e. Energy Generation: Building to produce 105% of annual energy use, therefore reducing CO2 emissions by 1.05 x (113.55 tonnes CO2) = 118.7 tonnes. Conversion to tonnes CO2e is as follows: 1 tonne of CO2e = 1000 kg	See above for energy reduction and on-site renewables	See above for energy reduction and on-site renewables
Criteria Air Contaminant Emissions by Pollutants (NOx, SOx, PM, VOC)		NOx, SOx - maintain indoor levels similar to outdoors PM - MERV 13 (or better) Filters VOC - see table listing g/L	Further reduction of Nox, Sox and CO2 levels	**Section 3.3 Air - 3.3.3 Criteria (page 107) & 3.3.5 Impact (page 108)**, Table: Air Systems Analysis Summary	Living Wall biofiltration media to help generate net positive indoor air quality by reducing levels of NOx and SOx. Also reduced CO2 levels. Ventilation rates required to change air in building sufficiently to reduce levels of NOx and SOx Meeting ASHRAE 62.1 - 2007 ventilation requirements, as per LEED 2009, ensures adequate ventilation rates are maintained within the building - eliminates the presence of air contaminants, VOCs and PM. Ventilation systems are equipped with MERV 13 filtration media to removed PM from outdoor air ventilation and recirculating air. In addition, maximum allowable VOC emissions criteria for materials and products to included within the building have been provided in report. Thresholds listed in g/L.	$232,524 85$m^2$ Living Wall Meeting ASHRAE 62.1-2007 is a prerequisite for LEED 2009 certification - no additional cost. No additional cost for low emitting product/materials - now industry standard.	9.1 (Living Wall)
Water Consumption (Corporate and Community)	m^3	Total Building Demand: 2,069,000 L/year Rainwater Harvesting Capability: 2,838,000 L/year Greywater Reuse 206,900 L/year Potable Water Demand: 1,862,100 L/year Stormwater Volume: 10,578,000 L/year	Total Building Demand: 2,069,000 L/year Rainwater Harvesting Capability: 2,838,000 L/year Greywater Reuse 413,900 L/year Potable Water Demand: 1,655,100 L/year Stormwater Volume: 10,578,000 L/year	**Section 3.2 Water - 3.2.4 (page 103)** Figure 3g: Annual Site Water Demands and Rainwater Availability	Reported in L/year. Conversation to m^3 is as follows: 1 Liter = 0.001 Cubic Meter	No additional cost for low flow fixtures & equipment - now industry standard.	N/A
Wastewater Treated to Regulatory Standards	m^3	0 m^3	2,069 m^3 1,187 m^3 (blackwater)	**Section 3.2 Water - 3.2.5 (page 104)** Table: Water Systems Analysis Summary, Option 3 & 4	Wastewater treated to tertiary standards reported in L/year and m^3/year	$517,500 Waste Water Eco-Machine $300,000 Waterloo Biofilter	432 (Waste Water Eco-Machine) 250.4 (Waterloo Biofilter)
Wastewater Quality	m^3	0 m^3	Tertiary Standards	**Section 3.2 Water - 3.2.5 Impact (page 104)**	Tertiary Standards - removal of more than 99% of all impurities from sewage including suspended soils, biodegradable organics, pathogenic bacteria, and nutrients including nitrates & phosphates.	As above.	As above.
Stormwater Runoff Eliminated from 24-Hour Rainfall Events	m^3	Minimum 90% of Annual Rainfall Eliminated Alternatively: using a campus approach a properly sized stormwater management pond on an adjacent site can be used	Minimum 100% of Annual Rainfall Eliminated Alternatively: using a Scale Jumping approach a properly sized stormwater management pond on an adjacent site can be used	**3.2 Water - 3.2.2 Objectives (page 102)** & 3.2.5 Impact, Table: Water Systems Analysis Summary, Option 2	Threshold target adopted from LEED BD+C, industry best practice for green building design. A site specific Stormwater Management Report including calculations for % of rainfall captured to be completed during design phase of project. Results to be provided upon completion. Bioswales, green roof, rainwater cistern, infiltration trenches and permeable pavers are incorporated where possible to lower the reliance on the stormwater management pond	The adjacent stormwater pond has been sized to account for stormwater management of this site. $365,964 Rainwater Cistern Permeable pavement is availble at an approximate cost of $6-15/sf	TBD based on strategies pursued.
Total Suspended Solids Eliminated from Stormwater Runoff	TSS	Minimum Removal of 80% TSS	Minimum Removal of 100% TSS	**3.2 Water - 3.2.2 Objectives (page 102) & 3.2.5 Impact**, Table: Water Systems Analysis Summary, Option 2	Threshold target adopted from LEED BD+C, industry best practice for green building design. A site specific Stormwater Management Report identifying % of TSS removed from site to be completed during design phase of project. Results to be provided upon completion.	Removal of 80% TSS is a credit requirement of LEED 2009 BD+C - no additional cost premium.	N/A
Waste Diverted from Landfill (weight)	Tonnes	75% Total Construction Waste	90%-100% per Material Type	**3.4 Waste - 3.4.2 Objectives (page 113)** Table: Minimum Waste Diversion Requirements	Waste diversion targets reported in percentage diverted from landfill, as per LEED BD+C and WELL green building rating systems. Reporting on actual weight/volume of diverted waste embedded within the building's specifications and LEED platinum strategy. Waste diversion tracking to take place during construction and monthly reporting to be provided. Final waste diversion report to be submitted post-construction. LEED platinum tenant waste strategies: collection and storage of paper corrugated cardboard, glass, plastics, metals and if a municipal collection program is available, organic waste. The Net Positive strategy would include organic waste on site.	$10,000 Organic Composter	N/A
Waste Diverted from Landfill (volume)	m^3	75% Total Construction Waste	90%-100% per Material Type	**3.4 Waste - 3.4.2 Objectives (page 113)** Table: Minimum Waste Diversion Requirements	As above.	N/A	N/A
Soil, Surface Water & Groundwater Remediated or Risk Managed		N/A	N/A	**3.2 Water - 3.2.2 Objectives (page 102)**	The site is defined as Class 1 agricultural land as per the Canada Land Inventory. Remediation of soil & groundwater is not required. Surface water will be captured and treated as noted above.	N/A	N/A
Vehicle Fuel Consumed	Litres	95,133 Litres	95,133 Litres	**1.5 Preliminary Research - Transport (page 18)** **Appendix N**	Alternative modes of transportation from single vehicle occupant use have been identified, and incorporated into site design. 3% of all parking spaces to be equipped with EV charging stations 5% of all parking spaces to be reserved for carpool/vanpool parking.	"Dual Pedestal EV charging stations: $8,000 Electric Vehicle: $32,000 - 40,000/car TravelWise Corporate Transit Pass: $69.70/ employee"	TBD based on strategies pursued.
Vehicle Kilometers Travelled (VKT) Avoided	Kilometers	575,221 Kilometers	575,221 Kilometers	**1.5 Preliminary Research - Transport (page 18)** **Appendix N**	As above.	As above.	As above.

4. Lead Applicant's Next Steps

a. Taking the Feasibility Study's recommendations into account, what next steps do you as the municipality plan to take? What potential benefits or internal municipal improvements would result from these next steps?

The City of Waterloo is a dynamic, leading-edge community with a reputation for hard work and innovation. These values are every bit as important to today's diverse business community as they were in our early agrarian days.

Located in the Region of Waterloo, we boast vibrant education, knowledge, financial services and manufacturing sectors within our borders. Next steps for the City of Waterloo include a continued partnership with SWR to realize the vision for this project. In addition, the City will work with SWR to make this economically viable project a reality. It is anticipated that the building will be a demonstration project and hub for innovation.

5. Lessons Learned

This project has taught us many things – both within and outside the bounds of the Feasibility Study itself. Working with such a large group of partners, stakeholders, and community members has been both challenging and rewarding, and has left the community with a number of new champions with skills and knowledge they did not have before.

The project emerged as a multi-sectoral partnership, which offered the opportunity to lean on different organizations and skill to accomplish our objectives. This proved to be a good way to crowd source ideas, aggregate funding, and solicit widespread community buy in. Figuring out how to work in the best way with so many voices proved challenging however – what is the best way to work with a lead organization setting the vision while maintaining shared responsibility? We're not exactly sure, but reflecting on our experience we have some thoughts to share.

The development industry has a standard process that is difficult to change, especially without a roadmap for that change. A good example that emerged in our project was around the performance gap – the challenge of green buildings typically do not achieve their performance targets because the tenants or operators are undermining the systems in the building (intentionally or unintentionally). Our research team conducted a significant amount of research and engaged with tenants to understand their needs, then compiled a set of recommendations for the building. While the design industry is familiar with this kind of input, receiving it from multiple sources can be challenging, especially when it is not in a familiar form, not from the team 'paying the bills', and contains recommendations that span design, construction, and operation of the building (while designing a building, how do we integrate long-term behavioural considerations?). Our recommendation is to hold regular meetings with ALL parties involved – from the project leadership and strategy setters to the "doers". For us this would have expanded our regular Leadership Team meetings from 6-8 people to 10-14 people (or maybe even more), but would have ensured that all parties were clearly heard and their concerns/learning were effectively included at all points throughout the process. A nice side effect would likely also have been to reduce the demands on the organization managing the project (SWR) for communication between the various partners.

The role that SWR played was very unique and caused several players, across multiple sectors, some confusion – there were many times when they were asked "Why are you here?" A legitimate question for a traditional development, as there was a developer, a land owner, and an anchor tenant at the table already. This project however could not have been done without this role dedicated to the vision. The benefit of this being an organization external to the City brought a few benefits as well – SWR was able to bring many more partners to the table and leverage their existing network of businesses, does not face the same amount of “red-tape”, and was able to bring a diversity of partners to the table.

To navigate the non-standardized processes that come along with this type of project, it is also very important to have a project driver that can take the time to collect input and help to set a course forward. In this project, the course was iterative and we believe that will likely be the case with similar efforts, however ensuring objectives, outcomes, and processes at any given time are aligned and mutually understood is a point worth stressing and pointing out that this was much more challenging than we assumed. As above, ongoing communication with all players and co-creation of these key pieces would have been have helped to maintain clarity in our respective paths and continued buy-in to the broader objectives of the project as a whole throughout. This kind of feasibility study is also much larger than what is normally seen in the industry, especially with the breadth and novelty of considerations of the project – to reiterate once more the most significant learning from this process: ongoing, clear communication in each partner’s language will help avoid confusion, expedite the process, and get the outcomes that every party is looking for/working toward.

Some significant challenges we have identified on the policy and regulatory side that will need to be addressed to further the design and development of high performance buildings. We thought it might be useful to identify them here, so others can be aware and perhaps together we can seek changes at the Provincial level to support or encourage future net-positive developments:

1. Net-metering disincentive: this project is likely to be rolled out with a net-metering solar array, meaning that the energy generated offsets the energy used with a bi-directional electricity meter. The billing model maintained by the utilities does not seem to have experience with net-positive installations, and in-fact could be a disincentive for further energy use reductions or even for using less that the 105% generated. The way we understand it works is that any surplus on an account is carried forward for one year, and during that year can be applied to any months where a payment is due. At the end of the year though any surplus disappears. So, for a building that is meant to generate a 5% surplus each year it is tough to recoup capital costs on the extra panels. In addition, for a case where the developer pays the capital cost for the panels and repays that investment through electricity payments from tenant use there is added disincentive for the tenants to achieve energy use reductions as this would also decrease the rate of return on the panels while allowing more electricity to flow back to the grid for free.
2. On-site wastewater treatment use regulations: Health regulations, here and elsewhere, do not allow water output from on-site wastewater treatment facilities to be used for anything other than greywater applications. This means that, in our case, the already poor investment case (250-432 year ROI) for this technology is made even less desirable because we have more than enough rainwater to use for greywater. This challenge however is substantiated by the fact that these types of distributed water treatment facilities do not have the same kind of oversight as larger municipal infrastructure and therefore could see an increased risk of contamination, from which the implications can be quite severe.
3. The Ontario Building Code does not allow this type of structure to be constructed with wood, and therefore it is a significant challenge to reduce the embodied carbon footprint of this type of building. Steel and concrete are the industry standard, and the calculations done for the Feasibility Study’s life cycle assessment show that rather than sequestering carbon through this building we are emitting a significant amount of GHGs.

In answering the questions in this section, please consider all aspects of undertaking the Study — from the initial planning through each essential task until the Final Study was prepared.
a. What would you recommend to other municipalities interested in doing a similar Feasibility Study? What would you do differently if you were to do this again?

b. What barriers or challenges (if any) did you encounter in doing this Feasibility Study? How did you overcome them?

6. Knowledge Sharing

a. Is there a website where more information about the Feasibility Study can be found? If so, please provide the relevant URL.

http://www.sustainablewr.ca/host/CSE%20Feasibility%20Study%20Report.pdf

b. In addition to the Feasibility Study results, has your Feasibility Study led to other activities that could be of interest to another municipality (for example, a new policy for sustainable community development, a series of model by-laws, the design of a new operating practice, a manual on public consultation or a measurement tool to assess progress in moving toward greater sustainability)? If so, please list these outcomes, and include copies of the relevant documents (or website links).

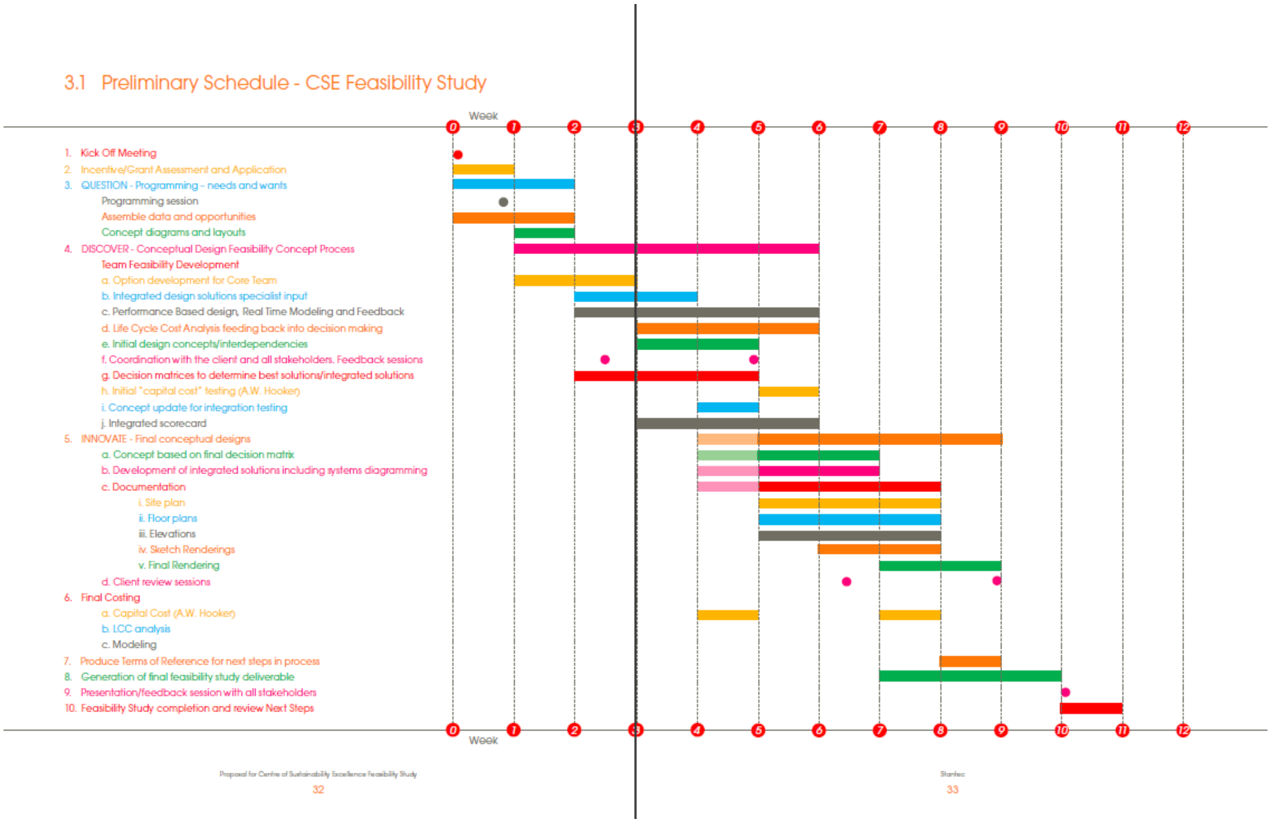
In addition to the technical feasibility study, our team has been working on the "People" side of design and building performance. An introduction to this work is provided below, also available online are the two first outputs – a research report that explores engagement with EY employees and a preliminary Citizen Engagement Strategy – and the outputs of a 2-day research symposium along with a significant amount of foundational research can be found at http://ccrla.ca/peopleinsustainablebuildings/.

Dr. Riemer, an Associate Professor of Community Psychology and the Director of the Centre for Community Research, Learning, and Action, is convening an interdisciplinary and multi-sectorial research team in partnership with SWR in order to consult, guide and study the sustainability goals and accomplishments of Evolv. A specific focus will be on the psychological aspects of creating and maintaining a culture of sustainability. This unique opportunity to study the design, implementation and operation of a cutting-edge green commercial office building over an extended period of time is both exciting and unprecedented.

Over the next two years this research team will work to obtain sufficient funding for multiple longitudinal research projects supported by a research institute within the heart of Evolv, alongside environmentally focused social innovators and entrepreneurs housed within the same innovation space. This institute aims to become a hub for cutting-edge interdisciplinary applied research with regional, national, and international impact. Ideally, this institute will be supported by an endowed research chair in behavioural sustainability.

Today, high-energy-performance, green-certified buildings often fall short of their potential due to occupant behaviour. It is central in sustainable-building scholarship that we cannot just rely on technological solutions, but must also consider human behaviour to achieve sustainability goals. Existing psychological research on the application of occupancy interventions in commercial buildings is very limited. In order to transition toward the regenerative paradigm, building occupants such as tenants, building managers, and employees need to be viewed as building citizens who become actively engaged in co-creating and maintaining a culture of sustainability. Looking to tomorrow, our goal is to develop an evidence-base of best practices for this type of engagement and building management. With the right support there is great potential for producing meaningful cutting-edge knowledge that will help Canada to better meet its sustainability goals.

Appendix A


3.1 Preliminary Schedule - CSE Feasibility Study
Week
0 1 2 3 4 5 6 7 8 9 10 11 12
1. Kick Off Meeting
2. Incentive/Grant Assessment and Application
3. QUESTION - Programming - needs and wants
Programming session
Assemble data and opportunities
Concept diagrams and layouts
4. DISCOVER - Conceptual Design Feasibility Concept Process
Team Feasibility Development
a. Option development for Core Team
b. Integrated design solutions specialist input
c. Performance Based design, Real Time Modeling and Feedback
d. Life Cycle Cost Analysis feeding back into decision making
e. Initial design concepts/interdependencies
f. Coordination with the client and all stakeholders. Feedback sessions
g. Decision matrices to determine best solutions/integrated solutions
h. Initial "capital cost" testing (A.W. Hooker)
i. Concept update for integration testing
j. Integrated scorecard
5. INNOVATE - Final conceptual designs
a. Concept based on final decision matrix
b. Development of integrated solutions including systems diagramming
c. Documentation
i. Site plan
ii. Floor plans
iii. Elevations
iv. Sketch Renderings
v. Final Rendering
d. Client review sessions
6. Final Costing
a. Capital Cost (A.W. Hooker)
b. LCC analysis
c. Modeling
7. Produce Terms of Reference for next steps in process
8. Generation of final feasibility study deliverable
9. Presentation/feedback session with all stakeholders
10. Feasibility Study completion and review Next Steps
0 1 2 3 4 5 6 7 8 9 10 11 12
Week
Proposal for Centre of Sustainability Excellence Feasibility Study
32
Stantec
33