

Project Closure Summary Report

Project Name: Living Wall Demonstration Project	CPP#: CP#/OP#: OP-001334	Completed by: Diane Wirtz
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Date: February 23, 2016		

1. Project Overview

The Tweddle Place neighbourhood in Mill Woods has experienced significant historical flooding. As a result, this neighbourhood was selected as a high priority for flood mitigation improvements under the City of Edmonton's Expanded Flood Mitigation Program. Preliminary and detailed design of the proposed improvement concepts was initiated in May 2014.

One of the recommended improvements for Tweddle Place is the expansion of an existing dry pond on the east side of 91 Street, between Whitemud Drive and Mill Woods Road. This expansion requires the removal of an earth berm that bounds the east side of the existing dry pond. The earth berm provides visual screening and acts as a sound barrier between residents and traffic on 91 Street and Whitemud Drive. Removal of the earth berm requires an alternative barrier that can provide these same functions with a smaller footprint.

During concept design, several options for an alternative sound/visual barrier were presented to the community in a public meeting held in November 2013. These options included conventional concrete, wood and synthetic sound barrier products, and a living wall. The living wall is an alternative to conventional barriers that uses two wood panels that encase a soil core. The soil core provides the sound barrier function. Live willow plantings line the outer surface of both wood panels, creating a hedge-like structure. It is touted as an environmentally friendly option that is more aesthetically pleasing than traditional noise barriers. A photo of the living wall is shown in Figure 1.



Figure 1. Living wall installation example in Eastern Canada.

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Attendees at the open house indicated a preference for the living wall over other sound barrier options. However, questions were raised concerning the living wall's effectiveness as a sound barrier compared with the existing earth berm, and the ability of the wall's plant material to survive in Edmonton's climate conditions. Attendees also expressed a desire to experience a living wall in application. City staff also had similar concerns. While the living wall has many installations in eastern Canada and other areas of the world, this would be the first installation of this product in western Canada.

To assess the effectiveness and viability of the living wall in Edmonton, and to address residents' concerns, a one year living wall demonstration project was initiated in June 2014. The objectives of the living wall demonstration project were to:

- Establish the effectiveness of the living wall as a sound barrier
- Confirm that the willow species used in the living wall could thrive in Edmonton
- Provide an example installation for residents to experience
- Obtain resident feedback on the living wall based on their experience with the demonstration project, and use this information to gauge resident support and concerns
- Identify considerations (lessons learned) to inform the design and construction of the full length of the living wall (approximately 900 m).

2. Living Wall Demonstration Project Scope

The demonstration project consisted of removal of a 100 metre section of the existing earth berm, and installation of a living wall in this section. To minimize throw away costs, grading for this section was established based on the ultimate design for the pond expansion. The location chosen for the demonstration project was west of the alley way for the 40 Avenue cul-de-sac. This location was selected because it was easily accessible to residents and shared use path users who wished to view the wall, and was a sufficiently long stretch for determining the wall's effectiveness as a sound barrier. Due to the need to preserve the continuity of the sound barrier for this area, the ends of the living wall were designed to tie into the adjacent earth berm areas. Safety considerations required the wall to "climb up" the earth berm at the ends, so that passersby could not access and walk along the top of the wall. The location of the demonstration project is shown in Figure 2.



Figure 2. Living Wall Demonstration Project Location.



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Activities included in the living wall demonstration project were:

- Designing the living wall demonstration project
- Procuring a construction contractor for earthworks and the living wall installation
- Removing the existing earth berm and re-grading the pond in this area
- Matching catchbasins in this area with new ground elevations
- Constructing the living wall
- Regrading a swale on the east side of the living wall to drain to a new catch basin
- Regrading the alley way at the north and south ends to direct overland flows to the new swale
- Establishing an irrigation source for the living wall
- Completing noise monitoring - baseline (prior to any change), summer and winter monitoring was conducted
- Developing a resident feedback questionnaire
- Communications with the public to introduce the demonstration project, solicit feedback and share results
- Applying noise monitoring results to update an existing noise model for the area. Results of the noise model were used to optimize the sound barrier design for the dry pond expansion.

Some of the above activities were completed to minimize future construction activity in the demonstration project area, and were not necessary for the demonstration project itself. Construction of the living wall was completed in October 2014. Final grading and landscaping was completed in May 2015. The demonstration project was concluded in October 2015.

3. Demonstration Project Outcomes Summary

3.1 Noise Monitoring Results Summary

The noise monitoring assessment was conducted by aci Acoustical Consultants Inc. Noise monitoring stations were established at a residence behind (east of) the demonstration project and at a residence north of the demonstration project, adjacent to the existing earth berm. The location to the north was used as a “control” location for comparative purposes. Monitoring stations consisted of a microphone, data loggers and a weather monitoring unit.

A baseline noise monitoring event was completed in September 2014, prior to commencing any construction on the demonstration project. A winter monitoring event was completed in January 2015, when the living wall was constructed but the willows dormant. A summer noise monitoring event was completed in July 2015, when the wall was leafed out.

The noise monitoring study found that replacing the earth berm with the living wall did not adversely affect noise levels at the adjacent monitoring location (a slight noise level reduction was detected at the adjacent station after the living wall was installed, compared with the control location). The report concluded that the living wall essentially performs as well as other commonly used sound barriers.

The full noise monitoring report is available on the City’s website.

3.2 Living Wall Growth Summary

City staff monitored growth of the living wall plant material in the spring of 2015 following an atypically mild winter. With warm weather arriving in Edmonton in April, the willows began to bud by early May (Figure 3). By mid-May, these buds had formed into tiny sprigs. Hot, dry conditions developed in mid-May and continued for the remainder of the month. In late May, the project team discovered that the irrigation source, critical for establishment of the willows and especially during drought conditions, had been turned off. This resulted in many willow stalks turning black and the death of many shoots (Figure 4).

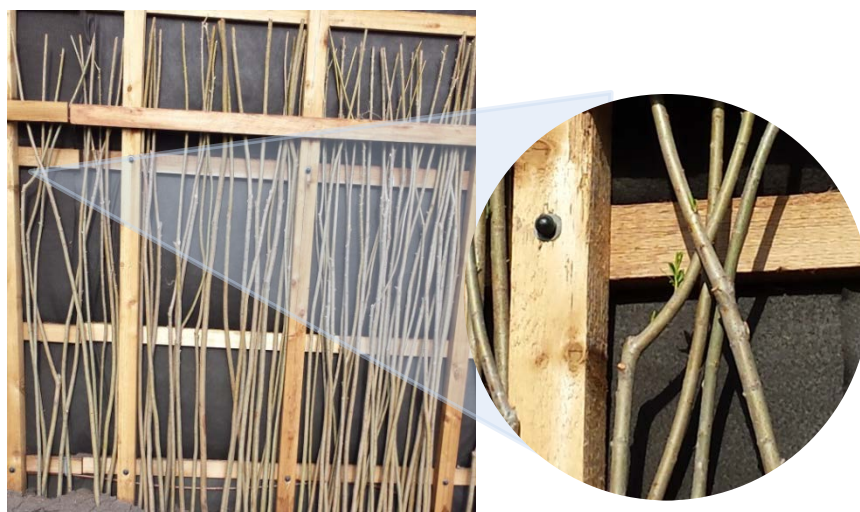


Figure 3. Development of Buds on Living Wall. Photo taken May 5, 2015.



Figure 4. Drought Damage to Willow Shoots on Living Wall. Photo taken May 28, 2015.

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Recovery efforts were applied in June. Irrigation was re-established, and watering rates increased. The living wall contractor also returned in June to plant an additional 2,000 willows. Additional plantings were centred on the wall to minimize wastage, as the north and south ends will ultimately be removed for the full dry pond expansion. By the end of the growing season, the living wall had developed into a hedge-like structure. However, gaps existed where willow growth had stagnated, particularly on the west side of the wall where conditions are driest (Figure 5).



Figure 5. Living Wall Recovery on Neighbourhood Side. Photo taken July 24, 2015.

The overall conclusion from the demonstration project is that the living wall shows good potential for growth in Edmonton's climate. The willows were able to survive the 2014-2015 Edmonton winter. However, the demonstration project highlighted the importance of sustained irrigation during the critical establishment period of the willows, for proper growth and development of the wall.

3.3 Resident Feedback Summary

The project team developed a living wall questionnaire that was available to residents online and at project open houses from November 2014 to November 2015. The City received a total of 192 responses to the living wall questionnaire. Highlights from the questionnaire are summarized below.

The majority (92%) of respondents to the survey lived in other Edmonton neighbourhoods, i.e. outside North Millbourne (Figure 6). In addition, only 23% of respondents had visited the wall. Of those who visited the wall, 61% had experienced the wall from the neighbourhood side.

The majority of respondents to the survey supported having the living wall as a permanent sound and visual barrier for the Tweddle Place dry pond expansion and as an alternative to more traditional sound barriers in other Edmonton locations (85% and 90%, respectively). Aspects of the living wall that respondents liked most were the wall's environmental value, the look of the wall and the use of plant material in the wall (Figure 7).

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Overall, most respondents were positive and supportive of the living wall. The complete survey report, including comments received in the questionnaire, is attached to this summary report as Appendix A.

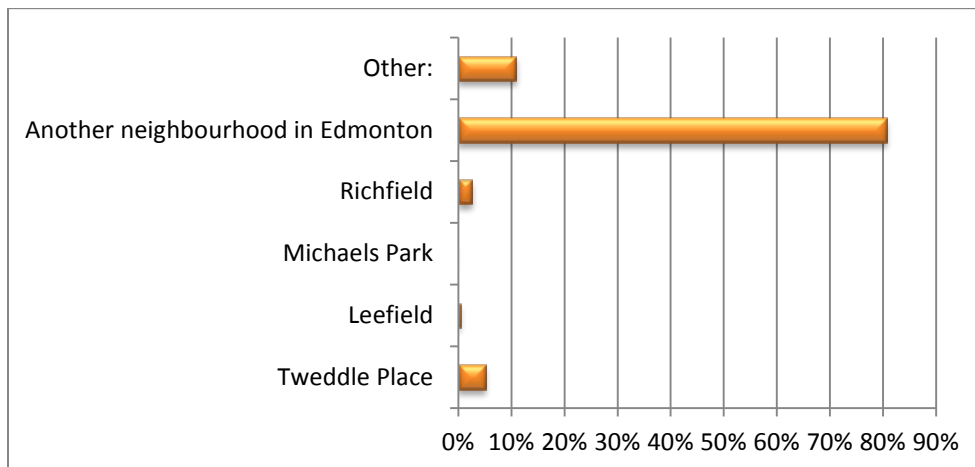


Figure 6. Survey Responses by Neighbourhood.

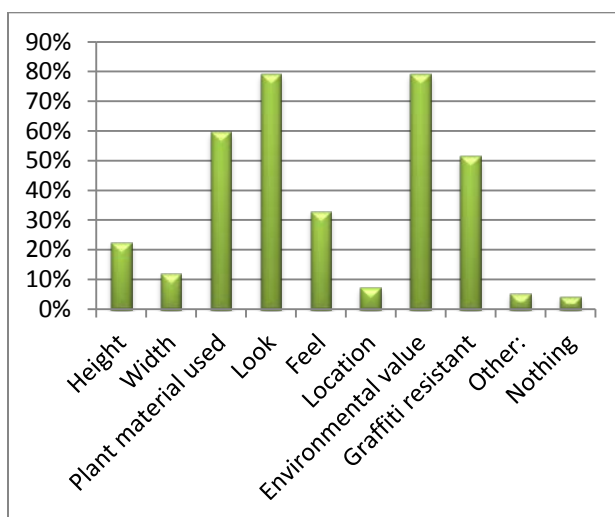


Figure 7. Aspects of the Wall Most Liked by Survey Respondents.

The questionnaire highlighted the need to educate the public about how the wall functions as a sound barrier, as many respondents raised concerns about this function during winter when the willows are dormant. Concerns were also raised about costs of the living wall.

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4. Project Cost Summary

Costs for the living wall demonstration project are summarized in Table 1. Actual costs include an 11% administrative overhead that is applied to all drainage design and construction projects. For the demonstration project costs, only a portion of the construction (living wall installation at ends of the demonstration project), noise assessment and irrigation costs would be considered throw away costs associated with the demonstration project, as the demonstration project was designed to be consistent with the ultimate dry pond expansion. Lessons learned from the demonstration project were applied to optimize the dry pond expansion design.

Table 1. Living Wall Demonstration Project Costs.

Task	Actual Cost
Project management, engineering, inspection and quality control	\$92,200
Construction	\$884,600
Noise assessment	\$19,500
Irrigation*	\$3,300
Total living wall demonstration cost	\$999,600**

*Assumes \$50/month due to resident use of water

**Difference due to rounding.

A brief internet search was conducted for comparative costs of other types of sound barriers. The literature showed a wide array of sound barrier configurations, applications and materials, and pricing information was provided in varying formats. This cost information was converted to an equivalent cost in Canadian dollars per linear metre of wall installed, and are presented in Table 2 as a cost range to account for the above differences. However, costs were not escalated to 2016 dollars. Therefore, the cost data should be regarded as approximate and are intended to provide an indication of relative capital cost differences, and do not indicate the sound barrier effectiveness of the various installations. The detailed data are attached as Appendix B, Table B1.

Table 2. Reported Costs for Various Sound Barriers.

Sound Barrier Type	Cost Range, \$/metre
Acrylic	5,520
Earth berm	283
Block	1,150
Brick	1,725
Concrete	1,012 to 3,034
Earth/concrete combination	1,538
Engineered plywood	920
Living wall	1,100 to 1,500
Metal	1,208
Polymer composite	674 to 1,011
Wood/timber	552 to 869
Other/combination	442 to 1,840

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Maintenance costs were not readily available for existing sound barrier installations. However, the City commissioned Stantec Consulting Ltd. to qualitatively assess the pros and cons of various types of sound barriers (letter report entitled “Millbourne Flooding Report, Sound Barrier/Privacy Screening Options for 91 Street Berm Replacement,” August 26, 2013). This information is summarized in Table 3 below.

Table 3. Pros and Cons of Various Sound Barriers.

Sound Barrier Type	Pros	Cons
Precast concrete	<ul style="list-style-type: none"> Noise reflective Available in a wide variety of aesthetic finishes Moderate cost Durable – withstands weathering Maintenance free 	<ul style="list-style-type: none"> Somewhat unnatural appearance Graffiti is difficult to remove Heavy; more difficult to handle
Vinyl	<ul style="list-style-type: none"> Noise reflective Available in several aesthetic finishes Lightweight & easy to handle Graffiti is easily removed with common solvents Low cost Durable – withstands weathering Maintenance free Relatively easy installation compared to heavier walls 	<ul style="list-style-type: none"> Somewhat unnatural appearance Graffiti prone Colour & finish may fade over time with sun exposure More susceptible to minor warping due to extreme heat Can become brittle in cold climate applications
Brick and masonry	<ul style="list-style-type: none"> Noise reflective Available in a wide variety of aesthetic finishes Moderate cost Maintenance free 	<ul style="list-style-type: none"> Somewhat unnatural appearance Graffiti is difficult to remove Heavy – more difficult to handle Longer installation time May not be as durable as other options
Wood or timber	<ul style="list-style-type: none"> Noise reflective Relatively easy to handle Moderate cost Low maintenance Easier installation relative to heavier walls 	<ul style="list-style-type: none"> Rough finish (splintering) Needs moisture treatment to avoid rotting Graffiti is difficult to remove Susceptible to sun exposure and other forms of weathering
Green or living wall	<ul style="list-style-type: none"> Noise absorptive Strongly graffiti resistant Natural aesthetics Willow stands are easy to handle Relatively low cost Durable – withstands weathering Low maintenance Easy installation compared to heavier walls Salt resistant 	<ul style="list-style-type: none"> Requires drip line in first year to establish growth Leaves drop in winter Similar installations in Western Canada are rare



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Sound Barrier Type	Pros	Cons
	<ul style="list-style-type: none">• Cold weather compatible• Environmentally friendly & sustainable (biodegradable, absorbs carbon dioxide, provides bird habitat, incorporates composted biosolids in soil core)	

8. Key Lessons Learned

The key lessons learned from the demonstration project were:

- ***A reliable irrigation source during the establishment period is critical for the viability and health of the wall.*** For the full scale dry pond expansion, a dedicated source with limited public access is critical during the establishment period for the wall. The irrigation system should remain intact for the life of the living wall, to be available for protracted hot, dry conditions.
- ***Integration of living wall construction with earthworks activities is necessary to ensure clear lines of responsibility between the living wall supplier and earthworks contractor.*** The living wall is installed following rough grading, but prior to final grading and landscaping. Procurement of contractors will need to be strategically managed for successful completion of the project, to minimize integration issues and establish clear lines of responsibility during construction and the warranty period. Prime contractor requirements will need to be considered in the tendering strategy.
- ***The shared use path along the east side of 91 Street is a well-used commuter pathway in all seasons, and alternate routes will need to be provided during the dry pond expansion.*** Construction of the dry pond will need to consider how pathway users can be safely accommodated, and will likely require staging to ensure access is maintained throughout construction. Detour routes need to be all season and all weather accessible, and be hard surfaced to enable snow clearing in the winter. The cost of constructing the detour and inefficiencies associated with staging the dry pond expansion will need to be accounted for in the pond expansion budget. It was noted in the demonstration project that the Mill Woods Christian School currently uses the berm for an annual running event as well as for routine physical education activities.
- ***Construction plans need to be communicated with both local residents directly affected as well as with a broader audience.*** Based on the survey responses, interest in the living wall project extends well beyond the North Millbourne community, and likely encompasses commuters using the shared use pathway and driving along 91 Street. The demonstration project also garnered interest from communities in Canada and the United States. Communication methods will need to consider this diverse audience. The City should also continue to implement targeted



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communications to ensure Tweddle Place residents are aware of the dry pond expansion and other flood mitigation works.

- ***There are misperceptions about the effectiveness of the living wall during winter, and how the sound barrier relates to flood mitigation improvements.*** Some survey respondents believed that foliage was necessary for the wall to act as a sound barrier. Respondents also questioned how the living wall could help mitigate flooding for the community. The City will need to address these misperceptions in future communications. One strategy that is recommended for the permanent installation is interpretive signage along the shared use pathway that explains the purpose of the wall and how it functions.
- ***Interdepartmental coordination is key to the success of the dry pond expansion project and the long term health of the living wall.*** The dry pond expansion project touches on services provided by many different areas in City Administration. While the project is primarily a drainage project, it occurs in a road right of way, and impacts use of the shared use pathway, traffic operations, trees, landscaping and naturalization, parks operations, waste management, biodiversity and community services. A comprehensive stakeholder management approach will be required to ensure these challenges are met. At the same time, the multi-faceted nature of the project offers unique opportunities to advance multiple City objectives such as naturalization, enhancing biodiversity in urban areas, and other sustainability outcomes.
- ***The living wall is as effective a sound barrier as the existing earth berm, and can replace the earth berm to enable the dry pond expansion while still providing sound barrier and visual screening functions.*** The outcomes of this project demonstrate the ability of the living wall to grow and function in this application. Field monitoring of noise levels before and after the project was implemented indicate the living wall performs as well as the existing earth berm. The collected data may be used to augment the existing noise model. The noise model can then be used to support the sound barrier design for the dry pond expansion, to optimize the sound barrier function of the wall.

10. Recommendations

Based on the living wall demonstration project outcomes, it is recommended that the City pursue a living wall sound barrier for the dry pond expansion project. Construction of the dry pond expansion should consider all lessons learned from the demonstration project.

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Appendix A. Compilation of Living Wall Survey Responses.

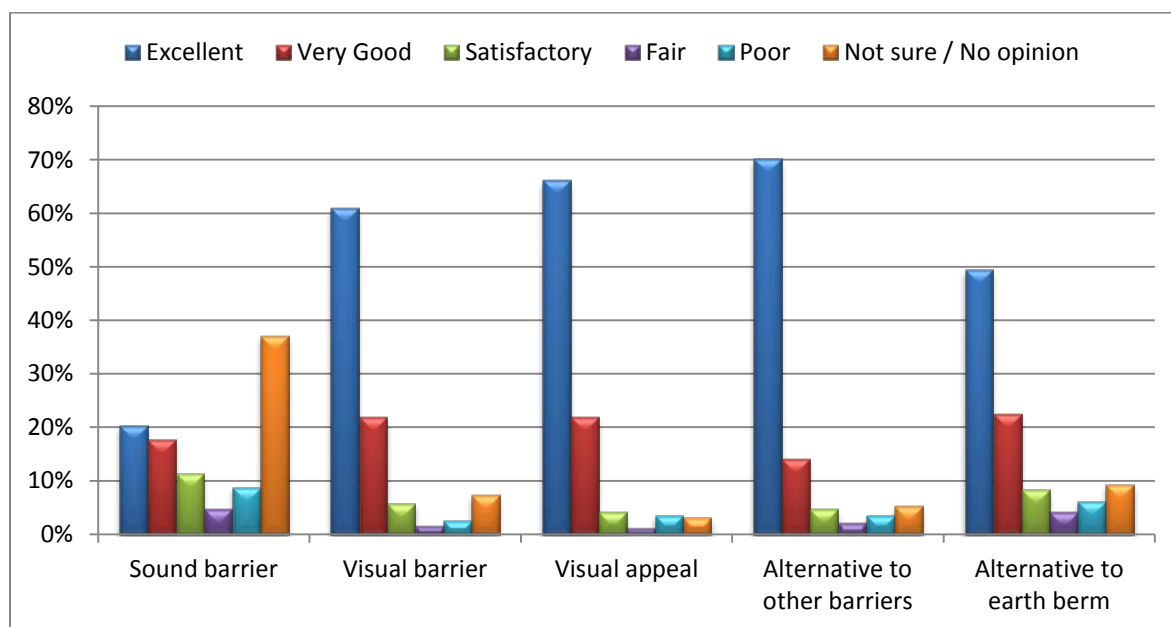
Q1. Have you visited the wall?

	Total
Total	192
1 Yes	23%
2 No	77%

Q2. Did you experience the wall from the neighbourhood side? That is, did you stand with the wall between you and 91 Street?

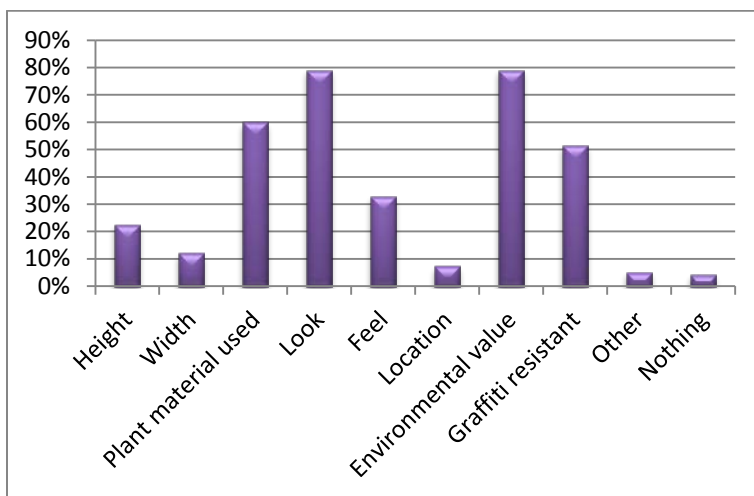
	Total
Total	44
1 Yes	61%
2 No	39%

Q3. From your observations, how would you rate the living wall as a (5 = excellent, 1= poor):



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Q4. What did you like most about the living wall?

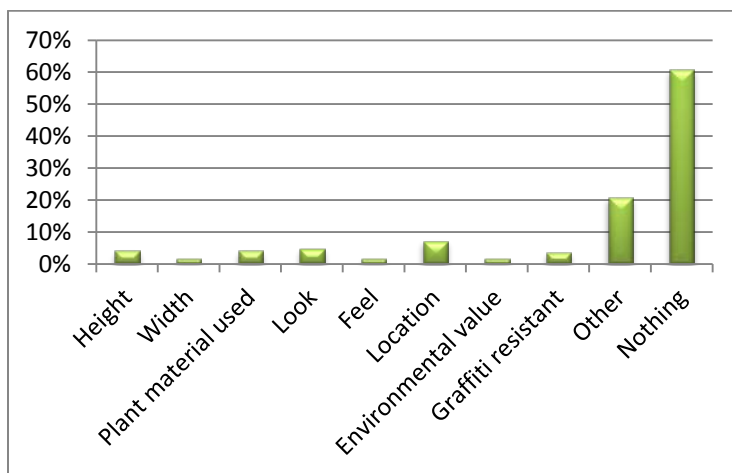


Comments from Other selection:

- Pollutant absorption
- I think I love everything; my only worry is water requirements. Could drought resistant native grasses be used?
- Creative
- I haven't seen this one but I've seen them in Germany and I like them. Looks better than the prison walls we have here
- Offers bird habitat
- My comments are based on research I have done as well as numerous types of walls such as these that I have visited in many other cities throughout the world
- Chance to plant veggies on the wall???
- No waste is created; shelter for wildlife; oxygen producer; progressive decision-making; role model solution for citizens to follow; shows that government is smart enough to take ideas from places (e.g. Europe & elsewhere) where the ideas have been put to practical, environmentally friendly and cost effective use (rather than government seeking to reinvent the wheel); city government has chosen a way to solve a problem and "give back to nature" at the same time; etc.)
- Green!

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Q5. What did you like least about the living wall?



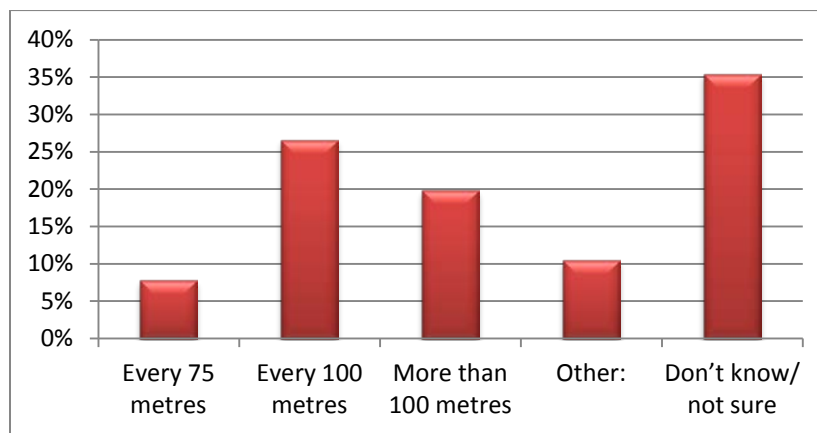
Comments from Other selection:

- Could have provided wind protection for the bicycle/walking path parallel to it
- Cost
- Cost of maintenance
- No info about at site (still being built at this time); we've been wondering since the supports have gone up!
- Once I visit it I will have an opinion
- Sound barrier effectiveness
- Not as effective as sound barrier as conventional structures
- Nothing! Bring them on!!
- Would like to see how it looks in winter
- Doesn't work in the winter
- Could be higher? Maybe more variety of plant material/ecosystem?
- If the wall were somewhat closer to 91 Street it would give a more open feeling
- I don't think it would stop an out of control vehicle
- Will it be easy to maintain? How much maintenance work needed?
- Boring wall
- It is still rather bleak
- Sound resistance
- Yellowhead Freeway could also use this
- Look in winter??
- Concerned as to whether it will sustain in our climate
- Lack of security or safety
- Local residents may have concerns to which I cannot comment
- Not as effective in winter and dependant on upkeep
- I haven't seen it, only commenting if I were to see it I would want it to be a high wall and not just wide but create more like it
- Monoculture
- Not high enough

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- Cost and need for irrigation to sustain
- Fall leaf clean up
- Concern re shabbiness during off summer season and the cost of upkeep
- It will not block sound in the winter and will have a lot of extra leaves in the neighborhood. Once the sewers are widened would it not be enough to deepen the ditch along 91 Street and leave the berm.
- Proposed breaks in the wall
- Obstacle to sight lines, potential barrier to walking/biking, limitations to human use vs earth berm, fence-like look
- Doesn't function in the winter (no leaves). Requires maintenance to trim and replace dead sections.

Q6. If permanently installed, the living wall will be extended from Mill Woods Road to the Whitemud Freeway. What would you consider to be appropriate breaks in the wall to allow access to the other side?



Comments from Other selection:

- I wouldn't think that it is necessary to have an opening more frequently the 2 or 3 city blocks. It affords security and should be opens be more frequent I believe it defeats the purpose of sound and security.
- Could troll doors be used? Or just an open break?
- Every city block, for walkability, access
- Every 50 metres
- At every current path and 100 metres
- For pedestrian connectivity so it should line up with sidewalks and walkway links
- Do not waste our taxpayer money
- Dependant on specific site conditions and existing connections
- Depends on what's there to have access to
- To open up to all roads and paths on the other side behind the wall to ensure the communities remain connected, if not at least every 75 m
- 1 – 2 blocks

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- Depends on what is on the other side
- I would have to go look at the locations carefully before responding to this part. Perhaps there might be different breaks needed at different locations.
- Check with neighbourhoods
- 30 m
- At the ends of avenues, and where walking trails would cross. No more often than if it were a concrete barrier.
- At 40 Ave back alley plate every east-west pathway or pipeline path
- 200 @ 10-12 homes
- More breaks rather than fewer, especially around access points from the adjoining neighbourhoods. Every 75 metres might feel like too few...

Q7. Would you support having a living wall as a permanent sound and visual barrier along 91 Street between Mill Woods Road and the Whitemud Freeway?

		Total
Total		192
1	Yes	85%
2	No	6%
3	Don't know / not sure	9%

Q7b. Please explain why you don't support:

- Cost
- The wall looks wild and unkempt and makes the area neighbourhood look shabby
- It has little effect in the winter. It needs to be an evergreen type of plant to work all year long.
- Initial cost and maintenance.
- This first example on 91st street at such a high cost is a total misuse of taxpayer funds. City Council should be ashamed of themselves. This is almost as bad as the pile of stainless balls by the Quesnel Bridge. Spend our money on projects that will benefit the city, like maintaining and renewing infrastructure.
- It is unattractive. It hides too much from sight so makes walking unsafe. It will attract a lot of small wildlife that interferes with city living. It is a costly and unnecessary expense that the city does NOT need to do. What we already have is more than sufficient for the neighbourhood. No one has ever complained about the berm in all the years we have been here. I think it is a big waste of time, resources and tax dollars.
- I drive in that area and the open space feel is wonderful, but unless the noise of the cars is too much then yes a living wall would be the right choice. I think living walls in the freeway would be good
- Visually unappealing (especially in winter months. - Ongoing costs to maintain living material as opposed to concrete, wood, etc. must be substantial. (After 40 years the City has stopped weekly mowing this summer on the east side of the 91st St. berm between Mill Woods Road and 34th Ave. and it has been a horrible adjustment from the neighborhood parkland that we used to enjoy to an unsightly overgrown area which I'm sure devalued our properties

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immensely.) - Willow trees do not shed their leaves until after the first snowfalls and surrounding areas become very messy as the material is scattered by the northerly winter winds in yards, garages when opening doors, etc.

- Plants die and that breaks up the barrier and a barrier like that makes it easy for muggers and other bad citizens easy to cause trouble to ordinary folk
- I do not understand why structures like this are better than a natural plant material such as trees and shrubs planted several meters deep as to resemble natural forest. It buffer the sound and it would be a home to many birds. I have watched the wall being built and the resources that it took to build it. Now I continue to cycle along it and watch it struggle to become green. Willow needs a lot of moisture in order to thrive and this we are lacking. It is an ugly sight right now.
- 1) The berm is natural and requires little maintenance now that the city is not mowing it. 2) The leaves only provide a sound barrier for 3-4 months out of 12. 3) The extra leaves are a nuisance to neighbors in the fall. 4) Fix the drainage issue first by widening the sewers then if needed dig the ditch wider along 91 St. 5) The city just paved the walk a few years ago. I feel that it is wasted money.
- The wall maybe environmentally friendly, however it does require a lot of maintenance to keep it looking decent. Leaves disappear in the winter eliminating part of the sound barrier and all of the visual barrier. Leaves if not picked up in the fall tend to clog sewers in the spring.

Q8. Would you support the City of Edmonton using living walls as alternatives to more traditional walls made of material like concrete, wood or steel?

	Total
Total	192
1 Yes	90%
2 No	4%
3 Don't know / Not sure	7%

Q8b. Please explain why you don't support:

- Cost
- Already said my piece about living walls, they are far too costly.
- Again, wasted tax dollars. Unnecessary and not cost effective. Unsafe and unattractive. Fix the roads and put money into repair of older neighbourhoods and existing problems instead of re-inventing the wheel.
- High maintenance costs and unsightly in winter months.
- already told you---plants die and that breaks up the barrier leaving open spaces and looks unsightly---these areas make it easy for hooligans to cause trouble out of sight of the general population
- High cost of maintenance, concern that it would look poor due to environmental conditions for the majority of the year.

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Q9. Please share with us any comments you may have:

- Will need to adjust to allow utility crossings underneath without hitting the utility with huge fees if they need to cut through the wall to complete repairs.
- I believe that ecologically these provide a greater difference to our environment. Should the trial wall prove to be able to withstand the rigors of mother nature's forces I would happily agree to building them everywhere.
- I hope these can be grown and well maintained without the use of pesticides. I would rather spend a little more for sustainable maintenance.
- Berms are awesome.
- I didn't see anything on water requirements is there a longer blurb I missed?
- they look great
- An innovative project like this is exactly what Edmonton needs a lot more of. It is also important though to avoid crucial mistakes such as not making enough through paths so people can still walk around conveniently.
- It is a great project and I love the environmental impact for good it has. Keep making great structures like this!
- I have not visited the current living wall. However, from what I have heard about living walls they appear to be more environmentally friendly, more visually appealing, and cheaper to maintain. I am in favour of having more living walls used in Edmonton.
- Am wondering about the appearance of the wall in the winter and would like information on the capital and ongoing maintenance cost of the wall. What is the Net Present Value over 25 years? How does that compare with wood or concrete?
- what DOES it LOOK like in winter? DOES IT COST MORE TO MAINTAIN?
- I would like to see data comparing the performance of the living wall compared to its alternatives, specifically in terms of noise reduction. If it's similar for noise reduction, I would have absolutely no concerns about applying the concept in every practical location in the City.
- Excellent idea, it looks nice. Plus it brings more nature in. I just hope it would be better maintained than other city property. That is my only concern.
- Hard to comment because I don't know the initial capital cost and maintenance costs compared to traditional walls.
- The living wall is a great addition and improvement PROVIDING it is properly maintained. **It would be nice thing to see, along side metres, yards for us non-converted persons.
- - use native plantings - consider winter design guidelines - appropriate planting is key - consider integrating Wildlife Passage Engineering Design Guidelines to ensure movement of wildlife is maintained.
- There's nothing included here about the cost of the wall. Although I like the idea very much I'm not sure if the consequences will be an increase in city taxes. That might be fine but it would be useful to know more from that perspective. Excuse my ignorance while filling out the survey!
- I live on the other side of 91st street and enjoy walking with my family on the top of the hill where the living wall would presumably be built, it would be nice if there were breaks along the wall to allow access in case of emergency/safety. There may also be an issue of people walking their dogs on either side and making the effort to clean up after their dogs.
- I would like to see the results from a peer reviewed study looking at the efficacy of living walls versus conventional structures in reducing sound from traffic.

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- I don't know what kind of results expected or how those have been experienced in other locations they have been tried (such as the bocage of Normandy).
- What an extremely awesome idea! I love it!!!
- I think it is important to receive direct feedback from impacted residents as to the wall's effectiveness compared to the traditional construction
- I'm just worried about what it would look like in the winter
- I have seen living walls in other cities (not necessarily used as sound barriers) and I love the concept of replacing concrete with nature
- Next time, ask the people in the neighbourhood what we want BEFORE you make decisions. No one in my neighbourhood was consulted about this. No information was given, etc. Ask the people!
- These are a wonderful alternative, and we should have as many as possible
- While I appreciate the living wall idea, will it be as easy to maintain as other traditional materials? Could edibles be incorporated and donated to charity groups when harvest arrives?
- Like most things in life the wall takes a bit of getting used to it. Lots of trees between the wall and 91 street
- How will the city provide clean up of the living wall. There may be wasp or bee nests and garbage will collect. Is there money to support clean up? What about crime. How safe is the wall?
- I love this project. I ride my bike to work along the 91 St. path and stopped to check out the wall yesterday. It looks great (much better than the existing berm), blocks out the noise really well and adds more greenery to our lovely city.
- Not only would it block sound, but the living wall would clean the air from the vehicles exhaust!
- You can come replace the ugly prison wall we have by the grain elevator around Athlone neighbourhood. If they are along roads and freeways, I think a low hill and then the wall would be better than just the plants. With just the plants it wouldn't be high enough. Six ft. isn't very high. Six ft. isn't high enough to act as a sound barrier. If you want it SPECIFICALLY for a sound barrier I would make it a lot thicker too as well as higher. You would have to adapt the height, thickness, low or no hill to the specific needs of the area. One size would not fit all areas. There are lots of neighbourhoods where walls are needed but are too expensive. So now, these plant walls could be put in all kinds of places in neighbourhoods with very low cost. Maybe community leagues and citizens could get involved. You could have courses on how to plant them and if a group of people or community league wanted to put some in their neighbourhoods they could do so. It would be a faster process than just the city building them. You could have plant wall education kits or plant wall building kits. The north end Henday has nothing beside it to prevent snow from blowing all over the highway causing accidents. It looks like a wasteland around there, ugly. You should be putting these all along there and on other freeways.
- Too soon to support this option. The residents of the area need to live with it for awhile and provide feedback. The visuals are good, but do not seem to have any variety. Variety of plant materials would make it much more attractive, in all seasons.
- Living walls as substitutes for concrete barriers would be effective depending on the location and if other factors are considered such as security or safety
- I drive along 91st all the time, and am looking forward to watching this grow.
- It would be great to see these around everywhere!

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- although I have not seen the Edmonton living wall, I am familiar with and have seen this concept elsewhere
- Fantastic concept. I'd love to see these piloted in other locations as well, such as a visual barrier behind 104 Ave at longstreet mall, on the neighbourhood side (103a?) or behind commercial/industrial backing onto any residential. One caution, these make a great barrier against noise / visual aggravation but can create spaces which are unsafe or appear unsafe because they obstruct people from being heard / seen in areas where they might be at risk of assault or harassment. All in all a great idea! Try some downtown? The corner of 124 and Jasper, high street businesses, etc.
- Fantastic idea through and through!
- Living walls are excellent alternatives to what we have been doing traditionally, time to do things differently
- The appeal of the living wall is not great in the winter, and the sound barrier might not work as well.
- It sounds like a great idea, and I can visualize it being fantastic. I would be guessing at sound reduction without visiting one first. Also, it needs to be self sustaining and not wither out and die if its not watered frequently.
- I love this idea. Bringing nature a little closer without having to drive past those industrial looking walls.
- Not sure how well it shields against sound compared to concrete, wood, steel materials etc...
- great idea, nice to see some nature instead of concrete
- I think this is a great idea! The more the better
- I appreciate the use of plant materials as a solution to sound and visual barriers. Being environmentally friendly as well as beautiful is a big plus in my view. Thank you for another innovative project. Keep 'em coming!
- Should try to use a mixture of species, and native plants that would require minimal inputs, why not mix in some rose, willow, cranberry, buffalo berry
- too costly and not pleasant to look at when it becomes broken down by vandals etc
- Living walls are not only functional they are a tremendous asset in increasing the visual attractiveness, not only to residents but also to visitors to our city. Over the years Edmonton has been increasingly gaining the reputation as a dusty, dismal looking city and not somewhere that anyone would be attracted to as a beautiful place to live. Most people say that they are here only for work. This is a mindset and a reputation we must change. I have visited many cities in the world and have enjoyed many beautiful sites including living walls and in every regard implementing them throughout our city must be given a thumbs up! Many who will argue against this idea will primarily be concerned over cost and maintenance however with proper research into the construction, plant material and maintenance will see that these costs are not much different than construction and keeping concrete walls graffiti free. Selection of the proper project management to implement the walls is the key.
- My only concern is that there may be a safety issue with the area in between the homes and the wall. The space is only wide enough for a mower to pass through.
- Another worthwhile and innovative initiative being soberly considered by the City of Edmonton.
- I like the idea of trying new things, but this solution is not practical in our climate
- What was missing, in questions was If new Walls were erected.. There still should be some form of Traffic Prevention. Such as Grading.. If the barrier is on level with road, that is problematic..

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- Stray vehicles, need a Metal or concrete barrier.. Instead of Cement wall.. In front of Living wall, the small cement barriers 4 feet long 3 feet high. Safety has to be addresses.. This is the gap , that I did not see addressed in the proposal.
- This should be a consideration all along the whitemud freeway and any other places where there are walls separating freeway
 - Please, PLEASE continue to use walls like these as often as possible.
 - Not sure of the life expectancy of these walls as the materials used are not significantly strong and look like they may decompose in a few years. Hopefully the living plant material will give it more structural integrity.
 - What about putting up a living wall on the berm from 50 Street to 66 Street and the Yellowhead Freeway. The noise gets so bad you can't hear when you are in the back yard and trying to talk to each other.
 - fantastic idea!
 - Great idea I am all for it! It makes Edmonton look cleaner.
 - Why call it a "living wall"?? It's a hedge. Or hedgerow. Call it that!
 - LOVE living walls. They're so much more visually appealing and environmentally friendly than man-made materials.
 - Living walls are not only sound barriers but research shows the more green in an area the less accidents and less stress and better air quality
 - My concern about living walls is what do they look like?/how do they function during winter vs summer. Also, we have lots of road salt and air pollution along the freeways so how will that affect the long term sustainability of living walls. My preference would be for living walls (if they perform well) vs other types of manmade materials.
 - This is a smart green option. I love seeing improvements to our city with innovative ideas like a living wall
 - It would be nice to switch up the types of vegetation if possible, garden spaces around exits/entries. And challenge Edmonton art students to create pieces to be placed along the lines as well... Possible led lighting solutions...
 - What an awesome concept. Using native trees and fruit shrubs could provide homes for birds etc. as long as one side is away from traffic. In California they use flowering trees on the berms.
 - would have to see the evaluation of the first living wall to respond further about future walls.
 - Great idea. I love it.
 - I do wish there would be some option of evergreen so that in the winter it wouldn't look so barren; but then again the concrete walls look barren too
 - I would like to see all existing barriers replaced with a living wall. These will add a lot of beauty to our city.
 - I would support them if they give close to the same sound barrier benefits and if their cost isn't much higher in comparison to traditional methods. You didn't give us any of that information on which to base our decision.
 - Can other plants be used as well in the living wall.
 - When trying to solve various city issues, why not bring in from Europe an expert(s) in those particular issues? For example, in Italy the focus is medium density housing. Why not have developers/builders here plan for 6-level apartment buildings where the main floor is devoted to small businesses (and nonprofit organizations) and the other levels to residents. In Italy, there are huge central courtyards—surrounded by the 3 structures/buildings and a large

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gate/entrance area to that group of buildings—in which there are fruit trees, gardens, statues, seating areas, etc. Each apartment/home has a huge balcony/deck so that residents can enjoy the outdoors right outside their living rooms, as well. This is not only building smart; it's also building community where people can more actively interact with one another. If the City ever plans to send a small group of "Insightful" citizens to Europe on a 3-week or so organized tour of some cities in that continent to research, photograph and present back to City Council and the public, I'll get in line to apply (I speak Italian, French and Spanish). I'm only half joking. North American cities spend a lot of money to arrive at solutions for certain issues when solutions for those issues have already been found elsewhere; we just need to access that information and bring in help to assist us in the initial stages of planning. This would be enlightening and cost-effective, in addition to many other benefits.

- Would like to know over time whether more cost effective than other structures
- Gives a better look than concrete and the only maintenance would be to the plants. Otherwise, would have graffiti and be an eyesore until the graffiti is removed.
- Drought/weather resistant plant selection is important for this to be a sustainable installation.
- Love the idea of a living wall. Not only greening the city but creating habitat and cleaning our air. It is imperative that we initiate these types of changes now. Edmonton is such a beautiful city with all its parks but the tree deaths everywhere has turned us into poster for Chernobyl.
- Using a living wall in an area that has none makes sense to deter vandalism and would hopefully be cheaper than a concrete structure in the long run. However tearing down a berm that is already providing a sound barrier does not seem like a wise financial decision.
- This is such a good idea on so many levels, the first two that come to mind are the environmental benefit and the aesthetic value. This is something that I think aligns perfectly with a City that is trying to put itself on the map as leading the way in urban planning and design.
- Just love it! I love that we are using nature, instead of an unnatural structure that requires maintenance and upkeep in the future.
- This is a very positive move toward creating a better environment for both the people and the wildlife (birds, native pollinators) living in the area. Could you please investigate whether growing a living wall down the center (and/or sides) of the Anthony Henday would reduce the amount of snow clearing needed by causing the wind to carry the snow up over the road and into the storm water ponds beside the road?
- I absolutely love this idea! Please consider using this in other areas of the city as well. Such a great alternative to sterile looking concrete.
- The flash elements of the survey are unnecessarily complex.
- Please consider this alternative for Yellowhead
- I would miss the earth berm because of the natural way it functioned both as a sound barrier and as a "park like" atmosphere for walking, etc. If the berm is removed and the alternative is a wall-sound barrier, I support the idea of a living wall over other materials.
- this is a sound idea with many benefits
- I would like to see evergreen material as well as some plants that produce color in the winter to keep it beautiful year round - as recommended by the work of Winter City Edmonton. I would also hope that pollinator-supporting plants are used as part of the naturalization efforts. To be clear, I support the living wall in whatever format it takes - would just like to think about its function year round. I would also like if the pedestrian access was done like a Chinese garden,

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while recognizing that CPTED may wish for something else. I would prefer the illusion of continuous plant life rather than visible holes in the wall.

- any increase in pervious surfaces is a good thing in my book. the wooden/concrete walls that shut off many of the city's newer neighbourhoods are an eyesore.
- Need for more noise barriers for communities near Anthony henday.
- I understand that the primary purpose of the living wall is as a sound barrier, but it might be interesting to incorporate more species diversity into the structure. Rather than one uniform wall using only one species, a mix of appropriate species with varied characteristics would enhance the aesthetics of the structure.
- It still seems very early for the living wall, but I was impressed with it when I finally walked over to see it October 30, 2015. Two key considerations will be how easy it is to maintain water to the wall as willows do like water, and how the wall fares over Edmonton winters.
- Would consider support if there was more study done before hand. "Evaluation Period The living wall will be in place by December 2014 and through the next four seasons, observed and tested. Evaluation will include gathering input from the community about their own observations and views. A final decision about keeping the wall and extending it north to Whitemud Drive will be made in 2015." How can a decision be made when the project hasn't even been in place for one year.
- - would love to see the City using organic material and low maintenance plants as 'walls' and living ground cover on boulevards in place of high maintenance grass which gets ratty looking and weedy
- An excellent option to ugly solid berm walls - it would make the city an even greener and more beautiful place!
- I would like to see this used everywhere, not just the current proposed location.
- What is the maintenance? Will a living wall need to be trimmed and shaped? What will happen if we get a dry spring, summer, and/or fall?
- It would also be great to explore options that also have flowers and plant material that change colours during the peak growing periods to make the walls more visually appealing and for the opportunity to add patterns.
- I am very pro using more natural environments to enhance our neighborhoods. Having lived near the Whitemud Freeway for the past several years, I feel a living wall would be very beneficial and superior to the wall which is there now.

Q10. Where do you live?

	Total
Total	192
1 Tweddle Place	5%
2 Leefield	1%
3 Michael's Park	0%
4 Richfield	3%
5 Another neighbourhood in Edmonton	81%
7 Other:	11%



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Other neighbourhoods identified:

Greenview, Millwoods, village, Kameyosek, Woodbridge, Youville Drive East, Cromdale, Silverberry, Millwoods, Athlone, Argyll neighbourhood, Woodhaven, Silverberry, Bonnie Doon, Walker, Central McDougall, Charlesworth 50 Street SW, Sakaw, Lymburn, Pollard Meadows, Riverbend, Woodvale

Q11. Are you...?

		Total
Total		192
1	Male	34%
2	Female	62%
3	Other	0%
4	I prefer not to answer	4%

Q12. What is your age group?

		Total
Total		192
1	Under 18 years of age	0%
2	"18-34"	36%
3	"35-49"	27%
4	"50-64"	26%
5	65+	6%
6	I prefer not to answer	5%



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Appendix B. Detailed Cost Data.

Sound Barrier Type	Height (m)	Unit Cost (low)	Unit Cost (high)	Unit	Converted Cost (Low, \$/m)	Converted Cost (High, \$/m)	Cost Notes	Source
Acrylic	5	6000		NZ\$/m	5,520	-	supply & install, design? - 2012	New Zealand Transport Agency, http://acoustics.nzta.govt.nz/noise-barrier-design-guide
Average	4.3	53		US\$/ft ²	3,335	-	supply & install	Washington State Department of Transportation website, http://www.wsdot.wa.gov/Environment/Air/NoiseFAQ.htm
Berm	2.7 to 3.7	6		US\$/ft ²	283		supply & install, 2010\$	US. Department of Transportation, Federal Highway Administration, http://www.fhwa.dot.gov/environment/noise/noise_barriers/inventory/summary/stable712.cfm
Block	2.7 to 3.4	26		US\$/ft ²	1,150		supply & install, 2010\$	US. Department of Transportation, Federal Highway Administration, http://www.fhwa.dot.gov/environment/noise/noise_barriers/inventory/summary/stable712.cfm
Brick	2.7 to 3.8	36		US\$/ft ²	1,725		supply & install, 2010\$	US. Department of Transportation, Federal Highway Administration, http://www.fhwa.dot.gov/environment/noise/noise_barriers/inventory/summary/stable712.cfm
Combination	2.7 to 3.9	23		US\$/ft ²	1,119		supply & install, 2010\$	US. Department of Transportation, Federal Highway Administration, http://www.fhwa.dot.gov/environment/noise/noise_barriers/inventory/summary/stable712.cfm
Concrete	1.8	1500	2000	\$/l.m.	1,500	2000	supply & install, 2015\$	City of Edmonton Transportation Services, personal communications with Maida Zederayko, Senior Transportation Engineer
Concrete	4.6	25	45	US\$/ft ²	1,686	3,034	supply & install	Eco Sound Barrier website, http://www.ecosoundbarrier.com/Projects-Gallery.html
Concrete	3	1100		NZ\$/m	1,012		supply & install, design? - 2011	New Zealand Transport Agency, http://acoustics.nzta.govt.nz/noise-barrier-design-guide



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Sound Barrier Type	Height (m)	Unit Cost (low)	Unit Cost (high)	Unit	Converted Cost (Low, \$/m)	Converted Cost (High, \$/m)	Cost Notes	Source
Concrete	2.7 to 3.3	31		US\$/ft ²	1,371		supply & install, 2010\$	US. Department of Transportation, Federal Highway Administration, http://www.fhwa.dot.gov/environment/noise/noise_barriers/inventory/summary/stable712.cfm
Earth/concrete combination	4.5	1538		\$/m	1,538		supply & install, 2010\$	"The Design and Construction of a Noise Barrier Along the Vanier Highway in Fredericton," Don Good and Dave Hallden. 2012 Conference of the Transportation Association of Canada, Fredericton, NB, http://conf.tac-atc.ca/english/annualconference/tac2012/docs/session21/good.pdf
Engineered Plywood	3	1000		NZ\$/m	920		supply & install, design? - 2011	New Zealand Transport Agency, http://acoustics.nzta.govt.nz/noise-barrier-design-guide
Living Wall	3	1100	1500	\$/l.m.	1100	1,500	supply & install, 2014\$	The Living Wall Inc.
Metal	2.7 to 3.6	26		US\$/ft ²	1,208		supply & install, 2010\$	US. Department of Transportation, Federal Highway Administration, http://www.fhwa.dot.gov/environment/noise/noise_barriers/inventory/summary/stable712.cfm
Other	1.5 to 3.6	480	2000	NZ\$/m	442	1,840	supply & install, design? - 2011	New Zealand Transport Agency, http://acoustics.nzta.govt.nz/noise-barrier-design-guide
Polymer composite	4.6	10	15	US\$/ft ²	674	1,011	supply & install	Eco Sound Barrier website, http://www.ecosoundbarrier.com/Projects-Gallery.html
Timber	3	600		NZ\$/m	552		supply & install, design? - 2011	New Zealand Transport Agency, http://acoustics.nzta.govt.nz/noise-barrier-design-guide
Wood	2.7 to 3.5	19		US\$/ft ²	869		supply & install, 2010\$	US. Department of Transportation, Federal Highway Administration, http://www.fhwa.dot.gov/environment/noise/noise_barriers/inventory/summary/stable712.cfm



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Sound Barrier Type	Height (m)	Unit Cost (low)	Unit Cost (high)	Unit	Converted Cost (Low, \$/m)	Converted Cost (High, \$/m)	Cost Notes	Source
Wood panel	3	1427		\$/m	1,427		supply & install, 2012\$	British Columbia Ministry of Transportation and Infrastructure Construction and Rehabilitation Cost Guide, July 2012, https://www.th.gov.bc.ca/Publications/const_maint/Cost_Guide_July2012.pdf

*Used exchange rate of 1 USD/1.37 CDN, from XE Currency Converter, accessed February 4, 2016

*Used exchange rate of 1 NZD/0.92 CDN, from XE Currency Converter, accessed February 4, 2016