

CALGARY PUBLIC ART DESIGN CONSIDERATIONS FOR ARTISTS



Wishing Well by Living Lenses, 2012

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Introduction

The longevity of artworks depends on many things including design, material selection, craftsmanship, the environment in which the artwork is situated and the activities taking place within its setting. This document aims to support the design of artworks to be built to last for the duration of their intended lifespans.

The intention of this guide is to help familiarize artists and their teams with general design considerations that must be taken into account when fabricating and installing artworks in public spaces and the Calgary environment. The considerations listed in this document are not comprehensive – artworks have a tendency to push boundaries and instigate new sets of considerations that need to be accounted for.

It's also important to state that the contents of this document are considerations only: this is not a list of design requirement specifications and the considerations discussed in this guide do not replace or attempt to cover regulatory codes and standards (such as the National Building Code) that apply to the construction of the artwork. Because each artwork is unique, it would be impossible to create a comprehensive list of specifications all artworks must follow. However, it should be expected that design requirements specific to the artwork will be stipulated by various technical reviewers during the detailed design phase of the artwork's development.

This document is meant to serve as a reference guide that artists may use while exploring and refining their concepts and early stages of design. In addition to using this document to better understand the risks that are likely to challenge the artwork's durability and longevity, artists can refer to relevant sections when contemplating the use of different materials or if

wanting to learn more about them. It's hoped that this guide will also provide artists with the language and context to support their conversations with fabricators, engineers, and conservators around artwork design and fabrication.

The guide begins with sections that cover the general challenges and deterioration risks at play in the public realm that the artwork will need to withstand. These include environmental factors, impacts of public interactions, restrictions from site operations and maintenance requirements. Next, the guide discusses high-level design choices and how things like form, construction and material interactions within a piece can create inherent vulnerabilities that impact its resilience. It then dives into more detailed considerations around different materials commonly used in public artworks and highlights forms of deterioration specific to those materials. The following section is a discussion of the considerations that apply to ephemeral artworks, such as performance or social practice art, and approaches to their preservation through documentation. Finally, the guide finishes by discussing the Calgary Public Art Collection, its objectives and the implications of artworks being acquired into the collection. This document will be regularly updated to reflect new and changing technologies, materials, and approach to artwork design.

Public artworks are often complex and multifaceted, and therefore numerous sections of this guide will likely be relevant to any single artwork. An installation may have both physical and ephemeral elements and may also incorporate time-based media such as lighting

or software. Artists are encouraged to think about all components of their piece and how they are situated within the fundamentality of artwork. Finally, please keep in mind that this guide is only meant to be a reference point; artists are not expected to become the expert

on every material considered for their work. The City's conservation team, as well as relevant consulting subject matter experts, will be available as resources throughout the design process to support you in the development of your artwork.

Other City of Calgary design requirement documents

Please note that the City of Calgary has numerous other Design Guidelines and Requirements in specific areas that may apply to your project. These may include (but are not limited to):

- Advisory Committee on Accessibility - Access Design Guidelines
- Calgary Climate Resilience Strategy
- The Sustainable Building Policy and Guidance Document
- Design Guidelines for City of Calgary Funded Buildings
- Calgary Transit - Transit-Friendly Design Guide (for site layout and building access)
- Calgary Parks – Development Guidelines and Standard Specifications: Landscape Construction
- Calgary Parks - Urban Forestry Plan
- Calgary Parks - Our BiodiverCity
- Planning and Development – Centre City Urban Design Guidelines
- Planning and Development – Bird Friendly Urban Design Guidelines
- Planning and Development – Centre City Illumination Guidelines
- Roads – Standard Specifications Road Construction
- Physical Security Standard and Security Standard

Physical artworks



Hawk Hill Calgary Sentinels by Beverly Pepper, 2013
Photo courtesy Carlos Amat



Below/Before/Between by Jill Anholt, 2022

1. Site/location, environment and maintenance

Artists need to consider the requirements for building in Calgary's unique climate. Our proximity to the mountains has a dramatic impact on our climate and results in Chinook winds known to raise winter temperatures by up to 20°C (36°F) in just a few hours. While our winters can be uncomfortably cold (often dropping to -15/-20°C (5°F/-4°F) in the coldest months with wind chill values as low as -40°C (-40°F), we are also one of the sunniest cities in Canada with droughts being a relatively common occurrence. Artworks need to be able to withstand the frequent freeze and thaw cycles associated with this climate. While our prairie summers can be hot and dry, we frequently experience severe thunderstorms, high winds, and heavy hail events during the summer months. Artists should not underestimate the negative impact of our rapidly changing climate on their artworks. Aside from adverse weather, artists should consider how sunlight and industrial pollution might impact the artwork.

When developing artwork for urban spaces, it's also critical to consider the function of the artwork's site, how the public uses the space

and the City operations that regularly support that site. The nature of the site will impose a maximum limit to the operational impact an artwork can create. This maximum operational impact should be considered an integral part of the design brief when designing an artwork for a site. For instance, if designing an artwork that is to be integrated with a bridge or structure and City operations needs to do annual volume washing of that structure to keep it clean, then the artwork should not impede access to the surrounding area for cleaning and should be designed to withstand this type of washing without damage. City subject matter experts will be made available early on in the design process to provide the artist with information about the operational requirements of the chosen site.

As well, it's important to consider how the maintenance features of the site, such as snow removal, ice melt, gravel, salt, fertilizer or landscaping, can pose deterioration risks to the artwork. Many of these risks as well as considerations about how they can be mitigated are outlined below.

1.1 Environmental considerations

- How will changes in temperature impact the artwork? Are components rated for Calgary's high and low temperature extremes? Will any components undergo thermal expansion? Will any materials or seals deteriorate at higher temperature, or become brittle and fragile at lower temperatures?
- Have water and condensation management considerations been addressed to avoid pooling and/or ingress of water, condensation and humidity?
- Does the site have vegetation, trees, etc. that grow close to or above the artwork? Will falling vegetative debris accumulate on the artwork? Will birds gather in trees above the work resulting in heavier bird droppings or nesting? Will vegetative growth impede visibility of the artwork? Is bio-growth on the surface of the artwork a concern?
- Will the materials and their hardware attachments be robust enough to withstand the impacts of heavy hail and the dynamic loads of high winds?
- Will the artwork require grounding to protect it in the event of lightning strikes?
- What measures will be required to protect porous materials (such as concrete, grout and stone) from damage due to freeze-thaw cycles?
- Will the artwork be exposed to heavy de-icing salts? Are additional protective measures required to protect it from salt damage such as corrosion or cracking/erosion/spalling?
- Will the artwork's materials and surfaces be vulnerable to soiling, staining or deterioration from industrial pollution?
- How will the artwork fare under intense sunlight? Will it be resistant to fading? Will the artwork create reflective glare or thermal issues?

1.2 Site challenges

- Are there functional requirements of the site that the artwork needs to comply with?
- Will the artwork be located next to traffic? Will it be at risk of impact? Will it be exposed to elevated levels of soiling and pollution?
- Are there clearance requirements to consider when designing the artwork, such as pedestrian accessibility requirements or proximities to adjacent buildings or structures?
- Will insects, birds, rodents or pets have an impact on this work?
- Does the site pose challenges for installing the artwork? Does the design of the artwork need to adapt in order to facilitate installation? Will road closures be required?
- Is there sufficient lighting to see the artwork at night? Is there enough lighting for the site to feel safer for viewers? Does new lighting need to be incorporated into the project? Is there existing infrastructure at the site to support it?
- Are there any anticipated or possible changes to the site (or adjacent to it) that will occur in the future? (E.g. new developments, construction, renovations, change of site use, etc.) How will these changes impact the artwork?

1.3 Site operations

- What type of snow removal is done at the artwork's location? Will the artwork's placement impede regular snow removal operations? Will snow removal equipment be used that could damage the artwork? Does the artwork require a low plinth or base to protect it from this type of equipment?
- Is there regular landscaping work that occurs at the site, such as lawn mowing, weed trimming or maintenance of garden beds? Could landscaping equipment damage the artwork (e.g. impacts, iron corrosion staining?) Do protections need to be in place to prevent this damage?
- Are fertilizers regularly used on garden beds or lawns around the artwork? Does the artwork have metal components that will corrode or tarnish when exposed to these fertilizers?
- Is the site irrigated by sprinklers? Will the artwork be located in the path of any sprinklers, and if so, how will this impact the artwork?
- Will the artwork impede access to the site required by City staff or other stakeholders? For instance, does associated infrastructure require regular inspection? Do facility crews require access to the site or to utilities located beneath it? Does the artwork design need to account for these access requirements?

1.4 Ease of artwork maintenance

The anticipated maintenance needs of the artwork needs to be carefully considered to ensure that there are sufficient resources available to keep the artwork in its desired condition and/or operational. The City of Calgary's conservation and maintenance team and resources need to support over 1,400 artworks in the Public Art Collection. The maintenance needs of individual artworks must

be relatively minimal in order to sustain the condition and accessibility of the collection as a whole for Calgarians. City conservators will be available throughout the design process to support these discussions.

Some considerations to ensure any necessary maintenance work is feasible include:

- Ease of access for maintenance. Wherever possible, maintenance of the artwork shouldn't require lane closures. If in a park, is there a route to access the artwork for maintenance without causing any damage to the landscape?
- Is there sufficient easement to access the artwork with the equipment necessary for maintenance, such as a City vehicle or an aerial lift? Is the terrain or floor around or below the artwork level, allowing for safe access via lift, ladder or scaffold?
- Access to water – is there a water source nearby, such as a turf valve? Keep in mind the limitations of hose length required for washing. Ideally, a water access point should be available within 100 feet of the artwork.
- If there are plantings incorporated with the artwork, are they relatively self-sustaining in the Calgary climate? Can maintenance be done to the artwork without harming the plantings?
- If there are interior features within the artwork (such as lighting or controls), are there access panels that will facilitate maintenance without the need for artwork disassembly or special equipment?
- If there are fittings that require regular greasing, are they within relatively easy reach?
- If there are any special tools or equipment required for maintenance, is there somewhere to safely store them on-site (such as in a nearby utility room)?



Public Art Associate Conservator Camille Lafrance removing graffiti from a public artwork.

2. Public interaction

It's important to anticipate how the public will interact with the artwork, in both positive and negative ways. The public can cause damage to the artwork whether it's intentional, via acts of vandalism or graffiti, or unintentional through actions like touching, climbing or swinging. The artwork must be designed to resist physical and chemical stresses brought on by these interactions. The artwork must also be safe for a broad spectrum of public uses, whether they are sanctioned or not. For example, this means that the artwork needs to be safe for climbing, even if climbing is discouraged.

2.1 Graffiti and vandalism

- Does the artwork design attract graffiti in any way? For example, do any of its components act as “blank canvas” for tagging?
- Are there elements of the artwork that may be attractive for theft? (E.g. small components that can be unscrewed or easily cut off, expensive materials, etc.)
- Is the site already prone to graffiti?
- Is the site isolated? Is there ample lighting and security at the site to discourage graffiti and vandalism?
- Consider the resistance of the artwork and its materials to both graffiti and graffiti removal methods. Is the artwork and its coatings resistant to solvents? Pressure washing? Are any of the artwork's components susceptible to scratched graffiti? Are any of its surfaces porous, making it prone to staining?
- Is the artwork designed to be robust enough to withstand intentional physical impacts, including jumping, pulling, bending, scratching or hitting with heavy implements?
- Are hardware connections designed to be tamper-resistant?

2.2 Impact on patterns of public use

- Does the artwork and/or its placement on the site align with the City's [Access Design Standards](#) and the Alberta Building Code's requirements for barrier-free design?
- While scoping the potential site, can you deduce if and how the greater public uses the space already? Would the placement and/or design of the artwork complement, hinder or completely obstruct the previous use? Expect the current patterns of public usage of the space to continue following the installation of the artwork and consider the usage of the site as you contemplate your design.
- Does the site have signs of walking shortcuts or "desire lines" (public-created paths)?
- Is the site a gathering place for socializing already? Is it a popular photo spot? How to you anticipate these forms of public gathering will interact with the artwork once installed (e.g. Will climbing be more likely? Will landscaping be worn/trampled? Will garbage or food spills be left behind on the artwork?)?
- Is there heavy pedestrian traffic across the site? What destinations are nearby that could influence the type and frequency of pedestrian traffic?
- Is the site popular with skating, BMX, biking and other sports groups? The surroundings usually show evidence of some of these uses, for example black skid marks and abrasions on low-grade structures like garden boxes or benches. Also consider the rise in popularity of e-scooters, and whether the site is or may become a popular spot to park them.

2.3 Skateboarding/biking/rollerblading

- Does the design of the artwork invite skaters, BMXers or rollerblades to use it as a prop? Continuous, smooth and low-grade surfaces are easily used as slides for tricks. Smooth, paved areas adjacent to the artwork allow for easy take-off and landing, making the artwork more appealing for tricks.
- Is the grade of the artwork and other components (for example plinths and plaques) low enough to be hit by biking pedals by accident or to be hopped on while rollerblading, skateboarding or similar?
- Skate deterrents are a common mitigation tactic. Can skate deterrents be incorporated to the artwork surfaces that may be attractive for skaters? Consider size and spacing of the deterrents, as well as the way they will be anchored to the artwork (for example, welded or bolted deterrents are longer-lasting and more effective than deterrents added with adhesives). Work with subject matter experts (such as contacts in the skateboarding or BMX community) to ensure the design of the deterrents will be effective.
- Adding skate deterrents should be used a secondary means of defense. First consider if there is a design solution that will make the artwork less appealing to skateboarders/bikers/rollerbladers. Think about the slope, height, and surface texture of components and what parameters would be needed to make the artwork difficult to skateboard or bike on. Consider also creating restrictions that inhibit take-off and landing.

2.4 Public safety

- Will the artwork create any form of barrier that could impede a safe pathway of travel? Refer to the City's Access Design Standards and the Alberta Building Code's Barrier-Free Design guide to ensure you are designing a space that can be accessed safely by all members of the public.
- Are there sharp edges or points that could scratch members of the public or catch on clothing?
- Will any surfaces of the artwork be walked upon, and if so, are the materials slip resistant?
- Does the artwork encourage climbing or can any of its elements be used as steps? How can this access be discouraged or changed?
- Is the artwork strong enough to withstand members of the public climbing, jumping or swaying on it? You'll need to account for the fact that these are dynamic loads, which have both mass and inertia and therefore represent a greater magnitude of force when imposed upon the artwork.
- Can you identify any elements in the artwork that could be hanging hazards?
- Are elements of the artwork protruding at a height where they can act as an overhead hazard?
- Does the artwork incorporate reflective surfaces that can create glare or overheating hazards?
- Does the artwork, its scale or placement, create hidden or out-of-sight spaces that can attract illegal or disruptive activities?
- Is the artwork and its site well-lit, improving the safety of the area at night?
- If the artwork has any integrated components that are intended to be walked on, does the surface offer safe traction in all weather conditions? Is the surface easy to walk on for adults, children and pets? Is the surface a safe and easy pathway of travel for those with vision impairment or for those using wheelchairs or other mobility devices?
- Could any component of the artwork cause distress to a person with sensory sensitivities? For instance, light components should not involve flashing at a frequency greater than three flashes per second. Static or moving striping patterns of alternating dark and bright stripes can also create problems for individuals with photosensitivity conditions.



Outflow (detail) by Brian Tolle, 2014

3. How it's made – Impacts of artwork design

3.1 Avoiding inherent vulnerabilities

Material choices are not the only factors that impact an artwork's durability and resilience. The design of the artwork – meaning its shape, structure and how material components are used and put together – will also affect the stability of the artwork and whether it will last for its intended lifespan. For instance, sometimes the failure of a material will be uniquely due to its specific use within the artwork. In these cases, deterioration is considered a result of an inherent vulnerability within the artwork's design.

It's also important to consider upfront the budgetary pressure that may be placed on the design as the project proceeds. It's advised that an artwork's design should be scalable, meaning it can be adjusted (in scale or ambition) to accommodate the costs of materials and construction methods required for a safe and durable result. If the budget gets tight, it's important not to sacrifice on material choices and quality that are essential for the artwork's resistance to deterioration and ease

of maintenance. These cuts will only result in greater costs later on in the life of the artwork and can cause the artwork to sustain damage or age in a way that you are not comfortable with. It's much easier and more cost effective to put initial measures in place to prevent deterioration than to rectify it after it occurs. In creating an initial design that is scalable, you'll be more likely to be satisfied with the end result, rather than feel that your artwork was compromised due to budgetary constraints.

Considerations around design choices and how materials are used and put together will impact the physical stability and durability of an artwork, as well as its aesthetic qualities as the artwork ages. Some high-level examples of considerations around inherent vulnerabilities include:

- Positioning on the site: setbacks, impact risks, etc.
- Does the design feature any seams, joints or narrow gaps that may be weak or vulnerable under regular/repeated stress or as they age over time?

- Will the artwork require significant energy or resources to operate? Will those resources always be readily available?
- Does the design encourage pooling of water, debris or soiling in any areas? How can the design be adapted to prevent this or to facilitate drainage? Will drainage routes create aesthetic issues or damage, such as staining or erosion?
- Are there cavities, voids, or hollow areas that may be susceptible to moisture condensation? Will ventilation strategies be necessary?
- If the artwork includes lighting components, will the lights be set to a timer or a solar sensor to ensure they come on according to natural daylight cycles/changes? Are fixtures set up to be independent of one another, or would a single outage cause a string of outages?
- Are the materials being used compatible with one another? Considerations around material interactions are elaborated on in section 3.2 below.

3.2 Material interactions

Many inherent vulnerabilities are a result of incompatibilities between adjacent materials within the structure of the artwork. Some of the key forms of these incompatibilities include:

3.2.1 Galvanic corrosion

One of the major causes of deterioration of artworks with metal components is galvanic corrosion. This occurs when two dissimilar metals are placed in direct contact with one another. The metal that is more resistant to corrosion (the more “noble” metal) will cause the less resistant (or less “noble”) metal to corrode at a faster rate. Whenever possible, dissimilar metals should not be used in direct contact with one another. In situations where this is unavoidable (such as a steel armature within a bronze sculpture, or the use of stainless steel bolting hardware to secure an artwork primarily

built of another metal), barrier layers must be used to separate the two metals. Examples of barrier layers include coating systems as well as neoprene gaskets used to separate stainless steel bolts from the substrate metal.

A side-effect of corrosion is the staining of adjacent porous materials used in your artwork. Stone, concrete and masonry work can suffer extensive aesthetic disfiguring corrosion staining if situated beneath or next to a metal element. This risk can be mitigated by carefully controlling water shedding and drainage throughout the artwork, by protecting the metal elements from corrosion through material choice and protective coatings, and in some cases through appropriate protective coatings of the porous material.

3.2.2 Differential thermal expansion

Nearly all materials react to changes in temperature through dimensional change. Materials with different chemical and physical properties will expand and contract to different degrees and at different rates. Even an individual material may respond differently to temperature change based on its thickness. When using materials together, it’s important to account for their anticipated movement as they warm and cool, as differing thermal expansion can cause stress at joints and connection points, sometimes resulting in damage. Examples of damage can include:

- Cracking of welds: considerable physical stress can be placed on joints if the connecting metal bodies expand at different rates.
- Failure of seals: a sealant connecting two different materials must be flexible enough sustain the movement and to bridge the gaps resulting from differing thermal expansion.
- Coating failure: coatings that cover multiple materials can crack, blister and peel due to the expansion and contraction of those materials as they warm and cool.

3.2.3 Differential reaction to moisture and freeze-thaw cycles

Similar to thermal expansion discussed above, some materials will expand and contract as the moisture content within them changes. This dimensional change needs to be accounted for when materials are used adjacent to one another. For example, if wood is used in such a way that it is set tightly or restricted by another material (such as concrete or metal), its inability to expand in its natural direction when wet could result in undesirable warping as it is forced to expand in another direction. Another example is coated materials; coating systems on wood are subject to blistering and peeling if the wood takes up moisture that then cannot escape via evaporation.

Although the significance of freeze-thaw cycles will be discussed in more detail under specific material sections below, it is important to also note here that the impacts of freeze-thaw on individual materials can have knock-on effects upon other components of the artwork. Examples of this include:

- Structural and non-structural cracking of artwork materials (e.g. concrete) from settling when an artwork's footings or site grading/drainage is insufficient to prevent settling and shifting due freeze-thaw cycles of the ground.
- Freeze-thaw expansion of concrete poured within the hollows of metal sculptures, causing the metal to fracture.
- Coating failure if moisture is trapped between the coating and the substrate and expands upon freezing.
- Loss of glazes from ceramic substrates when the ceramic body is subject to freeze-thaw damage, or when moisture is trapped between the ceramic and the glaze and expands upon freezing.
- Loss of glass mosaic tiles if the mosaic's grout or mortar experiences damage from freeze-thaw expansion.

3.2.4 Differing material strengths and other physical properties

Combining materials of different strengths and/or degrees of flexibility can also create tension on joints and bonding. This is particularly relevant to stonework, where the use of an overly high-strength mortar relative to the strength of the substrate stones can cause the stones to deteriorate more readily. It can also be a source of adhesion incompatibilities. For instance, if a relatively brittle material, such as certain epoxy resins, is cast within a more flexible material like aluminum, cracking and adhesive failure at the interface between the two materials is likely to develop over time (and worsen as water begins to penetrate these gaps). Differences in material strength and flexibility are exacerbated in the public art environment, as the materials are subject to dynamic forces such as wind, vibration or human activity.



Dale Hodges Park by Sans façon, 2019. Photo courtesy Wilco Contractors Southwest

4. Sustainability considerations

It's increasingly necessary to consider the carbon footprint of artwork development as well as the environmental impacts artworks may have in the social and physical ecologies of their sites.

The City of Calgary has committed to reach net zero by 2050 through its Climate Implementation Plan. Among many methods of reducing The City's greenhouse gas emissions, this plan also details actions to make all new infrastructure climate resilient, reduce waste, preserve and build natural infrastructure, reduce risks of environmental disasters and enhance community climate resilience. The City also has a Sustainable Building Policy, which includes a guidance document that provides an overview of how this policy can be applied to projects. Please see the further resources section at the end of this document to refer to these policies and guidelines in more detail.

While written for the design and construction of buildings, The City's Sustainability Policy's sustainability principles can also be applied to the development of other infrastructure, including artworks.

The City of Calgary Sustainability Policy's Sustainability Principles:

- Optimize for energy efficiency and conservation, specifically through passive design, thereby reducing and avoiding GHG emissions.
- Reduce potable water use through conservation and efficiency measures.
- Encourage the integration of green stormwater infrastructure.
- Maintain and improve biodiversity.
- Address occupant comfort, provide access, and maintain social wellbeing in design and operations.
- Select sites that have access to alternative transportation and consider the impact of site selection on the environment, people and the building.
- Design for resilience to changing economic, social and environmental conditions.
- Divert waste from landfills during construction, occupancy and demolition.

4.1 Life cycle assessment and project planning

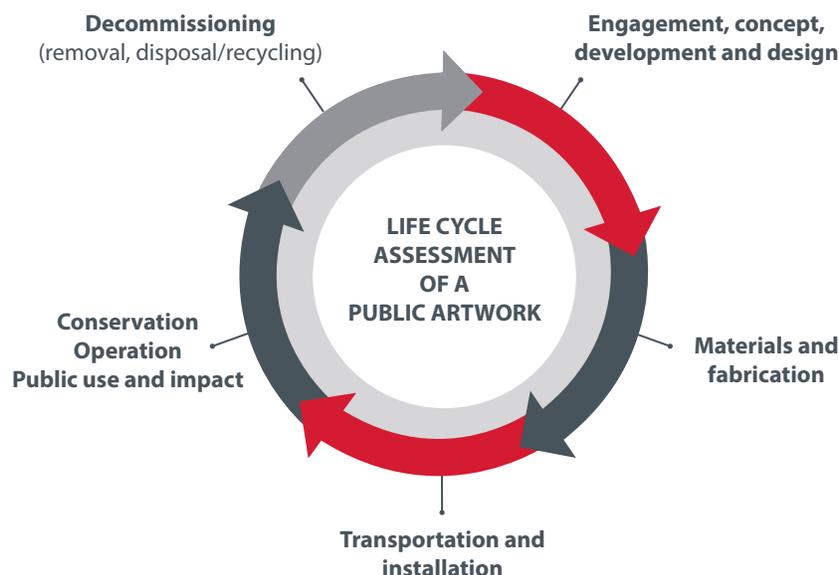
A life cycle assessment is a process undertaken to evaluate the environmental impact of a product or project over the course of its development and lifespan. This tool can be applied during the project planning of your artwork to identify opportunities to reduce or offset the artwork's overall carbon footprint and improve its environmental impact. Consider the footprint of activities and materials that will be involved at all different stages of the artwork's development from start to finish (engagement, concept, design, fabrication, installation) as well as the environmental impacts of the resulting artwork (energy used to operate the artwork, environmental impacts the artwork has on its site, how the artwork is used by the public, artwork maintenance, artwork decommissioning). For example, can you offset any necessary negative climate impacts of the artwork's fabrication (such as the need to use steel) by implementing sustainability practices elsewhere in your project (such as eliminating the need for artist travel)?

Doing a life cycle assessment of the overarching project in this way will allow you to balance the impacts of your work and help you achieve an environmentally positive outcome.

4.2 Sustainable practices

While consideration of the physical artwork's environmental footprint is paramount, the holistic impact of your artistic practice in developing a public artwork should not be underestimated. Some practices to consider include:

- **Travel** – If you are not local to Calgary, consider how you can optimize your time here to minimize travel. Identify which aspects of the process are critical to take place in-person and what can be accomplished remotely. Locally, consider ways in which you can take advantage of public transport for yourself as well as for those you are working with (e.g. hosting engagement sessions at venues easily accessible by transit).
- **Engagement** – Consult with local community and do research to learn about the artwork site's natural history, ecosystem, and cultural significance. Practice reciprocity during community engagement so that your learning isn't extractive but rather works to build deeper relationships and understanding between yourself, the community, and the artwork.



- **Advocacy** – Public art can be a powerful platform to advocate for the environment, whether it be highlighting environmental concerns local to the artwork’s site or a broader statement about climate change. Think about ways that your community engagement, your promotion and discussion of your artwork and art practice, and the artwork itself can center or spawn conversations and thinking about environmental concerns and sustainability.

4.3 Sustainable design

It’s important to consider how the design of your artwork and any affiliated landscaping will impact its surrounding environment and how the public interacts with that space. Incorporating sustainable design practices into your work can have a powerful impact; potentially increasing local biodiversity, improving the liveability of an urban space or influencing social practices.

Some of the ways in which artwork design can impact the sustainability of its local environment include:

- Designing the artwork so that impacts to local biodiversity can be minimized during installation as well as over the artwork’s lifetime of public use.
- Sustaining or creating habitats by incorporating native plants and/or building safe spaces for wildlife.
- Utilizing drought resistant plantings to minimize or eliminate the need for irrigation.
- Incorporating bird-friendly design through strategic landscaping and patterning/artwork on glazing.
- Designing the artwork site to ensure it does not negatively impact drainage basins or contribute to excessive rainwater runoff.

- Create shaded areas and/or adopt passive cooling strategies to help cool urban spaces.
- Influencing sustainable social practices within the public, such as encouraging public transit use or inspiring walking.

The City of Calgary has a Sustainability Building Policy that outlines specific requirements around Stormwater management, Responsible Landscaping, and Multimodal Accessibility that may be applicable to your artwork. In addition, The City has a 10-year biodiversity strategic plan and several policies in place to support biodiversity within urban spaces. Links to these policies can be found in the Further Resources section at the end of this document.

4.4 Materials, fabrication and installation

Whenever possible, materials with a lower carbon footprint should be selected for use in public artworks. The carbon footprint of materials is complex, as it includes the emissions associated with their production, post-production or refinement, transport, as well as afterlife (i.e. can they be recycled or repurposed).

There are a number of resources and tools available online that evaluate the carbon footprint of different materials. Some of these initiatives are specifically geared towards art materials and the materials used to transport, exhibit and conserve artworks, such as:

- [Sustainability Tools in Cultural Heritage \(STiCH\)](#)
- [Urban Art Project’s \(UAP\) Artwork Ingredient List initiative](#)
- [The Design Museum’s Exhibition Design Guide](#)

From the standpoint of material production alone, the following is a simplified summary of materials commonly used in public art and their comparative carbon footprints:

Comparative carbon footprint of the production of materials commonly used in public artworks			
High		Medium	Low
Concrete	Bronze	Glass	Timber
Aluminum	Fibreglass	Brick	Stone
Steel	Adhesives	Plywood	

However, considering emissions during material production is just one piece of the puzzle. In selecting materials for your artwork and how they are used, you'll want to consider the sum of all energy sequestered to produce, refine, transport and install the material within the artwork (the material's "embodied energy"). For example, stainless steel has a higher carbon footprint to produce than mild steel, but mild steel will require further treatments (paint coatings or hot dip galvanizing) to be made corrosion resistant and these come with their own greenhouse gas emissions. To assess the total footprint of a material in a specific application within an artwork, you'll also need to consider:

- Volume of the material required.
- Subsequent processing or treatments of the material that will be required and their respective carbon footprints.
- Transportation of the material: can it be sourced locally? If not, what is the carbon footprint of shipping the material?
- Production methods available that could reduce the carbon footprint of a material (e.g., incorporation of fly ash in the production of concrete or the use of recycled steel).
- Recyclability of the material: can off-cuts or scraps of the material be re-cycled or re-purposed?

Decisions during fabrication can also have an impact in reducing the carbon footprint of an artwork. Consider what methods can increase efficiency during fabrication to reduce the amount of material used or energy required to build or assemble the artwork. For example, computer or AI technologies used to map the cutting of materials can have a tremendous impact in minimizing waste.

For larger scale artworks, you'll also need to consider how you'll minimize the environmental impact during construction/installation. How can the natural biodiversity of the site be protected during the work? What types of equipment can you use to minimize emissions? And what measures could be put in place to minimize the waste produced on the construction site?

4.5 Lifespan, maintenance and decommissioning

When looking at the holistic environmental impact of an artwork through the lens of a life cycle assessment, the intended lifespan of the artwork is a central factor. Although the overall public impact of an artwork cannot be directly equated to the number of years it is in existence (even an ephemeral artwork can have a substantial social cultural effect), there should generally be a proportionality between an artwork's carbon footprint and its lifespan.

You'll need to consider whether the choice of materials is appropriate for the intended lifespan of the artwork. For an artwork with a longer intended lifespan, choosing higher quality materials – even if they have a higher initial production footprint – will likely result in a lower net carbon footprint of the overall artwork if they reduce the likelihood that the component will require repair or replacement. Conversely, if an artwork has a shorter intended lifespan, choosing materials that are too robust for that context will result in a higher net carbon footprint. For example, pouring concrete for a very temporary artwork would not be easily justified when evaluating the artwork's overall environmental impact.

You'll also want to consider the environmental impact of the artwork during its lifetime. This includes its operational requirements, such as:

- What amount of energy is required to power the artwork? How can this be minimized?
- For software-based artworks, what is the footprint of the artwork's data storage on remote servers?

As well as its maintenance and conservation needs:

- How much water will be consumed in washing or irrigating the artwork?
- What materials are required to maintain the artwork and are they sustainable? (E.g. are there specific coatings that require regular renewal, and how sustainable are they?)
- Are there elements of the artwork that require regular life cycling/replacement?

The final stage of a public artwork's life cycle assessment is its eventual decommissioning. Even for artworks that are intended to last for a very long time, it is useful to consider what will happen to them at the end of their life. Once it is time for an artwork to be decommissioned and removed, what impact will its removal process leave on the environment, and how can you minimize this impact during artwork design? Can you utilize materials that can be recycled or repurposed once the artwork is deinstalled? Regardless of the artwork's intended lifespan, you'll want to consider whether the artwork is leaving any environmental footprints behind and mitigate any negative impacts of these traces wherever possible.



Delta Garden + The City Unseen by Caitlind r.c. Brown and Wayne Garrett, 2018

5. Materials

The following considerations are intended to help you select materials that will help achieve your desired effect in the artwork over the long-term. While not an exhaustive list, consider this section as a resource you can consult as you develop your concept and design. Sections can be collapsed and expanded allowing you to filter to topics that apply to your artwork.

5.1 Murals

5.1.1 Selection and preparation of a wall

- Consider whether the mural will be within easy reach for graffiti. If within reach of graffiti, consider other factors that could help mitigate damage (good lighting, security, anti-graffiti coatings). See Section 5.3.4 below for considerations relating to anti-graffiti coatings.
- Are there any planned developments or changes to the wall's building or adjacent buildings anticipated in the future? Could they impact the mural during the duration of its intended lifespan?
- Inspect wall for signs of water problems, salt efflorescence, cracks and structural issues. Will any issues or repairs be addressed by the owner of the wall or do they need to be accounted for in the project budget? Do any repairs need to be addressed by a specialist, such as a qualified mason? Contact technical representatives of the products being used to ensure all repair materials will be compatible with primers and paints used for the mural. Will repair materials need to cure for a specific length of time before they can be painted over?
- If a new wall, consider the time required to wait for the substrate material to fully cure before priming and painting. This is particularly relevant to concrete, as efflorescence migrating out of the concrete can create an adhesion issue for applied primers and paints.

- If an old wall, could the substrate have any sensitivities? Historic substrates like sandstone or brick need to maintain higher levels of breathability (vapour permeability) to prevent deterioration of the wall. If creating a mural on a substrate of this kind, consider using mineral silicate paints, which are more suitable for older or heritage building substrates.
- Ensure the wall is clean and dry (with no lifting or unstable pre-existing paint) prior to priming and painting. Will the wall require detailed cleaning to prepare it for painting?
- It is recommended to prime the wall prior to painting. Primers are designed for a variety of purposes (sealing, stain blocking, adhesion, corrosion protection, etc.). What type of primer will be suitable for your wall?
- Consider installing flashing or a drip edge along the top of the mural to prevent water from running down the face of the artwork.

5.1.2 Murals on panels

- Consider how the panel(s) can be mounted to the wall. What type of hardware will be required to create a robust mounting system, does it require an engineer to review? Is a Building Permit required? What type of mounting system does the building owner allow? If the panel mural is temporary, will the wall require patching once the panel(s) is removed? Who will do this work? Details of the mounting system will need to be reviewed as part of the detailed design process.
- When selecting a material to use for the panel(s), consider how you'll need it to physically perform.
- Does the mounting system available require that the panels are very light? If so, honeycomb aluminum panels may be a good option.
- Will the panel(s) be within reach of the public, and therefore need to be impact resistant? Consider harder materials like plywood or MDF.
- Will the exposure of the mural require the panel to be highly weather resistant? If using plywood, ensure you choose a marine grade plywood and/or one that is impregnated with a phenolic resin (such as Crezon Medium Density Overlaid (MDO) plywood).
- Will the exposure of the mural require that the panel(s) are sun/UV/heat resistant? Note that some materials (such as PVC board) can warp from heat due to high sun exposure.
- Be sure to work with manufacturer of the panels to discuss how to properly prepare the surface for paint.
- Allow space for ventilation and drainage between the wall and the panel(s).
- Consider installing flashing or a drip edge above the top of the panel to prevent water from running down the face of the artwork.
- Where applicable, seal any gaps between the panels and the frame/mounting system with silicone or UV-stable, flexible polyurethane caulking (rated for outdoors).

5.1.3 Paint materials for murals

- Prime with an appropriate primer for the substrate.
- For acrylic paints, Zinsser Bull's Eye 123 or Benjamin Moore Start are good primer options. Note that these are water-based primers and won't seal water stains, smoke damage, water-based inks or mold/mildew.
- If preparing a wood surface, a minimum of two coats of acrylic gesso is recommended to prepare the surface.
- If painting on masonry, ensure you use a primer designated for exterior masonry.
- Follow all primer and paint manufacturers' application instructions carefully.
- Ensure all paints selected are compatible with your substrate, primer and each other.
- For outdoor murals, select paints that contain UV inhibitors and are mold/mildew resistant.
- Household/commercial exterior paint tends to be the easiest and most budget-friendly option for paint, but choose the highest quality possible. If the budget allows, consider using artist paints specifically designed for outdoor murals (such as Nova Color Paint).
- If using artist's paints for an exterior location, add a medium that will offer better durability outdoors (such as Golden Acrylics modified with GAC 200 acrylic extender).

5.1.4 Murals on pavement

Artworks painted on pavement require special permits and approvals from The City of Calgary's Roads traffic division. These artwork initiatives are very temporary in nature, as only water-based household paint is permitted for use in this application. Please reference The City's [Paint the Pavement Program](#) and guidelines for full details.

5.2 Objects and structures

5.2.1 Metals

This is an extremely broad class of materials that encompasses not only many different metals, but also their respective alloys. All of which have significantly different chemical and physical properties, and therefore come with their own sets of design considerations. This section is only meant to be a high-level introduction to some of the considerations at play around metal components of artworks. It is likely that more specific questions will emerge throughout the detailed design process as choices around metal selection and use begin to be made.

- Is the metal substrate corrosion resistant or will it depend upon a coating system for protection? Given the expected environmental stresses on the artwork and the anticipated levels of public interaction at the site, would a coating system provide adequate protection against corrosion in this case or would it be likely to fail?
- What alloy of your metal choice will offer the best corrosion resistance? Note that even stainless steels can be subject to corrosion and specific alloy requirements may be outlined during the detailed design process. Also consider where you'll source your metal materials from, as even high-spec alloys can be prone to corrosion if obtained from low-quality suppliers.

- De-icing salts significantly accelerate corrosion. Note that it's not only metal components in the lower regions of the sculpture are at risk of salt-exposure; roadway splatter and aerosolized salts can have corrosive effects on metals located even several stories above a roadway.
- What is the hardness of your metal choice? Are certain alloys more resistant to scratching? What thickness does the metal need to be to be resistant to impacts or other dynamic loads?
- One of the major causes of deterioration of artworks with metal components is galvanic corrosion. This occurs when two dissimilar metals are placed in direct contact with one another. The metal that is more resistant to corrosion (the more "noble" metal) will cause the less resistant (or less "noble") metal to corrode at a faster rate. Whenever possible, dissimilar metals should not be used in direct contact with one another. In situations where this is unavoidable, (such as a steel armature within a bronze sculpture, or the use of stainless steel bolting hardware to secure an artwork primarily built of another metal) barrier layers must be used (such as neoprene gaskets to separate stainless steel bolts from the substrate metal).
- Note that exposure to dissimilar metals can occur even temporarily throughout fabrication, transport and install and cause corrosion (e.g. steel strapping around stainless steel components during transport).
- Will the metal components be subject to thermal expansion and contraction? How does this impact the artwork structurally? How does this impact joints, seals and coating systems, and what measures can be taken to prevent issues?
- Any hollow sections of metal components could potentially trap water, which can result in corrosion problems and/or freeze thaw damage. If hollow metal components or pipe are being used in the artwork, consider where drainage holes will need to be installed to allow for water to escape.
- Are you working with a non-structural metal that will require an internal armature or structural reinforcement to meet the design requirements? If so, how will you ensure that the external metal and the internal structure are compatible? Consider connection points and how they could be impacted by different physical loads, differential thermal expansion and galvanic corrosion.
- How will the metal surface be finished to achieve the desired aesthetic effect of the artwork? How will the surface finish weather and resist corrosion, soiling and graffiti? (For instance, polished stainless steels are more resistant to spot corrosion than textured finishes).
- Will the metal surface become hot in the sun? If so, it may be necessary to use additional materials or coating systems as a barrier in areas of the artwork that will come in direct contact with skin (such as seats or ledges).

5.2.2 Concrete, stone and masonry

Porous materials like stone, concrete and masonry are prone to damage from freeze-thaw cycles (resulting in cracking, spalling and the development of internal voids), as well as damage from salt efflorescence (surface disintegration, delamination, blistering, spalling). Because of the highly cyclical temperatures Calgary experiences in the winter, as well as the prevalent use of de-icing salts, particular consideration should be made around the use and location of these materials.

- Consider the site: Pathways, plazas, and sidewalks are treated with high levels of de-icing salts. If your artwork incorporates stone, mosaic or masonry elements, consider raising them from ground level with a low concrete base or plinth to reduce salt exposure and absorption of salt water.
- Will melt water (which is often high in salt concentration) pool at the base of your artwork? Pooled water travels upwards into porous materials and causes damage. If the water contains dissolved salts, particular damage will be caused as the water evaporates out and salts crystalize. How can this be mitigated?
- Concrete, stone and masonry are susceptible to damage from biological growth. The growth of lichens and mosses can soften, erode and stain these porous substrates. They also retain more moisture at the surface, which can accelerate other forms of deterioration. Consider the environment of the site (Is it humid and damp? Does it receive much sun exposure? Do existing structures at the site suffer from bio-growth?) and assess whether biological growth could become a problem for the artwork. Consider ways you could minimize this risk through material selection (choosing a harder, smoother, less porous stone or concrete product), site drainage or through the application of a protective coating or sealant.
- Air pollution is a significant deterioration factor for stone, concrete, and masonry materials. Pollution can result in heavy soiling and staining of their porous surfaces, but can also cause more significant forms of chemical deterioration. If your artwork site is subject to heavy pollution (perhaps through heavy vehicle traffic or adjacent industrial activity), you may wish to consider selecting materials that are more resistant to these forms of chemical deterioration.

5.2.2.1 Concrete

- New concrete contains water soluble salts that will migrate to the surface with water when it evaporates slowly to the surface. This results in white, powdery efflorescence forming on the surface. Consider material choice and quality control measures that can minimize this, such as controlled moisture content during mixing, fly ash content, proper curing and use of sealers. Also consider site and installation considerations that can help mitigate the formation of efflorescence, such as site drainage, flashing or the creation of strategic gaps between the artwork and the road or sidewalk.
- Concrete typically requires structural reinforcement via embedded reinforcing steel (e.g. rebar). If this steel corrodes, it expands and can cause cracking and spalling of the concrete, in addition to visually unappealing corrosion staining. When designing concrete components, you'll need to consider steel embedment depth and steel type to meet all applicable codes and to prevent this type of deterioration.

- Glass Fibre Reinforced Concrete (GFRC) can be a lightweight alternative in some pre-cast applications, particularly when a thinner or more decorative product is desired. It uses alkaline resistant glass fibres to reinforce the concrete, generally removing the need for embedded steel reinforcement.

Note that GFRC mixes are often proprietary and limited information is made available about their mixes. This lack of information can be a challenge down the road if repairs or patches are required, so it is important to provide documentation of the brand and supplier of the GFRC mix in the maintenance or stewardship manual.

- Cast-in-place concrete inevitably shrinks as it dries and cures. Consider whether shrinkage cracking is aesthetically acceptable to you and if not, how will it be avoided or covered? Larger slabs should be designed with control joints to accommodate shrinkage and prevent cracking of the slab. Consider whether a pre-cast concrete option is more suitable for your application.
- Corners and edges of cast-in-place or pre-cast concrete should be beveled so as to prevent spalls or chips.
- Pores or pits are often left in the surface of the concrete due to air bubbles rising to the surface during casting. Pores larger than 3 mm in diameter should be filled to prevent water ingress and the formation of larger chips from freeze-thaw damage. Where applicable, it is also advisable to fill smaller pits and pores by applying a sack rub coating (a thin slurry of cement) to the wetted concrete surface after it cures.
- If you wish to use coloured concrete in your artwork, consider how that colour will be achieved. Will you use integrated pigments in the concrete mix, or apply a concrete stain or coating system? (See Section 5.3 below for considerations around coating systems). Pigments integrated into the concrete mixture (in particular, organic pigments) tend to be more UV stable and last longer than colour applied subsequently as a stain. However, when choosing your colour, always anticipate some fading over time. Research different brands of integrated pigments and compare their colour lifespan guarantees. It is also critical that the integrated pigment you choose is compatible with the concrete product being used; its usage should be approved by the concrete manufacturer.

5.2.2.2 Stone

Different types of stone vary greatly in their physical properties, which dictate their resistance to different environmental conditions. It's important to consider the physical properties of your stone to determine how it will fare under the conditions of the artwork's site.

- Stone types vary significantly in hardness. This is relevant to a stone's resistance to environmental conditions, but also to its resistance to public interaction. Harder stones like granite, quartz and various metamorphic rocks are resistant to scratching, whereas softer stones like limestone, sandstone, marble or soapstone are vulnerable to scratched graffiti or abrasions. The hardness of different stones is measured on the Mohs scale of mineral hardness.
- Softer stones are also much more vulnerable to erosion. For carved or engraved stone work outdoors, this can result in a significant loss of detail over time if too soft of a stone is used.
- Stones with a lamellar structure are more susceptible to delamination, where areas of the stone surface detach in thin layers upon exposure to freeze-thaw cycles and/or soluble salts.

- Certain types of stone are particularly vulnerable to granular disintegration, where single grains or aggregates of grains weather and detach from the stone, leaving a behind a rough and porous surface. In finer grain stones, this is sometimes called powdering or chalking. In granite, this is sometimes called sanding. This effect is exacerbated by the presence of soluble salts: even a hard polished granite is susceptible to this type of decay if regularly exposed to dissolved salts.
- Carbonate rocks (limestone, carbonate sandstones, marble) are particularly vulnerable to deterioration via air pollution and acid rain.
 - The surfaces of limestone and marble can react with pollutants to convert into gypsum (calcium sulfate), resulting in the formation of surface crusts. These crusts can become black from pollution and soiling and are soluble in water, which leads to the eventual loss of surface detail as the crusts dissolve in rain and snow. For this reason, carbonate-based stones are not ideal at sites exposed to heavier pollution (from roadways or pathway de-icing salts).
- Many stones contain natural iron inclusions that will oxidize in the outdoor environment. This is important to consider from an aesthetic perspective, as it results in rust-coloured oxidation staining on the stone. In some cases, the oxidation of iron inclusions can result in physical bursting of the stone, leaving behind small craters or pits.

5.2.2.3 Masonry

- To ensure the longevity of masonry construction, you'll need to pay careful attention to your mortar choice. Masonry mortars serve a structural function, and the physical properties of bonding strength, compressive strength, and flexural strength will need to be considered and balanced to meet the structural needs of your project.
- A stronger mortar is not always better: mortars also need to be compatible with the type of masonry units (bricks or stones) being used. Too hard of a mortar can cause premature deterioration or failure of the bricks or stones. Over the lifespan of a masonry construction, the mortar should be designed to fail before the masonry units do. Mortars can be repointed when needed, but damaged or cracked bricks or stones create a greater structural problem. For this reason, the type of mortar used should be softer (have less cohesive and compressive strength) than the type of stone or brick used.
- It is critical that the mortar has sufficient adhesive strength to maintain a good bond at the interface between the mortar and the masonry units. The quality of the bond between the mortar and the bricks or stones will be impacted by the appropriateness of the mortar selected, but also by how well the mortar is applied. Joints should be filled completely to ensure a full bond, and the manufacturer's application conditions of the mortar must be met to avoid shrinkage as it sets.
- Mortars should have similar or higher water absorption and vapour transmission rates to the masonry units. Otherwise, water will opt to move through the bricks or stones rather than the mortar, putting them at risk of deterioration by damp conditions, soluble salts and freeze-thaw cycles. More permeable mortars promote drying through the mortar, preventing moisture from accumulating in the masonry.
- Mortar joints should be finished using a standard concave joint shape to prevent water from penetrating into the joint over time.
- In some applications, the addition of air-entrainment agents into a mortar mix may be advised to improve its frost resistance and extend its service life.
- Mortars should be low in alkalinity and soluble salts to reduce the risk of efflorescence.

5.2.3 Ceramic and mosaic

Ceramic and mosaic can sustain the outdoor conditions in Calgary if designed and sited well. The biggest threats to ceramic and mosaics are damage from salts and freeze-thaw cycles. Salts dissolved in water and carried into the body of a ceramic or grout will expand as they crystallize, causing physical damage. Salts and water will also naturally want to migrate out of the pores of the ceramic and can cause damaging efflorescence on the surface as it does. Water trapped inside a porous ceramic or grout will expand as it freezes, also causing physical damage that can result in spalling, glaze loss and/or subsurface voids. The following considerations are necessary to prevent these forms of damage:

- Will the site be exposed to high levels of de-icing salts? If so, it may not be a safe environment for ceramic or mosaic.
- Will water be able to drain freely from the artwork? Are there any horizontal surfaces or catch-points where water will pool? How can these be avoided so water can readily drain?
- Is the mosaic situated in an environment where it will dry readily? If heavily shaded or closely adjacent to larger plantings or trees, this could result in the dampness retention, which could result in freeze-thaw damage or biological growth.
- Are the clay body and glazes you are using appropriate for Calgary's outdoor climate? Note that some types of clays and higher firing temperatures are more resistant to freeze-thaw damage due to the lower porosity of the resulting ceramic bodies.
- Grout and any unglazed ceramics should be sealed with an appropriate grout or tile sealer, whether indoors or outdoors. Sealers will help prevent water ingress outdoors but also protect against dirt and oils from becoming engrained in the porous body of the ceramic.
- What is the lifecycle of the sealer used? As much as possible, opt for sealers that require less frequent renewal in order to reduce maintenance demand.

5.2.4 Wood

Since wood is an organic material, it will weather and age naturally in the outdoor environment. Regardless of the wood species' climactic conditions, sun exposure, biological growth and insects will impact the wood. Consider what changes in the wood's visual appearance as a part of this weathering you are open to for your artwork. Do you wish to embrace the wood's natural colour change and changes in surface texture, or attempt to preserve or renew them via stains and finishes?

Consider the purpose of the wood in your artwork: is it the main material? Does it have a structural function? Is it purely aesthetic? Is it a substrate to support other media, like paint? These functions will inform what requirements you'll look for in your wood selection and preparation. For example, are you using the wood in such a way that you'll need it to have a high bending strength? Does the wood surface need be smooth to provide better paint adhesion? Does a structural application require the use of an engineered wood or beams?

Some properties to consider include:

- **Compressive and tensile strength.** Compressive strength is the amount of load a piece of wood can sustain when it is compressed. Tensile strength is the amount of load a piece of wood can sustain when it is elongated. A piece of wood will have different compressive and tensile strength values for when loads are applied parallel or perpendicular to the wood grain. Both compressive and tensile strength will vary depending on a number of factors, including:
 - Species – Softwoods like pine have considerably lower compressive strength and bending strength than some hardwoods like walnut. Consult with your engineer on what wood species may be options given the strength requirements in your artwork.
 - Grain direction has a significant impact on bending and tensile strength in a given application. Choose a straight-grained wood (meaning grain is parallel to the long axis of the piece) with few knots and defects. In the design and fabrication of the artwork, it is also important to orient the grain so that the wood fibres are supportive of the load.
 - What portion of the tree the wood comes from – heartwood tends to be stronger than sapwood.
 - Growth rate – Growth rate can influence the strength of wood, but this varies tremendously by species. In some softwoods, such as yellow pine and douglas fir, the slower the growth the stronger the wood. In contrast, certain ring-porous hardwoods, such as red and white oaks, become stronger the faster the growth rate. When selecting your wood, observe the spacing of the growth rings. The narrower the spacing of the growth rings, the slower the growth rate and the stronger the wood.
 - Moisture content – The drier the wood, the stronger it will be.
- **Hardness:**
 - Generally, the harder the wood, the more durable it may be to the effects from the environment and public interactions, such as resistance to scratched graffiti or accidental impacts.
 - You can reference Janka hardness ratings to identify the hardness of a wood species. These ratings are determined for each wood species by ASTM tests that measure the resistance of a wood sample to denting and wear.

- **Reactivity with moisture:** Changes in humidity and temperature result in wood swelling and contracting. This is particularly relevant to outdoor artworks with wooden components that will have ongoing exposure to moisture. The adsorption and desorption of water results in dimensional changes in the wood, including:

- Shrinking and swelling
- Splitting (from severe or differential shrinkage)
- Warping, cupping or bowing (distortions from uneven shrinking and swelling)

Keep in mind that changes in dimension are greater across the grain than along the grain.

To avoid this type of damage from moisture absorption and desorption, you'll need to take measures in the selection, design, preparation, and finishing of the wood to help maintain moisture equilibrium between the wood and the relative humidity of the artwork's environment. Measures you'll need to consider include:

- Thickness of wood sections – thicker segments of wood are more stable than thinner segments against warping and other dimensional change.
- Selection of the wood cut – quarter sawn or radially sawn boards are more resistant to warping and cupping than tangentially (or “flat”) sawn boards.
- Choice of a wood species that is resistant to splitting.
- Pre-drying/pre-shrinking prior to working with the wood. Wood that is pre-dried has slower moisture absorption, which reduces the degree of dimensional change and risk of splitting during drying. This is generally accomplished by air-drying or kiln drying. The goal is to reach a balance between the moisture content of the wood and the atmospheric humidity in which it will be used, so the wood should be pre-dried or pre-acclimatized to the Calgary climate.
- The average annual relative humidity in Calgary over the last 10 years has been 61 per cent RH with an annual average temperature of 5° C. The Equilibrium Moisture Content of wood in these conditions is roughly 11-12 per cent.
- Indoor conditions in Calgary are significantly drier on average due to central heating. If the artwork is to be sited indoors, wood should be pre-dried to a moisture content of about 7-8 per cent.
- Consider how your artwork design can allow for some dimensional change/movement to lessen the possibility of cracking, splitting or distortions. How are the wood elements joined to themselves and other materials? Have you incorporated gaps or flexible seals to allow for expansion and contraction? Are the wood elements cut along the same grain? If using a mechanical joint, like a stainless steel bolt, does the hole accommodate for dimensional changes?
- What protective finishes could be applied to reduce and slow the wood's moisture uptake, and how frequently do they need renewal? See Section 5.3.3 below for further considerations around coating systems for wood.

You'll also need to consider how the wood is likely to weather, and what materials and design choices can help control weathering to the extent you desire, as well as to prevent more significant forms of deterioration.

- Are there any areas where the wood could be in regular prolonged contact with moisture? Are there aspects of the design that could cause water to pool on the wood or where the wood would be in close contact with other materials that would prevent the wood from drying completely?
- Is the wood in direct contact with grass or sod? Can it be elevated or separated?
- What degree of rot resistance will be required given the application of the wood in your artwork? Note that rot resistance varies by species and can to some extent be mitigated by different types of wood preservatives. Careful consideration will be required when selecting a wood preservative to ensure it appropriately targets the deterioration concern (some may target insects or fungi whereas others may be specifically for protection against mold or mildew). You'll also want to ensure that the product you choose is environmentally friendly and safe for the public and will not discolour the wood or chemically react with other components of the artwork.
- Prolonged exposure to sunlight and UV radiation also cause wood to degrade over time. What degree of degradation by sun exposure (greying, splitting, roughening, etc.) do you feel acceptable for the artwork? What protective finishes will you apply to prevent this damage and how frequently do they require renewal? See Section 5.3.3 for further considerations around coating systems for wood.
- How will the wood react with other materials in the artwork? Is it at risk of being stained by adjacent steel or copper elements? Is the wood species acidic, creating a corrosion risk for metal fasteners? What types of barriers or coatings could you employ to prevent these risks?

Even with protective coatings, wood is vulnerable to irreparable damage by graffiti and scratching. You'll need to consider what your preference is for the approach to more significant damage. What degree of damage do you consider acceptable? If graffiti can't be removed by specialized cleaning, would you be open to the wood being locally sanded and refinished? If damage is severe, could entire boards or wood elements be replaced? Would you want the refinished or replaced element to be made to match the current appearance of the surrounding wood, or is the contrast between new and aged wood acceptable?

5.2.5 Glass

Because of the high breakability of glass and its susceptibility to vandalism, careful thought should be put into how and where it is used, and a risk assessment should be conducted. Consider the site and the likelihood of vandalism, as well as whether the glass will be within reach of the public. Generally, it is recommended that glass should only be used as a replaceable component of public artwork, meaning that if it were broken it could be replaced fairly easily by The City without requiring the artist to remake it.

It's a requirement that all glass used in public space be tempered safety glass and must meet the associated ASTM standards for glass tempering. Glass thickness is another safety consideration, as thicker glass offers increased strength and breakage resistance. For reference, glass used in The City's transit structures is a minimum of 21 mm thick, consisting of two 10 mm thick panes laminated together with a 1 mm polyvinyl butyral (PVB) interlayer. It's also important that the edges of the glass are polished and smooth, or even bevelled. Sharp edges put the public at risk and are also prone to chipping. Finally, you'll need to consider the mounting hardware used to set the glass within the larger structure of the work. High-quality gaskets are important to include within hardware or brackets for additional cushioning to prevent breakage. If multiple panels of glass are being used up against one another, ensure a high-quality, UV stable silicone is used between them to create a tight seal to prevent moisture ingress, particularly if using laminated panes.

One of the general aesthetic considerations around glass is glass clarity. Opt for low-iron glass if clarity is important and you wish to avoid a greenish-blue tint.

5.2.5.1 Printing on glass

Decorative printing on glass comes with its own set of considerations to ensure that the printing meets the aesthetic requirements of the artwork and is durable and long lasting. Considerations will include:

- What is the desired or required light transmittance of the glass? Meaning, how transparent does the printed glass need to be to achieve the desired effect? Certain printing technologies are more opaque than others. Are there any site, illumination or safety requirements that dictate a certain level of light transmittance?
- If digital printing, what printing resolution will be required to achieve a clear picture on the size of the glass component? In what colour space will the printing medium need to be available? Quality assurance will be necessary to ensure your artwork is reproduced to your satisfaction. It is recommended that you request to review samples so that you can assess for defects such as colour or saturation discrepancies, banding, pinholes or fisheyes, stress cracking, etc.
- What degree of lightfastness is required? This will depend on site (indoor versus outdoors, degree of UV exposure) as well as the intended lifespan of the artwork. For outdoor artworks meant to last longer than five years, digital ceramic frit printing is advised over any organic ink printing media. Note that UV inhibiting films can provide some protection against fading, but on their own are generally insufficient to provide the lightfastness required under outdoor conditions.
- Will the printed surface be accessible to the public? What abrasion resistance and graffiti/solvent resistance will be required. For printed glass surfaces within reach of the public, it is recommended that the printed surface be protected by laminating with a secondary pane of glass. This "sandwiching" technique will protect the imagery from abrasion and graffiti, but note that the layers must be very well-sealed to prevent moisture from seeping in and damaging the print media.

5.2.5.2 Glass enamel

The longevity of metals coated with glass enamel are highly dependent upon the quality of the enamelling process. The type of metal alloy used, proper preparation of the metal surface and environmental controls within the shop are all key to the successful adhesion of the enamel layer. It's important to find a manufacturer with a proven track record for processing enamel on metal and, if the artwork will be situated outdoors, that has products that have been tested in the outdoor environment. There are ASTM standards that should be followed for producing enamelled metals and for testing the adhesion of the enamel to the metal substrate.

It's also important to note that enamelling on its own does not provide sufficient corrosion protection for metals in the urban outdoor environment. Corrosion spreading to the surface of the metal beneath the enamel can be a primary cause of enamel loss. For outdoor applications, a corrosion-resistant substrate metal is required, but the alloy must be carefully reviewed to ensure its compatibility with the enamelling process.

5.2.5.3 Glass beads

Beaded artworks are not recommended for outdoor applications. Even the indoor public art environment can be very harsh on glass beads and on the beadwork's substrate materials (e.g. fabric or leather). Some chemical formulations of glass can be inherently unstable over time and may suffer accelerated deterioration under prolonged exposure to moisture, high humidity or sharp fluctuations in relative humidity. Glass beads can be particularly vulnerable to this type of decay due to the high surface area of the glass.

Beaded artworks typically also have organic substrate materials (fabrics, leather or hide), which are also subject to deterioration from inappropriate temperature and relative humidity conditions, as well as light and UV. Consider the environmental conditions of the space where the artwork will be on display and whether they may put the artwork at risk over time.

With beadwork in the public space, it's important to also think about how accessible the artwork is for cleaning. Dust is hygroscopic and when it builds up on glass beads it puts the glass at higher risk of decay. For this reason, City conservators should be able to access the artwork for regular conservation cleaning.

If appropriate for your artwork, a sealed display case or cover is recommended for beadwork to protect it from the above risk factors at play in public spaces.

5.2.6 Plastics

With the vast number of different plastics formulations on the market, all with varying physical and chemical properties, it's not possible to cover them in detail under the scope of this document. However, there are some overarching properties of plastics and the ways in which they deteriorate over time that can be summarized to inform the considerations and decision-making around their use in public artworks. There are also some categories of plastics that are more commonly used in the public art context and are therefore discussed in more detail.

5.2.6.1 General properties and causes of deterioration

Plastics are generally not considered to be stable, permanent materials. They all deteriorate chemically via oxidation and hydrolysis, albeit at different rates. These processes of decay are accelerated by light, heat, certain pollutants and, in some cases, higher levels of humidity. Different plastics vary greatly in their stability (meaning, how quickly they deteriorate) and the way in which different plastics deteriorate can look quite different. In addition to the different types of polymers used to create plastics, plastics are also made with different stabilizers, plasticizers and fillers, which all impact the mechanical and physical properties of a plastic and how it ages. Similarly, different processing methods also play a role in the physical properties and stability of plastics.

As plastics age and deteriorate, common physical and aesthetic changes they undergo include:

- Yellowing.
- Embrittlement.
- Hazing.
- Chalking (dry white residues that migrate to the surface).
- Deformation (either from thermoplastic effects or from the swelling of different fillers or bulking agents.)
- Migration of plasticizers to the plastic's surface, leaving a sticky residue.
- In cases where a less stable plastic is used, the vapours off-gassing from the plastic as it deteriorates can cause adjacent metals to corrode.

If using a plastic product in your work, it will be necessary during detailed design to select a plastic for both its physical properties (e.g., flexibility/rigidity, strength, clarity, etc.) as well as its resistance to these various forms of deterioration. Consider the environment of your artwork and whether there are accelerating factors at play, such as solar/UV exposure, sources of heat or the presence of pollutants (e.g. fertilizers, car exhaust). You'll need to select plastics that are suitable for the artwork's environment and guaranteed to last for the duration of the intended lifespan. There are many ASTM standards established for the control and measuring of the resistance of different plastics to common forms of decay.

In the public art context, the main criteria required of plastics are:

- Resistance to yellowing, hazing and embrittlement (UV stabilizers are generally necessary additives).
- Graffiti and solvent resistance – Note that most plastics are not resistant to graffiti or the solvents used to remove graffiti. Therefore, it's not recommended for plastics to be used in artworks within public reach at sites that have moderate to high risk of graffiti.
- Resistance to thermal deformation (typically caused by high solar heat exposure).
- Scratch resistance.
- Flammability/burn resistance.
- Strength/resistance to fracture.

Note that most plastics will not meet these criteria to the extent that they are suitable for long-term artworks in the outdoor context.

5.2.6.2 Plexiglass and polycarbonate sheeting

Acrylic (Plexiglas) and polycarbonate plastic sheeting are generally not considered permanent or long-term materials in the public art context, but can be useful in some applications for artworks with shorter life spans. Additionally, in some circumstances, plastic sheeting can be used as a sacrificial barrier in order to protect vulnerable materials underneath. Their main vulnerabilities are the same as those for all plastics, as listed in Section 5.2.6.1 above. In particular, plastic sheeting is not resistant to graffiti or graffiti removal chemicals, and is highly susceptible to scratching and scratched graffiti. You'll also likely need to consider size of plastic sheeting you are using and how thick it will need to be to prevent it from flexing.

Finally, note that plastic sheeting that has been bonded with adhesives to create shapes (such as display cases) can be susceptible to stress cracking at these joints. It's important to only use adhesive products recommended by the manufacturer and that all manufacturer recommended bonding processes are carefully followed.

5.2.6.3 Fiberglass

Fiberglass-reinforced resin (colloquially referred to as "fiberglass" or Glass Reinforced Plastic (GRP)) is a versatile material that has been used by artists for decades. It can be built up in layers of alternating fiberglass mesh and resin over an armature or formed in a mold. The resins are typically polyester and can be pre-coloured or painted after the fact to achieve the artist's desired surface appearance. Paint systems applied to fiberglass must be specified by the paint manufacturer to be compatible with the fiberglass resin substrate and/or gelcoat.

Fiberglass used in public artworks will generally need to conform to architectural fiberglass standards. These standards include specific quality requirements for resin mixes as well as flammability ratings. Engineers will also need to review any structural armatures that support the fiberglass body and its connection points. Note that if the artwork is to be installed outdoors, the internal armature must be built with corrosion resistant materials, as the fiberglass body will not provide sufficient weather protection.

The durability of fibreglass in the public setting will depend on a number of factors, including:

- Thickness of the casting. The required thickness of the fibreglass construction will vary by application, but in an outdoor setting within reach of the public, a minimum thickness requirement of 0.5 cm should be expected.
- Fibre to resin ratio of the glass fibre reinforcement. This will vary depending on the application and products used but must strictly follow manufacturer guidelines.
- Gel coat thickness. This will also vary by product and application but must strictly follow manufacturer guidelines.
- Attention to seams. Seams are often the first point of failure of fibreglass artworks. Additional care should be taken during fabrication to reinforce all seams. In addition, ensure that the artwork's internal armature sufficiently supports the fibreglass body so as to minimize movements that can cause seams to open up.
- For outdoor works, UV inhibitors within the resin and gel coat and the application of appropriate protective coatings are necessary to prevent accelerated oxidative degradation of the plastic.

5.2.7 Textiles, leather and other organic materials

Artworks comprised of textiles and organic materials such as leather, skins, fur, bone, horn, feathers or woven plant materials are particularly vulnerable in the public setting. They are not suitable materials for outdoors, but even the uncontrolled indoor environment can put them at risk of significant deterioration.

Uncontrolled temperature and humidity can cause organic materials to deteriorate by desiccation, embrittlement and physical stresses created as the materials expand and contract under fluctuating humidity. Ongoing light and UV exposure cause these materials to bleach or darken over time and will also cause the fading of any dyes or pigments. Organic materials are also more susceptible to damage from soiling; dirt and grime are easily engrained, and the resulting oils and moisture can cause the material to deteriorate more rapidly.

For these reasons, it's generally recommended that artworks composed of organic materials be exhibited within display cases whenever possible so that their environment can be more carefully buffered or controlled.

5.3 Coating systems

Paint and related coatings on public artworks differ from other artistic settings in that their function extends far beyond an aesthetic feature of a work. Coating systems in the public art context also serve to protect underlying materials from corrosion, moisture ingress and related damage, deterioration by UV exposure, staining, soiling, rot, etc. Nevertheless, the aesthetics of coating systems is also typically a significant consideration for artists, and therefore identifying coating systems that can meet both the artistic and functional demands of an artwork can require considerable research, sampling and testing.

It's always valuable to consult with paint technicians and paint manufacturer representatives during the design phase to discuss available products that could meet the needs of the artwork, as well as to advise whether there are any aspects of the artwork design that could compromise the application of the coating system.

Considerations around coatings systems vary by different substrates and are therefore broken out into more detailed sections by substrate below. However, one important consideration that applies to all types of coating systems and substrates is how the design of the artwork can impact the ability to properly apply a protective coating to it.

If you plan to apply a protective and/or decorative coating system to the artwork, you'll need to consider access during painting/coating and whether the coating will be able to penetrate and fully cover all the surfaces required.

- Will welds or narrow gaps require bridging via seam sealing (the application of a compatible caulking) prior to painting?
- Are there tight gaps that will be difficult to coat?
- Does the artwork have any sharp edges that will be difficult to coat?

In some cases, hard-to-reach areas and harsh edges can be addressed by brush-application of the coating, but keep in mind that these requirements will increase the labour costs of the coating application.

Even when optimal coating products are used and applied correctly, coatings systems have limited life expectancies in the outdoor urban environment. For artworks intended to have very long lifespans, it's possible that they'll require a full renewal of their coating system at some point in time. The City's conservation team may ask for samples of artwork coatings (in addition to technical and colour details provided in the stewardship manual) that can be preserved and archive should the need arise to match the coating in the future.

5.3.1 Coating systems for metals

- Will the coating need to function as a protective coating against corrosion, soiling and graffiti? What are its protective requirements and what are its aesthetic requirements?
- What will be required to promote adhesion of the coating? Does your metal substrate present adhesion challenges? (E.g. stainless steels). What kind of surface preparation will be required prior to coating?
- What type of coating will be resistant to the environmental, chemical and physical stresses of the site? Does it need to be scratch resistant? Resistant to salts or chemical spills? Resistant to bird dropping or staining from soiling? Will it be resistant to fading or blanching from UV exposure?
- To achieve the durability required of outdoor public artworks, we highly recommend industrial coatings applied in specialized industrial paint booths. What can be done to ensure the aesthetic requirements of the coating can be met within these industrial application settings?
- Is the artwork designed in such a way that it is practical to apply a coating to it? Are there any narrow gaps or hard to reach areas that would cause problems during the coating stage? Will stripe coating be required to ensure full coverage? Think about any design solutions that could make it easier to achieve full coverage of the protective coating(s).
- For protective clear coats to bronze artworks, is it more practical in this situation to opt for a permanent (lacquer) or a renewable (wax) coating? Is the coating pigmented or dyed, and if so, will this be easy to maintain or renew? Is the formulation of the coating appropriate for the Calgary climate? How resistant does it need to be to graffiti?

5.3.2 Coating systems for concrete, stone and masonry

- Consider the intended function of the coating system you plan to use: is it aesthetic, protective or both?
- Entrapping moisture within a porous substrate can cause damage as that moisture expands and contracts during freeze thaw cycles. When coating porous materials like concrete and stone, coating systems (including sealants, paints, stains or anti-graffiti coatings) need to be breathable in order to allow moisture from the substrate to evaporate outwards, without causing the coating to lift or peel. When looking into coating systems, investigate the vapour permeability rating of products to choose an appropriate option for the substrate you are working with.
- Some paint systems may require a primer on porous substrates to ensure the coating is applied evenly.
- When coating concrete, it is critical that the concrete is allowed to cure the length of time recommended by the concrete and the coating manufacturers before applying a coatings system. You'll need to ensure your project schedule accounts for the cure time required prior to coating.
- Concrete coatings must allow for shrinkage cracking. If you wish to cover the appearance of shrinkage cracking, consider waiting to apply your coating (for example, a sac-rub-finish) after significant shrinkage cracking has occurred. These types of coatings should also be flexible enough to sustain some movement from minor shrinkage cracking without cracking or peeling.
- Is the coating or stain UV stable? Stains in particular are subject to fading over time. Select products that are suitable for the intended lifespan of your artwork, and avoid those that require frequent re-application. If you wish to colour concrete, integrated pigments (dry pigments added to the concrete mixture) tend to last longer than applied stains.
- Ensure all products used are compatible with one another, ideally by the same manufacturer. For example, avoid using a primer manufactured by one company and applying a top-coating that is made by another.

5.3.3 Coating systems for wood

- Does the design of your artwork account for a water repellent or protective coating? Is it your preference to use a film forming coating, like a varnish, shellac or lacquer, or a penetrating finish (like a water repellent or oil)? Both can provide high levels of sun and water protection for the wood, the choice is typically mainly an aesthetic or conceptual one. A film forming coating like a varnish can provide greater protection against graffiti and scratching (so long as the coating is resistant to graffiti removal solvents). However, a penetrating finish may be easier to maintain.
- Consider the anticipated lifecycles offered by the coatings you are considering and what impact it will have on maintenance needs.
- If the artwork will be outdoors, is the coating product designed for outdoor conditions? Does it contain added UV inhibitors? Note that most clear coatings, even those with UV inhibitors, have a tendency to yellow as they oxidize over time. Consider what degree of yellowing is acceptable. If yellowing is not desirable, look for products that market themselves as non-yellowing. Many acrylics are resistant to yellowing, however, they may be less resistant to graffiti or graffiti removal solvents than polyurethanes.
- Does your water repellent have other properties such as preservatives or fungicides or mildewcides? Can these properties be achieved by layering products and what is the compatibility of those products with each other?

- Is the coating compatible with the wood species you've chosen? Denser, less porous woods might not absorb certain penetrating finishes as well others. Be sure to do mock-up trials on off-cuts of wood to achieve your desired finish. The City's conservators can also test how resistant these samples are to graffiti and graffiti removal.
- Tinted/pigments varnishes are not generally recommended for wood in public spaces, as when the coating is scratched or worn it can be aesthetically disfiguring. Using a penetrating stain followed by a clear lacquer offers better protection of the finished colour.
- Do you plan to coat all sides of each wood element? Finishing the wood components prior to assembly allows for better coverage and longer lasting protection than applying a finish to only the surfaces accessible following assembly. Generally, a minimum of three coats applied to all surfaces is recommended for optimal protection, but application guidelines should be followed carefully for each individual product.

5.3.4 Anti-graffiti coatings

There are two categories of anti-graffiti coatings to consider for your artwork: permanent coatings and sacrificial coatings. Permanent anti-graffiti coatings work primarily by creating an isolation layer between the artwork and the graffiti that is resistant to graffiti removal treatments and solvents. Sacrificial anti-graffiti coatings also create an isolation layer between the artwork and the graffiti, but one that can be removed by hot water and scrubbing or pressure washing. Sacrificial anti-graffiti coatings require re-application each time graffiti is removed. Permanent anti-graffiti coatings may also require renewal if they are damaged or thinned during the graffiti removal process.

Also note that not all surfaces require an anti-graffiti coating. If the surface of the artwork is non-porous, and can withstand graffiti removal methods and exposure to solvents without damage, then an anti-graffiti coating is not usually necessary. Examples could include glass, certain uncoated metals (e.g. stainless steel, galvanized steel, uncoated aluminum) as well as some types of industrial paint coatings.

5.3.4.1 Permanent anti-graffiti coatings

Permanent anti-graffiti coatings are often marketed as creating a surface that is easy to remove graffiti from. Some of these coatings contain waxes and silicones that can create problems if the coating needs touching up or re-application. Recent conservation research has found that artistic varnishes can be equally effective as many anti-graffiti coatings on the market. This indicates that the key function and success of these permanent coatings is to provide a sacrificial barrier layer between the graffiti and the artistic surface so that removal methods and solvents never come into direct contact with the artwork itself.

Qualities that make a good permanent anti-graffiti coating:

- Does not alter the appearance of the artwork.
- Is compatible with the substrate and any other coatings that have been applied.
- Is relatively resistant to solvents used in graffiti removal.
- If for a porous substrate, should be relatively breathable.
- Is easy to re-coat if needed.

5.3.4.2 Sacrificial anti-graffiti coatings

Sacrificial anti-graffiti coatings are a good option in situations where graffiti may need to be removed by non-specialists. For example, large scale murals or artistic surfaces at sites that are hit with graffiti on a regular basis benefit from this type of protection, as it allows crews to remove large tags quickly without the use of solvents that could damage the artwork below.

Qualities that make a good sacrificial anti-graffiti coating:

- Creates a good barrier that prevents graffiti media from penetrating to the artwork below.
- Can be easily removed with hot water, gentle scrubbing or pressure washing. For substrates which could be damaged by pressure washing, the coating and graffiti should be easy to remove without pressure.
- Removal should not require the use of solvents or specialized conservation expertise.
- Should be relatively affordable per square foot, as it requires more frequent re-coating.

5.4 Welds and seals

5.4.1 Welds

- Will weld joints be tack welded or seam welded? How will this impact seals and drainage? Will it impact the paint application methods required? (E.g. will seam sealing be necessary prior to painting?)
- When working with your fabricator and engineer, consider the types of welds that will be necessary and aesthetically appropriate for the artwork. Consider the required strength of the welds and what types of loads they will be exposed to. Also think about the appearance of the welds and how visible you would like the joints to be.
- Note that welds are particularly susceptible to corrosion (even with stainless steel), which can become a structural issue. Furthermore, corroding welds will have an aesthetic impact on an artwork even in cases where they are found not to pose structural concern. Preventing weld corrosion through careful material selection, surface preparation/cleaning and weld design is an important conversation to have with your fabricator during detailed design and a critical element of quality control during fabrication.
- Welding can be challenging or infeasible to execute from certain angles and other access constraints. Discuss with your fabricator to ensure that there is adequate space in the design to allow for access to joints for welding during fabrication.
- Will welding be required during the installation of the artwork? If so, consider what needs to be in place to facilitate on-site welding from a health and safety perspective. What site access and/or weather constraints might also be a challenge?
- In certain scenarios you'll need to weigh whether or not welding is the preferred method over a mechanical/hardware attachment. For example, would a welded option impede access for maintenance or repairs? Would welding or mechanical attachment better facilitate the painting process, if painted?
- Note that third party welding inspections are often required for art installations as part of The City's quality assurance.

5.4.2 Sealants

When selecting a material type of sealant (e.g. silicone, polyurethane, acrylic, etc.) you'll need to consider:

- Specified lifespan of the product (does this align with the lifespan of the artwork? If not, how frequently will it require replacing during the artwork's lifetime?)
- Temperature ratings (will the sealant be able to weather Calgary's climate if outdoors?)
- UV resistance (will the sealant become brittle and fail under prolonged sun exposure?)
- Flexibility/rigidity required of the application (are you bridging two similar materials or two materials that are expected to move due to thermal expansion, moisture exposure, or freeze-thaw cycles?)
- Adhesive properties of the sealant (is it compatible and will it form a strong bond with the materials you are bridging?)

5.5 Hardware

Hardware requirements will primarily be dictated by the structural needs of the artwork. Therefore, the majority of relevant specifications will be unique to the work and provided by engineering consultants. In addition to their structural requirements, some general considerations around hardware that will also need to be addressed include:

- Corrosion resistance – Selected hardware must be corrosion resistant and therefore stainless steel hardware is generally preferred. Barriers such as neoprene gaskets may also be required to prevent galvanic corrosion.
- Tamper resistance – Hardware must also function to prevent theft and tampering of the artwork or parts of the artwork. This could be achieved through the use of tamper-resistant varieties of hardware, but also through other strategies such as hardware peening or the use of Loctite to secure bolts. The degree of tamper resistance required will be dictated by the nature of the artwork and its site.
- Concealment – it is sometimes necessary for hardware to be discretely hidden either for aesthetic purposes or for reduced access for public to discourage tampering. Note that hardware should still be accessible to City conservation staff or their contractors for artwork maintenance or any necessary de-installation.

5.6 Mounting systems, plinths and pads

Mounting design and base requirements will primarily be dictated by the structural needs of the artwork. Therefore, the majority of relevant specifications will be unique to the work and provided by engineering consultants. A few high-level considerations that should be taken into account during the design of mounting system include:

- How will water be shed from the mount, plinth, pad or surrounding grading? A minimum 2 per cent drainage slope away from the artwork and its mounting system is always required, but in some instances a more complex drainage system will be necessary (e.g. drains, weeping tile, etc.).
- For artworks with hollow interiors, note that accommodations will need to be made to allow for any internally accumulated moisture to drain out. This is typically achieved by a small, unsealed gap between the bottom of the sculpture and the plinth or pad.
- Will the mounting system remain accessible, or will it be buried below grade? What would be required in the event that the artwork had to be moved in the future (e.g. deinstalled for repairs)? For instance, would destruction of surrounding concrete be necessary to access the mounting system and remove the sculpture? Is there a design solution that could mitigate some of this disturbance? Also note that permanently buried mounting systems present some risk over the long term since they cannot be regularly inspected.
- How easy will it be to install the artwork utilizing the proposed mounting system? Will the artwork be vulnerable to damage during the process? Are there any adaptations to the mounting design that could help minimize this risk?
- Does the height and other dimensions of the artwork plinth, base or pad help to mitigate environmental and impact risks to the artwork? For instance, is it large enough to prevent snowbanks from being piled on the work? Is it large enough to protect the artwork from impacts from snow clearing or landscaping equipment?
- Does the plinth need to accommodate signage? How will the signage be mounted?



Chinook Arc by Creative Machines, 2014

6. Lighting and time-based media

Public art installations are very often composite works and can rarely be defined by a single medium or category alone. For instance, a sculpture may incorporate light or sound components, and these components may utilize custom software to create the artist's intended effect. In the public art context, a software-based artwork is often integrated with a site-specific installation that exhibits its spatial output. It will often therefore necessary for artists to consult many of the following media subsections to garner a full picture of the design and preservation considerations that will apply to their work.

6.1 Lighting and light-based artworks

Whether it's a component of your artwork or companion lighting installed to illuminate your work, lighting can be one of the most challenging items to maintain. Light fixtures, as well as software systems made to control or program them, have inherently short lifecycles

due to fast-changing technologies and limited weather resilience. It's critical to select lighting systems that are as sustainable as possible: choosing systems that are either expected to last the duration of your artwork's intended lifespan, or that can be easily and cost-effectively replaced at reasonable intervals throughout the artwork's life. Your project budget will need to account for lighting life cycling, if applicable.

Because the lighting hardware and software available on the market changes so quickly, it's also important for you to be thoughtful about what your intended lighting effect is within your artwork and to describe this in detail in your artwork's stewardship manual so that it can be respectfully replicated with new technology in the future, if the need should arise.

6.1.1 Lighting hardware

- Is the lighting hardware rated for Calgary's climate and the specific environmental conditions of the site?
 - **Temperature:** Hardware needs to be rated for extremely low temperatures (-40°C) as well as sharp temperature fluctuations. It's advisable to look at Canadian lighting manufacturers as they typically supply hardware built for this climate.
 - **Exposure to salts and debris:** If the artwork is integrated into transportation infrastructure or if it is located adjacent to a roadway, it will be subject to high levels of salts, grit and dust that can create serious problems for lighting hardware if fixtures and connectors aren't sufficiently sealed. Consider the IP ratings to discern the dust ingress resistance of the hardware you choose, as well as additional measures of protection that can be added to shield the hardware from these abrasive and corrosive elements.
 - **Water resistance:** Lighting hardware installed in outdoor urban environments needs to be highly resistant to water ingress. Fixtures and hardware are rated for different types of water exposure (condensation, spray of different angles, immersion, high pressure water jets). Consider what type of water resistance is most applicable to your project. For instance, will the maintenance of the site include pressure washing? If so, this will necessitate the use of hardware rated specifically for resistance to high pressure water jets.
 - **Freeze thaw cycles and condensation:** Due to the numerous cycles of freezing and thawing we see over the Calgary winter, the build-up of condensation in light fixtures and/or their housing is a significant problem. In-ground lighting is not recommended in our climate due to high failure rates related to condensation.
- Will fixtures, connections, drivers, controllers, etc. be easy to replace if they fail? It's advisable to use off-the shelf hardware available from relatively local manufacturers rather than custom hardware elements that are challenging and costly to repair or replace.
- What will happen if any of your hardware elements become obsolete and are no longer available for replacement? It's recommended that you utilize the most current and established hardware available so as to minimize the risk of obsolescence. It's important to design the artwork in such a way that it's not dependent upon any specific piece of hardware. You'll need to develop an obsolescence plan (to be included in the artwork stewardship manual) that outlines the compatibility requirements if a component needs to be replaced or migrated to an alternative piece of hardware. For light fixtures, this might include documenting the desired colour temperature, beam spread, brightness, etc. to be provided by the fixture. This should be described in the artwork stewardship manual, however, a video recording of the completed artwork that demonstrates/documents the intended lighting effect is also extremely valuable.
- What warranties are offered by the hardware manufacturer? Depending on the nature of the project, The City may stipulate a minimum warranty period required for fixtures, connectors and/or drivers.
- How easily accessible are the hardware components for maintenance or replacement? Since electrical hardware tends to require a higher frequency of maintenance, it is important that hardware components are as accessible as possible so that artwork outages can be addressed swiftly and at minimal cost. If separate from the light fixtures, LED drivers should be located together in an easy to access spot. Fixtures and drivers should ideally be accessible without the need for special equipment or lane closures.

- How will your design minimize the impact of a failed piece of hardware? Avoid daisy chain systems where a single fixture outage will result in the outage of a full lighting string.
- If you are incorporating lighting programming that involves an on-site computer and data cabling:
 - Consider where the on-site computer will be located. Ensure it is secure and that its site and housing will have the temperature controls and ventilation the computer requires.
 - Ensure data cables used are specified to minimize electrical interference. DMX lighting systems in particular are prone to electrical interference resulting in communication errors that can cause fixtures to flicker, flash or fail.
 - Ensure computer runs on an operating system that is likely to remain supported throughout the lifespan of the artwork.
 - Computer running the software should be relatively easy to access, secure from public tampering and situated in a well-ventilated cabinet and/or room.
 - Consider whether the computer will need to be connected to The City’s network (may be a City IT requirement). What security measures will be required? How will remote access be facilitated?
 - If not connected to The City network or an internet source, how will troubleshooting and support be managed if no remote connection?
- Will the lighting run 24/7 or just when it is dark outside? Controlling when the lighting runs via solar panel or astrological timers can reduce electrical usage and extend the lifecycles of fixtures. However, the incorporation of these controls should be considered carefully during your design process to ensure they do not create challenges or glitches in the programming. Ensure that the hardware of the timers is installed where it cannot be tampered with. Grid-powered timers should be designed to automatically restart following a power outage. Solar panel timers should be carefully placed to ensure they receive sun exposure throughout the day.

6.1.2 Lighting software

If the lighting component of your artwork is programmed or programmable, it will likely incorporate DMX lighting controllers that need to be directed by software run on a site computer. This technology has become very widespread across many different industries, so can be relatively easy to operate and maintain if the system is designed well. When designing and configuring this system, consider the following:

- Is the software user-friendly on a variety of operating systems? How easy will it be for you to build out your lighting program, is it something you can do on your own or will you need a specialist’s support?
- Whenever possible, consider building your lighting programs with open-source software that is compatible with different operating systems and a wide range of lighting hardware. This will not only keep your hardware options open and flexible while designing and building the lighting system but will also help support any necessary future hardware life-cycling or software migration during the lifespan of the artwork.

- How easily can the software program be troubleshooted or rebooted?
- How will you ensure the program will automatically restart following a computer reboot or a power outage?
- Will the software lighting program continue to run/function on the site computer if the software program should become obsolete or unsupported? Is the lighting program you've created easily migratable to another software system?
- Does the software program require a network/internet connection to function and be supported? How will this be achieved considering the nature of the artwork's site? Note that connecting to The City's network can be a complex process with a number of security measures involved, but may be a necessary requirement by City IT.
- What degree of software support will be required to seamlessly run the lighting program throughout the duration of the artwork's lifespan? Will it require a specialized support contract to conduct maintenance such as monitoring, updates, resets, connection troubleshooting, bug fixes or recalibrations? During the detailed design phase, software support requirements will need to be outlined and costed out for approval by The City.
- How will the volume be controlled, where will the controls be located, and who will require access?
- If outdoors, speaker hardware will need to be appropriately rated for and/or sheltered from Calgary's climate and the specific environmental conditions of the site. Consider temperature extremes, anticipated water exposure (including pressure washing), freeze-thaw cycles and resistance to dust, debris and de-icing salts.
- If the audio component will run on a computer software program/media player, whenever possible consider using open-source software that is compatible with different operating systems. Design your system so that it could be easily run by an alternate program/media player in the event that the software becomes obsolete.
- Will you be using multiple audio tracks (channels) and if so will they be discrete or embedded? Meaning, can different audio layers be controlled (e.g. volume) independently or are they combined together? You may wish for these channels to be embedded so that the balance and effect you desire will remain fixed over the artwork lifespan. However, this could limit the ability to adjust if required in the future.
- On what type of carrier (e.g. CD, tape) or file format (e.g. mp4, Dolby Digital) will the audio recording be stored? Is it anticipated that the recordings will need to be migrated to new formats over the course of the artwork's lifespan? You'll need to work with The City of Calgary conservator to develop an obsolescence plan that is incorporated into the artwork's stewardship manual.
- If the audio will be stored on a physical carrier (e.g. CD, tape), what hardware will be required to play it and is this hardware appropriate for the site?

6.2 Audio

- When using audio in a public setting, you'll need to consider what volume levels are permitted by City bylaws. These regulations vary by location and time of day. In addition to official bylaw regulations, you'll need to also take into account more nuanced sound considerations specific to the artwork site. For example: is there a residential dwelling that could be particularly impacted? Does the site have existing noise patterns that would interfere with the listening experience of the artwork? Or could a sound element disrupt wildlife in the area?

- If the audio will be in a digital format, will an audio codec program and library be required? Consider what files will need to be stored on the site computer (and copies submitted to The City) in order for the audio to continue to be run over the long-term. Note that The City may request a preservation copy, such as a disk image, of all relevant digital files.
- What degree of software support will be required to seamlessly run the audio software program throughout the duration of the artwork's lifespan? Will it require a specialized support contract to conduct maintenance such as monitoring, updates or resets? During the detailed design phase, software support requirements will need to be outlined and costed out for approval by The City.

6.3 Video

- Will the video play on a loop? At specific times? Consider how will this be programmed/timed.
- If the video will have sound, you'll need to take into account the audio considerations described in Section 6.2.
- What hardware and software will be required to run the video? Where will this be stored and how easily can it be accessed for maintenance/support?
- If the video component will run on a computer software program/media player, whenever possible consider using open-source software that is compatible with different operating systems. Design your system so that it could be easily run by an alternate program/media player in the event that the software becomes obsolete.
- On what type of carrier (e.g. DVD, CD, VHS, BETA) or file format (e.g. mp4, vlc) will the video recording be stored? Is it anticipated that the recordings will need to be migrated to new formats over the course of the artwork's lifespan? You'll need to work with The City of Calgary conservator to develop an obsolescence plan that is incorporated into the artwork's stewardship manual.
- If the video will be stored on a physical carrier (e.g. DVD), what hardware will be required to play it, and is this hardware appropriate for the site?
- If the video will be in a digital format, will a video codec program and library be required? Consider what files will need to be stored on the site computer (and copies submitted to The City) in order for the video to continue to be run over the long-term. Note that The City may request a preservation copy, such as a disk image, of all relevant digital files.
- What degree of software support will be required to seamlessly run the video software program/media player throughout the duration of the artwork's lifespan? Will it require a specialized support contract to conduct maintenance such as monitoring, updates, or resets? During the detailed design phase, software support requirements will need to be outlined and costed out for approval by The City.
- What hardware is required to display the video (e.g. monitors, projectors, screens)? Consider the site and how you'll select, design, and position this hardware so that it's safe from vandalism, tampering and theft.
- If considering a video component outdoors, how will the display hardware be made weather resistant for Calgary's climate?

6.4 Software-based artworks

6.4.1 Considerations before you begin

Before you begin developing the artwork system, there are a number of artistic decisions and broad practical considerations that you'll need to consider. Some of these considerations will need to be explored through conversations with other stakeholders, such as the City's IT department, electrical contractors, etc., in order to identify opportunities and constraints that could impact the approach taken to realize the artwork's concept. Depending on the nature of the artwork, these broad considerations can include, but are not limited to:

- **Location considerations:** Not unlike more traditional object-based artworks, safety, public interaction and location suitability need to be considered for software-based components of artworks as well. Some possible considerations may include:
 - Will any hardware or electrical components be accessible to tampering or theft?
 - Would the operation of the artwork pose any potential risks to the public? (e.g. Distracted driving? Sensory distress?)
 - Would the artwork present any content that could be traumatic or triggering for certain members of the public?
 - If the artwork is interactive, could members of the public engage with the artwork in a malicious manner that could pose harm to others?

Consider how any of the above risks could be mitigated while still realizing the artwork's concept.

- **Legal permissions:** What permissions will you require from any persons/companies/groups that will have material or intellectual property incorporated into the artwork? This could include, but is not limited to: images, audio or video of individuals; published or transcribed text materials; or any other copyrighted materials or components. When utilizing

proprietary software, read through terms and conditions around intellectual property very carefully to ensure you have full legal rights use it as you intend to in the artwork. Also ensure that the artwork's operation or preservation will not be restricted or bound in any way by intellectual property restrictions.

- **Software support/maintenance contracts:** Ideally, the requirement maintenance of the artwork software should be as minimal as possible. However, if ongoing maintenance and support of the artwork will be necessary, is critical this work should be within the capabilities of either IT professionals within The City or by any external IT specialized contractor. IT resources within The City are limited and can be cumbersome to coordinate or manage. Therefore, the establishment of an external maintenance contract is often the best option to support the artwork throughout its lifespan. If ongoing support will be required, the following steps should be taken early on during the artwork planning and development:
 - Identify and quantify the support that will be required. Obtain accurate cost estimates for the scope of work that will be required. If these costs exceed the Public Art maintenance and conservation budget available to support the artwork for the length of its lifespan, then project budget will need to be allocated and set aside to cover these costs.
 - Ensure that the scope and expertise of services required are readily available from a variety of local vendors. The City will be required to obtain multiple competitive quotes in order to procure software maintenance and support contracts.

- Work with The City to procure a maintenance and support contractor early on during the design development phase, so that the contracted vendor can be engaged during the design process and advise on maintenance/support considerations. Contracting the maintenance and support vendor early will also ensure a smooth transition once the artwork is operational and ready to be handed over to the Public Art Program.
- **Artistic approach to obsolescence:**
Carefully consider your artwork concept and whether there are any particular elements of hardware or technology you plan to use would compromise the artwork's integrity if they were to be lost or become obsolete. What are your comfort levels around migration and life-cycling of components throughout the life of the artwork? How can you mitigate this type of loss without shortening the intended lifespan of the work? Consider your preferred options and approach (such as purchasing of attic stock or outlining detailed specifications for replacement parts), work with conservators during the detailed design process to identify solutions, and clearly document your wishes and artistic intentions as you develop the artwork's stewardship manual.

6.4.2 During design and software development

- What measures can you put in place to prevent vulnerabilities or failures caused by dependency relationships? Particularly vulnerable dependencies include:
 - Particular versions of supportive software – for example plug-ins, drivers.
 - Particular versions of supportive hardware (for example, a particular type of GPU or particular models of cameras or sensors).
 - External links (web environment), web services and APIs.
 - Proprietary software.
 - Features of hardware which are likely to change (for example, types of connecting cables/ports).
- When possible, consider working on open-source platforms and using open-source supportive software. This is to mitigate the loss of work/need to re-engineer software developed in proprietary environments once they are no longer accessible.
- Consider the digital file formats you'll be using and how these may impact the preservation of the artwork. The Library of Congress has a helpful resource that outlines the following seven sustainability factors of file formats to consider: formats, evaluation factors and relationships (loc.gov).
- Consider utilizing a Version Control System (such as Git) to document and trace changes you make to software code over time.
- File access: The files should not contain measures that limit or control access to them or the overall artwork work (i.e. encryption, digital rights management technologies).
- How easily can the software program be troubleshooted or rebooted? Does this need to be done on-site? What are the challenges of troubleshooting on-site? (Consider physical access challenges, weather, security, etc.).

- Does the software program require a network/internet connection to function and be supported? How will this be achieved considering the nature of the artwork’s site? Note that connecting to The City’s network can be a complex process with a number of security measures involved, but may be a necessary requirement by City IT.
- How will you ensure that the artwork will automatically restart following a computer reboot or a power outage?
- When possible, utilize “off the shelf” manufactured hardware components that are readily available and easy to source for replacement/maintenance reasons. To avoid premature obsolescence or failure of hardware, some additional considerations include:
 - Is the equipment still being manufactured? Are parts still available?
 - How many years is the manufacturer committed to providing parts?
 - Would the replacement or migration of one hardware component create compatibility problems for another? Try to select hardware that is widely compatible with other components and across operating systems.
 - Are there methods you can implement to minimize the wear and tear of hardware components? For instance, how can temperatures be regulated to reduce stress on the equipment? Can you utilize heat sink cooling instead of fans? Can you reduce the number of moving parts by selecting different equipment options (e.g. solid state hard drives rather than spinning disk hard drives)? How can you protect the hardware from dust and debris?
 - If there are specific or unique hardware components that are critical for the artwork’s operation or artistic, budget should be set aside to purchase a practical amount of attic stock of these components so that they can be replaced as necessary, even if they become obsolete or difficult to source.

6.4.3 Software preservation considerations

Software-based artworks will generally need to undergo considerable change over the course of their lifetimes in order to ensure that they remain operational and accessible. In order to preserve the artwork and manage this change appropriately, The City’s conservation team will need to have a very in-depth understanding of the artwork and what is integral to it. Artists should therefore consider and discuss with the conservator the aspects of the artwork that they consider to be the “work-defining properties” of the artwork – meaning, what characteristics such as hardware elements, audiovisual content, aesthetic properties, installation components, spatial parameters, etc., are defining properties of the artwork’s identity and how it is experienced by viewers? As you work with the conservation team on the stewardship manual, we will go through and inventory all of the software, hardware and project files that make up the artwork, and identify which have aesthetic or conceptual significance and which are merely functional aspects of the work.

Along with the artwork stewardship manual, The City will require you to submit copies of artwork files to ensure the preservation of the artwork. Generally, these files will be required in a variety of formats to create:

- A native copy (i.e. a copy of the files produced in the original software/environment used to produce the artwork)
- A preservation copy
- An exhibition copy

These copies should consist of all assets/ materials required to maintain the proper work function of the artwork. This may include, but is not limited to:

- A master copy of the executable file and any additional files necessary to run the artwork (e.g. software libraries). Media files should be extracted and submitted separately from the software to reduce the risk of access loss.
- A master copy of the uncompiled, human-readable source code used to run the artwork.
- A copy of the source code editor and compiler.
- A disk image of the native copy/artwork computer (site computer) with the artwork installed and fully functional will also be required to submit to The City at the time of completion. This should capture:
 - Any third-party applications or browsers installed for the exhibition of the artwork.
 - The computer running the artwork as intended by the artist without the need for the installation or loading of any additional programs or files.
- Copies of supporting software, including production software, operating systems, media play-back software, libraries, plug-ins and drivers. Details of any applicable license keys or account information to access or update these components will also be required.

All files should be submitted on a hard drive storage device that has not been previously used. Preservation copies will not be accepted by online transfer. This is to eliminate risk of compression and loss.

The City must be granted the permissions to migrate, update and/or prepare further derivative copies of the artwork files if the need arises for the artwork's preservation or display. Ideally, any of this work would be done in consultation with the artist. The City compensates artists for their time whenever they are engaged for future conservation or restoration purposes. Note that because public software-based artworks are generally on display for a sustained period of time, The City may need to hire a third-party software maintenance contractor to support the continuous operation of the artwork. For this reason, permissions to access files and prepare derivatives will need to be extended to The City's partners, under strict oversight and regulation by The City's conservation team.

In addition to the preservation of the artwork software, technical specifications of the artwork's hardware will also need to be documented and preserved. The City may request attic stock of integral hardware elements, see above.

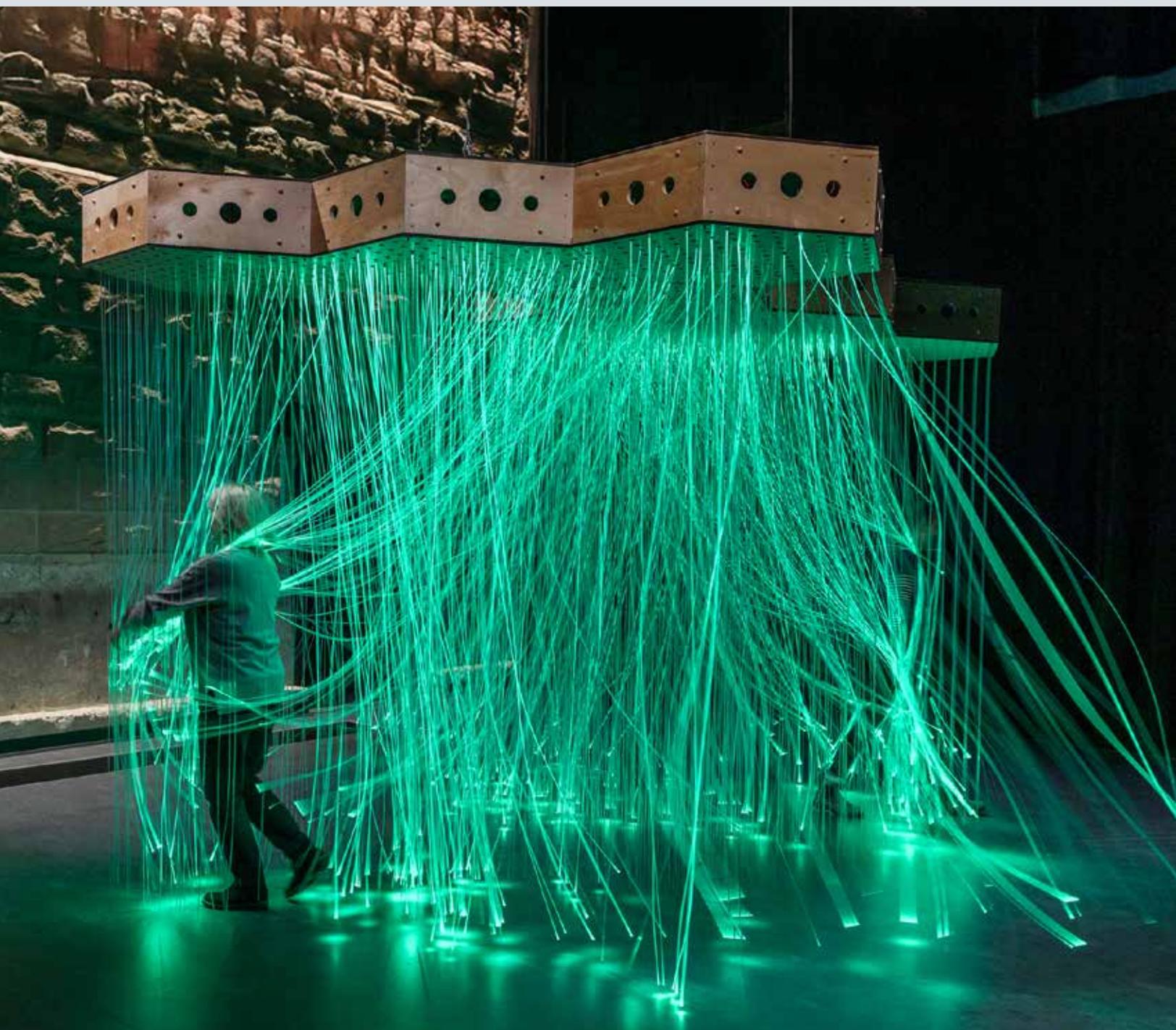
Finally, once the artwork is operational, it will be critical to document the intentional operation and experience of the artwork via video and/or screen recording. This ensures that if any future emulation or restoration work needs to take place, the City conservation team can reference this documentation to ensure the restored artwork is functioning as intended. A copy of this recording will be saved alongside the stewardship manual and the preservation copy of the artwork. Further written documentation around the intentionality and installation/display of the artwork can be captured in the stewardship manual.

6.5 Web-based artworks

In addition to the software-based artwork considerations listed above (Section 6.4), artworks that have a web-based component or a web-based interactive component should also consider the following:

- Consider where the artwork website will be hosted. How will you ensure the artwork's website remains supported throughout the duration of the artwork's lifespan? What will be the cost of hosting the artwork website over the course of its life? Will The City need the rights to any critical domains?
- What measures/maintenance procedures will need to be in place to ensure that website links (QR codes, URLs, APIs, external links) remain unbroken?
- If the artwork will use any real-time communication systems or data (e.g. active internet links, live feeds, GPS, atmospheric data, etc.), what maintenance procedures will be required to ensure the artwork remains functional?
- The artist may need to supply The City a full back-up of the website (web archive copy) for preservation purposes.

Ephemeral artworks



Trailing by Alia Shahab and Michel Gignac, 2021



Calgary Scroll (detail) by David Rokeby, 2017

An introductory note on performance, social practice and experience-based artworks

The Calgary Public Art Program recognizes that not all artworks are intended to be permanent or preserved. The City's Collections and Conservation team welcomes artists to work with them and direct them in how an artwork is meant to be preserved or evolve over time, as well as if and how it should be documented.

Whether an artwork is permanent or not, questions around artist and public safety, copyright and approaches around documentation generally still apply. This section outlines the considerations that artists will need to reflect upon and discuss with the Collections and Conservation Team as the artwork is being conceived and developed.

Artwork site(s) and public interaction

Safety

Consider whether the site(s) where the artwork will take place could present any health and safety challenges to the artists, anyone they are

working with or the public interacting with the artwork. Health and safety considerations may include, but are not limited to:

- Does the site have a history of any public safety issues?
- Will any security, peace officer or police presence be required to ensure the safety of all participants?
- Is the terrain of the site safe for the planned activities? Consider potential hazards such as proximity to water, slip/trip/fall hazards and overhead hazards.
- If the artwork will take place outdoors, how will you need to prepare for unpredictable or hard weather, such as extreme heat, cold or high wind? What contingency plans will need to be in place?
- What is the maximum number of people who can be present in the space due to fire code restrictions? How will this be controlled or enforced?

- A health and safety plan will likely need to be developed during artwork planning. This plan should include:
 - Emergency contacts lists.
 - Emergency response and, if applicable, evacuation procedures.
 - Plans for safety orientations, meetings and inspections, if applicable.
 - Hazards identification and control measures.
 - Lists and certifications of any required trained health and safety representatives (e.g. first aid).

The City will work with you to identify specific health and safety plan requirements relevant to the scope of your project.

Permits and bylaws

Depending on the planned activities of the artwork and the nature of the site, special permits may be required. For public sites, you may require special event permits, street use permits or environmental compliance approvals. The artwork may also be restricted by different city bylaws relating to noise, nuisances, outdoor lights, public behaviour, signage, streets, safe and inclusive access, or waste.

Accessibility, public safety and cultural safety

If the artwork is intended to involve public interaction, you'll want to consider accessibility, public safety, cultural safety and public permissions around photography and video. Consider what barriers may be in place that could prevent some members of the public from accessing the artwork.

- Will experience of the artwork be inclusive to those with physical or mental disabilities, those with sensory sensitivities?
- Will the artwork be welcoming and create a safe environment for all equity-deserving groups?

- Will any measures or plans need to be in place to address unwanted or hostile public interactions with the artwork or with any of its participants?
- If photography or video is being captured as part of the artwork or to document the artwork, consider what signage and/or waivers will be required to notify the public and to receive permissions to use images or video of participants.

Documentation

In the context of ephemeral art practices, the goal of documenting the artwork is generally to guide how it is remembered and interpreted over time. How should its story be told, and in some cases, how should it be engaged with again in the future? Recognizing that these types of artworks are generally not fixed or static, but often change over time, how should we record and understand the artwork's changes? How do we continue to situate the artwork in its social, cultural and/or political contexts?

Considerations for the artwork's stewardship and/or activation into the future

Conservation documentation is not neutral; it has a real impact on how artworks may be understood in the future. For this reason, artist involvement in the artwork's documentation is critical. It is often valuable for artists to begin thinking of how they want their work to live on (or not) already while they are conceiving/developing it. This section outlines some questions artists may wish to consider in regard to how the artwork should be interpreted and/or experienced in the future.

Documenting the intended concept and/or experience of the artwork

- What do you consider to be essential to the artwork, and what do you consider to be only supportive or associated elements?
- Is the artwork multifaceted with multiple forms of media? For instance, a performance work may have a sculptural component, or a social practice work may utilize communication tools like brochures and zines. What components do you consider to be part of the artwork and which are tangential to it? How would you like to see the artwork classified? (E.g. Should it just be classified as a performance work, or is it both performance and sculpture?)
- What aspects of the work are considered to be constant or unchanging, and what aspects are in flux – meaning you expect they will evolve over time?
- Does the artwork engage with any particular social, cultural, environmental or political contexts? How should the nuance of these contexts be communicated within the documentation of the artwork? Are there any contexts in which it would not be appropriate for the artwork to be realized?
- For interactive works: does social interaction drive or change the essence of the artwork? If yes, should the interaction be documented? How will you do this and what permissions may be required from participants?

Considering future activation or exhibition of the artwork

- Could the artwork ever be activated again in the future? What would this look like? Would you want this process to be controlled through performance specifications or installation instructions?

- Is the artwork dependent upon any specific individuals? Any particular sites or places? What about social dependencies: are there social/human interactions or behaviours that are an essential part of the artwork or that it relies upon to be experienced as intended? (For example, an artwork that depends on participants to interact with the work through their smartphones.) If the artwork were to be activated again in the future, how would you navigate the changes in social context that have occurred?
- Should future activations of the artwork be documented? Would future activations be considered part of the artwork and its evolution over time? Meaning, would they change the essence of the artwork or would they be considered more as interpretations of a fixed work, similar to the musical performance of a composition?
- Could documentation of the artwork ever be exhibited? What documentation would you like to see included in this?
- Are there any contexts in which it would not be appropriate for the artwork to be activated or exhibited?

Documentation methods and approach

The goal of artwork documentation is not to fix an “original” artwork into a static document that can be preserved. Rather, it’s a dynamic process with the intent to bear witness to the artwork, to the contextual information that it exists within and to any evolution or change it undergoes. The approach to how the artwork is documented can impact how it’s understood into the future and therefore should be artist-led. If you feel it is appropriate for your artwork to be preserved through documentation, you’ll need to work closely with the City Collections and Conservation Team to guide what this documentation should look like.

There are also limitations to documentation that must be considered. The experience, interpretation and memory of experience-based artworks are in a sense shared by all those who witness it. It is therefore only ever possible to document a partial viewpoint and understanding of the artwork. Documentation is subjective in that it is up to the artist, and to some extent the conservation team, to tell its story. Throughout the documentation process, it's important to consider: what information is being missed or left out?

Forms of documentation

There is no single approach to artwork documentation, it must suit the artwork and the artist's intentions around if and how they would like the artwork preserved. However, at a minimum, documentation should include the completion of the Stewardship and Conservation Manual, which is the document where the artist's intentions and wishes around preservation should be communicated in writing. The conservator will customize a template of this manual that is for the artwork that asks the critical questions necessary for a basic understanding of how the artwork should be stewarded into the future. Supplemental forms of documentation may include:

- **An extended artist interview:** This may be done to capture more detail than can be communicated in the Stewardship and Conservation Manual. The interview may be conducted in writing or via audio or video recording.
- **Sound and video recordings:** Media recordings of the artwork being performed/realized/experienced.

- **Written documentation:** A written piece or a collection of writings summarizing the experience of the artwork. This is one method to document multiple viewpoints, perspectives and experiences of the work. Consider what permissions may be required from the authors in order to include this as part of the artwork's record and to use it in the future.
- **Participant interviews:** This is another means to document different viewpoints, perspectives and experiences of the artwork. Interviews may be conducted in writing or via audio or video recording. Consider what permissions may be required from participants to include this as part of the artwork's record and to use it in the future.
- **Websites and blogs:** Digital repositories of information that may be produced as part of an artwork's realization. Consider whether these should be archived as part of the artwork's documentation. If the artwork were every to be activated again in the future, would these websites require reactivation and/or migration to a contemporary format?
- **Associated physical objects:** Physical objects produced for or during the realization of the artwork that can be subsequently preserved as utilized as artwork documentation. May include paper documents (such as brochures, flyers, testimonies, zines, etc.), sculpture or other objects significantly tied to the artwork. It's important to distinguish any of these elements that should be considered part of the artwork itself from those that are considered only associated or peripheral to the work.

- **Component inventories:** A documentation tool utilized by the conservation team to catalogue all relevant components of the artwork. This may be incorporated into the Stewardship and Conservation Manual.
- **Performance specifications or installation instructions:** Detailed instructions written by the artist outlining how the artwork should be performed, activated, installed or exhibited in the future. Depending on the artwork, these may be highly detailed and instructive, or may be a more general description of preferences.
- **Iteration or activation reports:** Supplemental documentation produced whenever the artwork is activated or performed. A template of these reports may be developed with the artist at the time of the artwork's commissioning to ensure that future activations of the work are being documented as intended. Iteration reports are specific to the display/exhibition of time-based media artworks.

Preservation of documentation

The types of documentation listed in the section above come in a variety of media formats (paper, objects, digital files, etc.), which all come with their own preservation requirements.

The City's conservation team is equipped to preserve all these forms of documentation; however, the same considerations apply as those described elsewhere in this document by material (e.g. Section 6.3 for video files). Please see the relevant material categories above for considerations around the design and preservation of different material/media formats of documentation.

Appendix A

The Public Art Collection and artwork acquisitions



Convergence by Laura Haddad and Thomas Drugan, 2017

The Calgary Public Art Collection vision, purpose and mandate

Vision

The City of Calgary Public Art Collection exists for the people of the city and the Indigenous people who live in Treaty 7. It grows within a collective memory that contains the knowledge and shared experiences of art in the city by its people. The collection builds on the art of its time, embraces ambition, recognizes its history and reckons with its colonial past. It engages art and ideas seeded in the land as well as beyond its own geographic boundaries. The collection contextualizes itself over time to weave together a narrative of art and place to be a marker of the deep-rooted history of this place, land and the contemporary moment.

Purpose

The Calgary Public Art Collection exists to:

- Foster, through experimentation and practice, the role of artists and public art in public space.
- Connect to and support living Indigenous knowledge and practices in this place now called Calgary.
- Share and further knowledge about contemporary art and Calgary art history.
- Share and contribute to histories of the region.
- Explore and interrogate how contemporary issues and discourses affect citizenry, civic discourse and civic action.

- Actively encourage and support the self-determination and formation of communities of marginalized people. Be open to the redefinition of what and who constitutes “the public.”
- Support and represent a diversity of artists, practices, ways of knowing and worldviews that are reflective of those who live in Calgary and Treaty 7.

Mandate

The Calgary Public Art Collection:

- Is a publicly accessible and publicly cared for art collection held in the public trust for the people of Calgary and Treaty 7 in perpetuity.
- Acquires diverse artworks to achieve equity within the collection.
- Stewards, researches, exhibits and fosters connections to its content through ongoing interpretation, education, programming, etc.
- Supports artists’ research and multidisciplinary art practices. Embraces holistic approaches to visual culture and cultural expression as practiced by diverse cultures.

Artist-led decision-making around artwork acquisition

The Calgary Public Art Program recognizes that Western art collections are intrinsically tied to a damaging colonial history of cultural theft and control, and that the practices of collecting and conservation are rooted in settler-colonial values. We are committed to respecting the rights of Indigenous peoples to maintain, protect and develop their cultural heritage as well as their visual and performing arts, as per UNDRIP articles 11, 12 and 31. As part of this, we understand the importance of following the artist's lead in respect to the decision-making around how their artwork is cared for. In response to the Truth and Reconciliation Commission's Call to Action #67, we are also committed to continue to reflect upon and change the institutional policies and practices of the Calgary Public Art Collection to better comply with UNDRIP, and to create a more culturally welcoming and safe environment for the stewardship, care and sharing of artworks.

We recognize that not all artists will wish to have their artwork formally acquired into the Calgary Public Art Collection. In some cases, the artwork may be culturally sensitive, and it may be inappropriate for The City to collect and own the artwork in this way. In other instances, collecting the artwork may be oppositional to the artist's concept and intentions around the work.

Traditionally, ephemeral art forms such as performance art challenged the art museum and the whole notion of collecting by creating temporary artworks that could not be fixed, owned, bought and sold. The rebellious history of these art forms is significant and continues to be relevant to ephemeral art practices today. In recent decades, however, there has been a shift in the contemporary art landscape, and we are now seeing many artists who have embraced the acquisition of their ephemeral works into

institutions. Acquisition into collections has become a means for these artworks to be documented and activated over time, and has become a method of ensuring artists working in these art forms can continue to be financially compensated for the experience, interpretation and exhibition of their work.

Objectives of collecting

In order to help an artist's decision making as to whether they wish for their artwork to be formally acquired into the Calgary Public Art Collection, it is helpful to consider what some of the motivations may be around collecting in general. The goals of collecting an artwork are diverse, as they include the interests of the artist, the Public Art Program, and the citizens of Calgary and Treaty 7. Motivations may also be unique to a particular artist or work.

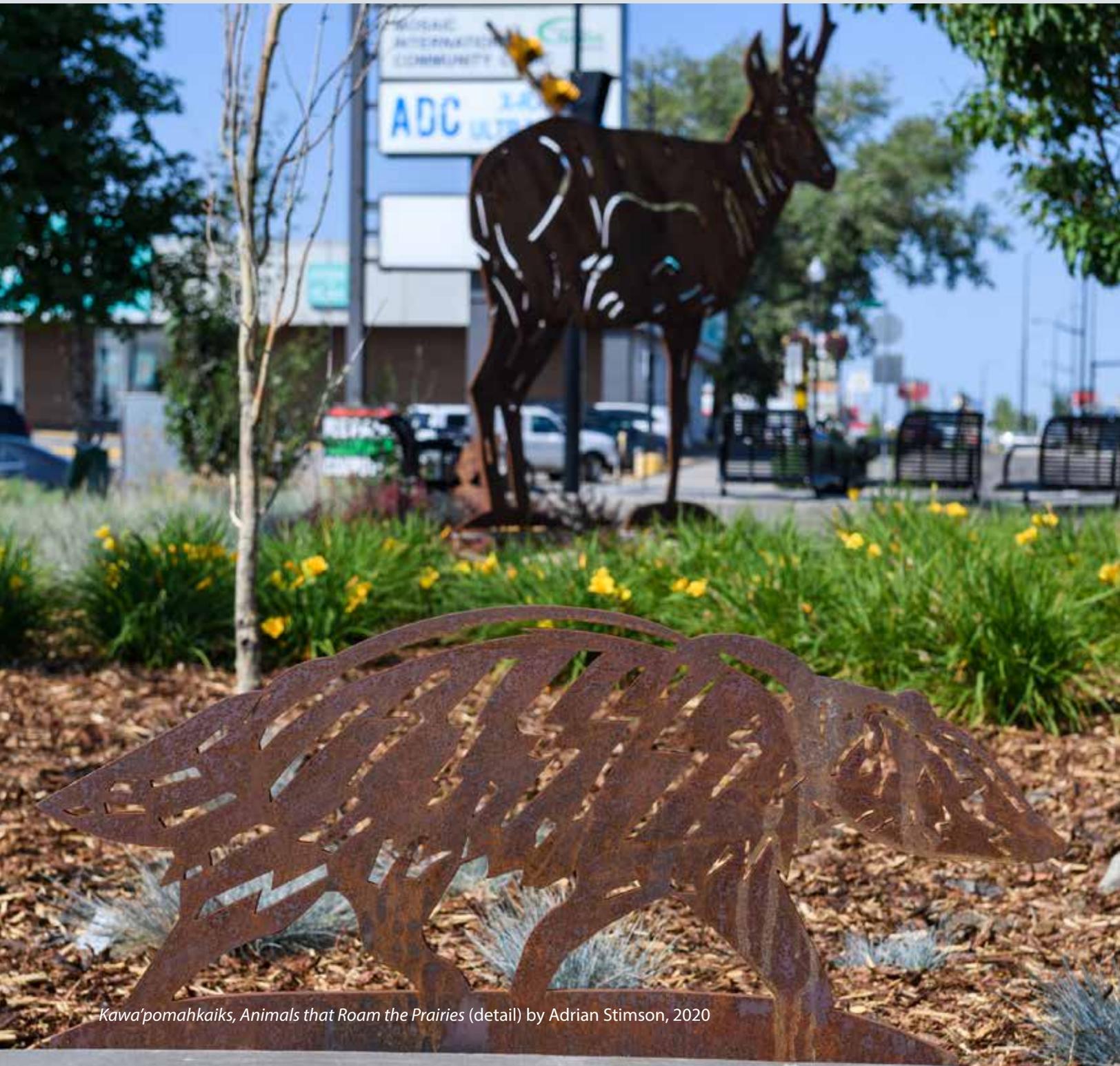
From the perspective of the Calgary Public Art Program, the goals of bringing artworks into the Calgary Public Art Collection include:

- Share, interpret and preserve our city's cultural legacy through art.
- Provide free access to art through the continued sharing of artworks with the citizens of Calgary and Treaty 7. This is achieved through artwork exhibition, storytelling, research and programming.
- To provide the space and resources to either preserve the artwork or responsibly manage its evolution over time. This is achieved through collections and conservation tools such as:
 - A collections management framework that directs the operations of the collections and conservation team to align with best practices in the art field.

- A specialized collections database (Collections Management System or CMS) to catalogue and preserve information relevant to the artwork.
- Conservation documentation, such as the artwork stewardship and conservation manual, condition reports, damage reports and treatment reports. For ephemeral artworks, this may also include artist interviews, component inventories, iteration/activation reports and performance specification templates.
- Regular monitoring of an artwork's condition and the performance of any required artwork maintenance and/or conservation treatment.
- A climate-controlled and secure art storage environment that is consistently monitored.
- To support artists in their careers as an example of a collection holding their artwork.
 - Unless an artwork is offered as a gift or a donation, artists are paid for the acquisition of their artwork.
 - Artists are paid exhibition fees (following current CARFAC rates) whenever their artwork is exhibited with other institutions.
 - Although as a public collection it does not directly participate in art economies (artworks stewarded by the Calgary Public Art Collection are not typically sold), artists can still benefit financially from having artworks represented in the collection, as it can potentially increase the exposure, demand, or value of an artist's work.
 - Artists are paid exhibition and/or reproduction fees (following current CARFAC rates) whenever their artwork is included in coordinated exhibitions and related published materials.

Appendix B

Further resources



Kawa'pomahkaiks, Animals that Roam the Prairies (detail) by Adrian Stimson, 2020

City of Calgary standards, policies and guidelines

[Public Art Policy](#)

[Advisory Committee on Accessibility – Access Design Guidelines Standards](#)

[Design Guidelines for City of Calgary Funded Buildings](#)

[Climate Resilience Strategy](#)

[2023-2026 Climate Implementation Plan](#)

[Sustainable Building Policy and Guidance Document](#)

[Transit-Oriented Design Guidelines](#)

[Development Guidelines and Standard](#)

[Specifications: Landscape Construction](#)

[Urban Forestry Plan](#)

[Our BiodiverCity](#)

[City of Calgary Bird Friendly Urban Design Guidelines](#)

[Centre City Illumination Guidelines](#)

[Standard Specifications Road Construction](#)

[Centre City Urban Design Guidelines](#)

[Paint the Pavement Program](#)

National and provincial codes and standards

[National Building Code](#)

[Alberta Building Code](#)

[Alberta Building Code's Barrier-Free Design](#)

[National Fire Code – 2023 Alberta Edition](#)

[Canadian Electrical Code and Alberta Electrical Utility Code](#)

Other useful reference materials

[Washington State Arts Commission Materials and Fabrication Handbook](#)

The Artists' Handbook of Materials and Techniques, 5th Edition. Ralph Mayer, 1991.

Modern Metals in Cultural Heritage: Understanding and Characterization. Virginia Costa, 2019.

Conservation of Time-Based Media Art. Deena Engel and Joanna Phillips (Eds.), 2022.

Stone Conservation: An Overview of Current Research, 2nd Edition. Eric Doehne and Clifford A. Price, 2010.

Properties of Plastics: A Guide for Conservators. Thea B. van Oosten, 2022.

[Sustainability Tools in Cultural Heritage \(STiCH\)](#)

[Urban Art Project \(UAP\) – Artwork Ingredient List project](#)