**City of Fredericton**
November 21, 2012

# Fredericton Playhouse Condition Assessment

**RVA No. 122576**

# Final Report

# FREDERICTON PLAYHOUSE CONDITION ASSESSMENT

# FINAL REPORT

Prepared for:

City of Fredericton



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# FREDERICTON PLAYHOUSE CONDITION ASSESSMENT

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# EXECUTIVE SUMMARY

This report presents the results of a high level condition assessment of the Fredericton Playhouse, a life cycle cost analysis of refurbishing the current facility or building a new facility at either the current location or a new location, and a sustainability rating of these same options using a Stage 1 Assessment of the Envision™ sustainability rating system. The objective of the above analyses was to evaluate the current condition of the Playhouse and provide insight into either refurbishing the Playhouse or constructing a new performing arts facility based on financial and sustainability data developed using a standardized approach.

The condition assessment indicates that overall the Playhouse is in fair to poor condition, but that there are a number of code and accessibility issues, and that the entire electrical and mechanical systems are in poor condition and should be completely replaced (based both on their overall condition and code compliance issues).

A full life-cycle cost analysis was performed for the refurbishment of the Playhouse, as well as the construction of a new facility of equal size or a larger facility. The life-cycle costs analysis included both the total construction costs (consisting of the capital cost and the debt servicing cost over 20 years) as well as annual average operating costs (consisting of: energy costs (heating and cooling), operational costs (e.g. custodial services, waste management, water and sewer services) and maintenance and repair costs (e.g. roof replacement, window replacement, repainting)).

The cost analysis indicated that the construction of a new 24,000 $ft^2$ facility would be the most cost effective option, as shown in the following table.

Summary of Annual Costs

| Scenario | Initial Construction Costs | Annual Debt Payment<br>Over 20 Years | Annual Operating Cost<br>(ref. Table 9) | Total Cash Outflow<br>Over 50 years | Present Value of 50 Year Lifecycle Costs |
|---|---|---|---|---|---|
| Refurbish Existing (rebuild in 30 yrs.) | $12,300,000 | $925,204 | $438,000 | $111,156,590* | $34,734,147** |
| New 24,000 $ft^2$ Facility (50 year lifecycle) | $16,100,000 | $1,211,039 | $438,000 | $67,141,176 | $30,146,363 |
| New 40,000 $ft^2$ Facility (50 year lifecycle) | $28,000,000 | $2,106,155 | $730,000 | $113,657,090 | $51,410,605 |

*Includes construction of a new 24,000 $ft^2$ facility after 30 years

**Includes the residual value of the facility at the end of 50 years

The Envision™ Stage 1 Assessment is used to assist with evaluating the sustainability aspects of the different options. The assessment did not provide a strong indication of a preferred alternative at both the high level and detailed categories primarily because the sustainable contributions of the facility can be incorporated in both the refurbishment or replacement options.

While the report identifies risks involved with each option, the refurbishment of the existing facility has the biggest risks (construction risks and business interruption) and the shorter useful life on investment. The construction of a new facility at the same location does reduce the construction risk but does not eliminate the significant business interruption. The construction of a new facility at a new location either of the same size or a larger size reduces the construction risk and the business interruption. The costs associated with land acquisition and disposal, demolition, decommission and re-commissioning has not been included in our analyses.

The results of the above analyses indicate that the construction of a new facility has the lowest total annual cost and that there is no significant environmental or sustainability advantage for refurbishing the existing facility or constructing a new facility, based on the Envision™ sustainability rating system. The preference of building a new facility is further supported by the significantly higher level of uncertainty associated with the capital cost of the refurbishment option.

We recommend that the City review this report and develop a policy to establish the variables that should be subjected to a life cycle analysis to evaluate and compare future infrastructure projects. We also recommend that the City define their corporate goals with respect to advancing infrastructure projects that are sustainable from an economic, social and environmental perspective.

# 1.0 INTRODUCTION

## 1.1 Project Retainer

R.V. Anderson Associates Limited (RVA) was retained by the City of Fredericton to perform a high level condition assessment of the Fredericton Playhouse and evaluate refurbishing the current facility or constructing a new facility at either the current location or a new location. In addition to the condition assessment, an analysis of the capital costs, debt servicing costs, energy costs, operations costs and repair & maintenance costs is performed to assist with the evaluation of the different options. Finally, the alternatives are evaluated using the Envision™ infrastructure sustainability rating system developed by the Institute for Sustainable Infrastructure. RVA's approach to complete the project was detailed in the proposal document submitted May 14, 2012.

## 1.2 Project Objectives

The objectives of the project were to perform a high level condition assessment of the existing Playhouse performing arts facility, and to evaluate if the existing Playhouse should be rehabilitated or replaced with a new performing arts facility. The different options were compared using financial information and a project evaluation based on the Envision™ Stage 1 Self-Assessment. The annual energy costs are analyzed under the framework of international life cycle analysis standards ISO 14040/14044.

## 1.3 Project Challenges

The Fredericton Playhouse was built in 1961 and has seen many upgrades over the years. It is understood that while many betterments have been added to the Playhouse, many of the building's core component are still original and need to be replaced or refurbished. A detailed condition assessment of the current facility would be a significant undertaking due to the number of building components that require replacement. An approach to deal with the above project challenges was identified in RVA's proposal document, and is reported in later sections of this report.

## 1.4 Approach

As mentioned above, a detailed condition assessment at this stage of the planning process would be costly and would not provide an indication of the full cost of ownership of the facility as it does not include the annual operating costs. The approach taken in this study was to use the component profile of the Playhouse (similar to those in the City's Tangible Capital Asset inventory of facilities) to evaluate the condition of the existing facility at a high level, and facilitate the development of comparable capital costs to rehabilitate or replace the Playhouse.

In order to go beyond the capital costs associated with the rehabilitation or replacement of the existing facility, the annual average operating cost (energy, operations and repairs & maintenance) of the different options is also evaluated. This will ensure that the alternatives are compared based on the full cost of ownership over their projected life spans.

The Envision™ rating system is also used to evaluate the sustainability of the alternatives beyond the capital or operating costs. The Stage 1 Self Assessment of the Envision™ rating system is used as a backdrop in the evaluation of the alternatives. The Stage 1 approach is intended for the pre-planning phase of projects to evaluate the options in using economic, social, and environmental dimensions. This process will attempt to determine the most sustainable project for the City. The details of these approaches are described in later sections of the report.

# 2.0 Condition Assessment

## 2.1 General Facility Condition

The Fredericton Playhouse was originally constructed in 1961. The facility has a seating capacity of approximately 700 and a gross floor area of 24,000 $ft^2$ (2,230 $m^2$). The usable area of the facility is approximately 18,000 $ft^2$ (1,672 $m^2$). Over the past several years there have been a number of investigations into the condition of the various components of the facility. Although there have been a number of refurbishment projects completed on the facility over the past decade, the result has been only a marginal improvement in some of the systems. The following points summarize the current condition of the facility:

- The mechanical and electrical systems require complete replacement.
- Significant structural refurbishment is required.
- The building envelope (with the exception of the roof) is inefficient and needs to be completely refurbished.
- There are several code violations and inadequacies (e.g. barrier free access and fire exits, sprinkler system upgrades).
- The public gallery and the exterior façade are in fair condition.

In general the facility is in fair to poor condition.

## 2.2 Facility Functionality

Although it is not within the scope of this project to evaluate the functional adequacy of the facility, it is noted that previous reports have indicated that the existing facility is inadequately sized for a number of functions including the size of the public gallery and the rehearsal space.

## 2.3 PSAB 3150 componentization

During the past years, the City of Fredericton has been reporting their financial statements in accordance with the PSAB 3150 guidelines. These guidelines require municipalities to account for every asset they own. In order to facilitate the financial reporting for complex facilities like the Playhouse, RVA has developed a component profile that distributes the total cost of a facility into seven categories (Table 1). These profiles can be used to project future cost requirements, in addition to satisfying the financial reporting requirements of PSAB 3150.

Table 1 – PSAB Component Profile for the Fredericton Playhouse

| Component | Structure | Architectural Exterior | Architectural Interior | Building Mechanicals | Building Electricals | Specialty Items and Equipment | Site Works |
|---|---|---|---|---|---|---|---|
| Percentage of Total Facility Cost | 19% | 19% | 16% | 18% | 17% | 5% | 6% |

## 2.4 Component Condition Assessment

On April 25, 2012 RVA completed a site visit to the Fredericton Playhouse to determine the condition of the facility at the PSAB component level of detail. RVA staff investigated all of the relevant mechanical and electrical rooms in the facility. The condition assessment was based solely on visual observations with no physical testing of any of the components. Subsequent to the site visit, City staff provided RVA with a list of refurbishment projects that had been completed at the Playhouse over the past several decades. This site visit and upgrade information was compiled to develop a high level condition assessment for each component of the facility, which is presented in Table 2.

Table 2 – Component Condition Assessment

| Component | Condition | Comments |
|---|---|---|
| Structure | Fair | The building structure is original to the facility. Some localized significant damage was observed. |
| Architectural Exterior | Fair | Block walls and single pane windows with poor insulating qualities, although the physical condition is fair. The roof was completely replaced in 2010. |
| Architectural Interior | Fair | Some upgrades over the past decade to carpets, seating and public washrooms. Overall the interior finishes are in fair condition. |
| Building Mechanical | Poor | Some work has been completed on the mechanical system over the past decade, however overall the various systems are in poor condition. It is noted that in 2011 the cooling system was modified to use the chiller from the adjacent convention centre. |
| Building Electrical | Poor | The majority of the electrical system is in poor condition with some components being original to the facility. |
| Specialty Items and Equipment | Fair | Some production equipment has been upgraded over the past few years. |
| Site Works | Good | The exterior grounds of the facility were upgraded in 2010 and are in good condition. |

## 2.5 Operational Concerns

Through discussions with Playhouse staff and a review of previous reports, it is apparent that there are significant operational concerns with the facility. The primary complaint is the inadequacy of the mechanical systems to effectively heat or cool a majority of the areas in the building. These issues are attributed to the number of additions to the mechanical system that have been completed over the years as the facility was expanded, as well as the lack of sufficient insulating properties of the exterior block walls and single pane windows. The Playhouse has several mechanical rooms that control the building services to separate parts of the facility.

# 3.0 Evaluation of Alternatives

## 3.1 Development of Alternatives

The alternatives that are considered in the analysis are the refurbishment of the existing facility, the construction of a new facility of similar size, and the construction of a new, larger facility. Capital costs and associated debt servicing costs are developed for these three alternatives. The annual energy and maintenance & repair costs were analyzed for the existing facility based on historical records, and were calculated for the refurbishment and new construction alternatives. The Envision™ assessment was conducted for three alternatives of rehabilitating the existing facility, constructing a new facility at the same location, and constructing a new facility at a new location.

## 3.2 Life Cycle Analysis

The development and evaluation of alternatives is guided by the international standards ISO 14040 – Environmental Management – Life Cycle Assessment – Principles and Framework and ISO 14044 – Environmental Management – Life Cycle Assessment – Requirements and Regulations.

It is important to note that ISO 14040 and 14044 are intended to integrate environmental management with a formal life cycle analysis. The standards are used to guide the development of a life cycle analysis of any number of variables within a defined system boundary. For example, the variables or factors that could be subjected to a life cycle analysis for a given system include:

- Costs
- Carbon dioxide emissions
- Embodied energy
- Fuel consumption
- Waste generation

The standards are a useful tool to assist a project team with first selecting the variables that should be analyzed, and then defining the system boundary. In the analysis in Section 3.4 of this report, the system boundary is the Playhouse and the variable that is being analyzed is the cost of energy associated with the electricity and natural gas consumption.

For purposes of discussion, the natural gas consumption could also be used to analyze the life cycle greenhouse gas emissions by converting the estimate of natural gas that will be consumed to equivalent greenhouse gas emissions. For example, 1 $m^3$ of natural gas = 1.8 kg of $CO_2$ emissions. However, for the purposes of the analysis in this report, the life cycle variable that was quantified is costs (i.e. 1 $m^3$ of natural gas = $0.40).

The City should develop a policy to establish the variables that should be quantified through a life cycle analysis for the purposes of evaluating and comparing infrastructure projects.

## 3.3 Capital Costs

Capital costs are estimated for both the refurbishment and replacement options based on accepted industry cost resources, including the Marshal & Swift Valuation Service and R.S Means. Some aspects of the construction activities are difficult to estimates, such as additional costs to achieve LEED accreditation; however the costs that are provided account for a moderate amount of sustainable components in the construction activities. In order to allow for a direct comparison of alternatives, see table 5. Please note that no cost allowances for land and decommission have been made.

### 3.3.1. New Construction

Using the above cost resources, the capital cost for the replacement of the existing 24,000 $ft^2$ facility is estimated to be approximately $16.1 million including allowances for soft costs and contingencies, but excluding land acquisition if the new construction is at a different site. This estimate is based on replacing the existing facility with one of similar size (i.e. approximately 24,000 $ft^2$). However, it is noted by some that the existing facility layout is considered to be inadequate based on the over 700 person capacity and the relatively small size of the public gallery. A new facility of a similar size is likely to have a reduced number of seats to create a building that functions properly and is adequately suited for the number of seats. A new facility should have a useful life of approximately 50 years before major refurbishments are required.

The breakdown of the replacement cost by PSAB component is provided in Table 3.

Table 3 – Replacement Cost Estimate

| Component | Percentage of Total Facility Cost | Cost (millions) |
|---|---|---|
| Structural | 19% | $2.3 |
| Architectural Exterior | 19% | $4.0 |
| Architectural Interior | 16% | $3.0 |
| Building Mechanical | 18% | $2.8 |
| Building Electrical | 17% | $2.2 |
| Equipment | 5% | $0.8 |
| Site Works | 6% | $1.0 |
| TOTAL | 100% | $16.1 |

A new facility that can accommodate over 700 seats and is properly sized in terms of public areas, performance areas and backstage area may be up to 40,000 $ft^2$ (3,716 $m^2$) with a usable area of at least 30,000 $ft^2$ (2,787 $m^2$). The capital cost of a new facility of this size is estimated to be approximately $28.0 million.

### 3.3.2. Refurbishment

As described in Section 2, the majority of the existing facility is in fair to poor condition. The majority of the facility would need to be completely refurbished to bring the facility up to the current building code standards. Due to the condition of the existing facility and the condition and arrangement of the mechanical and electrical systems, a minor rehabilitation of the existing facility would not be cost effective.

Table 4 presents the estimated cost of the refurbishment based on the condition assessment provided in Section 2 and the cost estimate of a new facility provided in Section 3.3.1. The total estimated cost for the refurbishment of the facility would be approximately $12.3 million including allowances for soft costs and contingencies. A rehabilitation effort at this scale would essentially be almost a complete rebuild of the entire facility and should extend the useful life of the facility by approximately 30 years.

Table 4 – Refurbishment Cost Estimate

| Component | Component Cost (millions) | Component Condition | Percentage of Component Requiring Refurbishment | Cost Estimate of Refurbishment (millions) |
|---|---|---|---|---|
| Structural | $2.3 | Fair | 50% | $1.2 |
| Architectural Exterior | $4.0 | Fair | 75% | $3.2 |
| Architectural Interior | $3.0 | Fair | 75% | $2.3 |
| Building Mechanical | $2.8 | Poor | 100% | $2.8 |
| Building Electrical | $2.2 | Poor | 100% | $2.2 |
| Equipment | $0.8 | Fair | 75% | $0.6 |
| Site Works | $1.0 | Good | 0% | $0 |
| TOTAL | $16.1 | | | $12.3 |

### 3.3.3. Summary of Capital Costs

Table 5 summarizes the capital costs associated with the replacement or refurbishment of the Playhouse and the useful life of each option. Table 5 also summarizes the cost of borrowing the initial capital over a 20 year term with an interest rate of 4.25%.

Table 5 – Summary of Capital Costs

| Scenario | Capital Cost (million) | 20 Year Borrowing Cost (million) | Total Cost of Construction (million) | Useful Life | Annual Debt Payment Over 20 years |
|---|---|---|---|---|---|
| New facility – 24,000 $ft^2$ | $16.1 | $8.1 | $24.2 | 50 yrs | $1,211,039 |
| New facility – 40,000 $ft^2$ | $28.0 | $14.1 | $42.1 | 50 yrs | $2,106,155 |
| Refurbishment of Existing Facility | $12.3 | $6.2 | $18.5 | 30 yrs | $925,204 |

## 3.4 Annual Operating Costs

The annual operating costs of the existing Playhouse are first compared to industry standards using existing historical records provided by the City, building modeling software to estimate the energy demands for an efficient facility of similar size, and standard industry cost resources for maintenance and repair costs of similar types of facilities. Next, the annual operating costs for the three alternatives are developed based on industry accepted cost resources.

In the context of a building such as the Fredericton Playhouse the operating costs can generally be grouped in to one of the following categories:

- Energy (section 3.4.1)
- Building Maintenance and Repair Activities (section 3.4.2)
- Custodial Services (operational costs, section 3.4.3)
- Grounds Services/Winter Maintenance (operational costs, section 3.4.3)
- General Management & Security (operational costs, section 3.4.3)
- Waste Management (operational costs, section 3.4.3)
- Telecommunication (operational costs, section 3.4.3)
- Water and Sewer Services (operational costs, section 3.4.3)

### 3.4.1. Annual Energy Costs

A building model was developed using a software application called eQuest and accepted industry cost resources to estimate the annual electricity and natural gas costs for a new 24,000 $ft^2$ facility (i.e. similar dimensions to the Fredericton Playhouse) and a new 40,000 $ft^2$ facility. It has been assumed that a major refurbishment will result in a facility that has efficiency levels that are the same as a new facility. A summary of the assumptions used in the modeling process are provided in Appendix A.

The results of the computer model results and a comparison of actual historical records from the existing facility are provided in Table 6. It is evident from the comparison that the existing facility uses much more natural gas to heat the facility then a new energy efficient building of similar size should consume.

Table 6 – Annual Energy Costs

| Scenario | Annual Electricity Cost | Annual Natural Gas Cost | Total Annual Energy Cost |
|---|---|---|---|
| Existing 24,000 $ft^2$ Facility (Historical Records)* | $59,000 | $67,000 | $123,000 |
| New Construction or Refurbishment of Existing 24,000 $ft^2$ Facility (Computer Model) | $57,000 | $21,000 | $78,000 |
| New 40,000 $ft^2$ Facility (Computer Model) | $90,000 | $40,000 | $130,000 |

*Note: Historical numbers are based on the average of 2009-2011

The inefficiency in the operation of the mechanical system is attributed to the addition of separate heating systems over the decades. It was also noted during the site visit that a number of the steam traps in the facility were not in proper working order, resulting in much more steam needing to be produced than what should be required.

### 3.4.2. Maintenance and Repair Costs

The City provided records of the maintenance and repair activities at the Playhouse over the past several years. These records included annual maintenance contracts, general building maintenance & repairs, and major capital expenditures. The average annual cost over the period from 2009 to 2011 was approximately $290,000 or $12 per $ft^2$ ($129 per $m^2$) Industry accepted cost resources suggest that an average annual cost over the life cycle of a facility of this type should be in the range of $5-$6 per $ft^2$ ($54-$65 per $m^2$), however in the last 20 years of a facilities' life span the industry cost resources suggest that an average annual cost of closer to $7 per $ft^2$ ($75 per $m^2$) is more appropriate. It is evident from the review that the existing maintenance & repair costs of the Playhouse exceed industry standards by at least 70%.

Proper asset management practices aim to ensure that the right amount of money is spent on the correct component at the most efficient time during its life. The elevated maintenance and repair costs suggest that the continual investment in the facility is not the optimal use of resources. This is due to the poor condition of many of the existing components. Rehabilitating or replacing the facility should reduce the annual maintenance & repair costs to a level on par with a newly constructed energy efficient facility.

Table 7 provides average annual maintenance & repair costs based on industry standards. These costs include the average annual costs to make periodic replacements of the major components of the electrical, mechanical & architectural systems over the building life cycle, as well as annual maintenance & repair costs of smaller components.

Table 7 – Average Annual Maintenance & Repair Costs

| Scenario | Average Annual Maintenance & Repair Costs |
|---|---|
| New Construction or Refurbishment of Existing 24,000 $ft^2$ Facility | $120,000 |
| New Construction of 40,000 $ft^2$ Facility | $200,000 |

### 3.4.3. Operational Costs

This section summarizes the other expected costs for the annual operation of the Playhouse for the factors that will not change for the different options (i.e. everything else except energy and average annual maintenance & repair costs). Table 8 provides an estimate of the annual operational costs for the proposed options based on industry standards for facilities of this type of approximately $10 per $ft^2$.

Table 8 – Other Annual Operational Costs

| Scenario | Annual Operational Costs |
|---|---|
| New Construction or Refurbishment of Existing 24,000 $ft^2$ Facility | $240,000 |
| New Construction of 40,000 $ft^2$ Facility | $400,000 |

### 3.4.4. Summary of Annual Operating Costs

It is evident from the analysis that the existing Playhouse has annual energy costs and maintenance & repair costs that exceed industry accepted standards.

Table 9 summarizes the annual operating costs for the proposed alternatives for both the new construction/refurbishment of the existing facility or the construction of a new larger facility. As mentioned in Section 3.4.1, it has been assumed that the refurbishment option will achieve efficiency levels on par with a new facility, and therefore the annual operating costs are equal in the analysis provided this section.

Table 9 – Total Annual Operating & Maintenance Costs

| Scenario | Annual Energy Cost | Annual Maintenance & Repair Costs | Annual Operational Costs | Total |
|---|---|---|---|---|
| New Construction or Refurbishment of Existing 24,000 $ft^2$ Facility (Industry Standards) | $78,000 | $120,000 | $240,000 | $438,000 |
| New 40,000 $ft^2$ Facility (Industry Standards) | $130,000 | $200,000 | $400,000 | $730,000 |

## 3.5 Envision™ Stage 1 Assessment

The Envision™ sustainability rating system is a tool developed by the Institute of Sustainable Infrastructure to move projects toward increased sustainability. The Stage 1 Assessment of the Envision™ system is intended for use at the pre-planning stage of a project to assist in determining if the right project is being considered/constructed.

There are five main sections of the Envision™ system (Quality of Life, Leadership, Resource Allocation, Natural World and Climate/Risk) that contain fifty five (55) individual credits. The Stage 1 Assessment reviews the 55 credits for their applicability to the specific project and attempts to determine if one alternative is preferred over another based on the elements of the rating system. Appendix B contains a summary of the 55 credits.

When using the Envision™ system to complete the assessment of alternatives, it is important to understand how each credit can be achieved. For example, the "Divert Waste from Landfill" credit is achieved by demonstrating that a percentage of waste that would have gone to a landfill is being diverted when comparing the proposed approach versus the baseline approach. Therefore, it is possible to achieve the same diversion target for each of the alternatives that are being considered.

The purpose of the Stage 1 Assessment is to quantify the potential sustainable performance contributions of the alternatives being considered for the Playhouse, namely a new facility at either the same location or a new location, or the refurbishment of the existing facility. At the preliminary level of detail of this report, it is not possible to determine what particular level of achievement will be for each alternative for the majority of the Envision criteria. The same achievement levels can be applied in the design of each alternative.

The following sections outline how the unique aspects of each alternative can be viewed in relation to the Stage 1 Assessment.

### 3.5.1. Replacement of the Existing Fredericton Playhouse at the Same Location

The replacement of the existing facility at the same location would have an advantage to the refurbishment option because it provides the opportunity to improve the building's functionality. This could include a secondary performance space in a new facility or the inclusion of an orchestra pit in the main performance space. A new facility at the existing location could replicate some of the architectural features associated with the existing facility, as well as maintain the integration with the Fredericton Convention Centre and the location of significance within the downtown core. A new facility could also enhance the environmental sustainability of the facility, such as reducing water consumption, the installation of a rainwater harvesting system, or the use of geothermal heating. These measures would be much more difficult to incorporate into the refurbishment of the existing facility.

### 3.5.2. Replacement of the Existing Fredericton Playhouse at a New Location

The primary advantage to replacing the existing facility at a new location is the opportunity for the project to act as a catalyst to redevelop a different part of the downtown core. If a suitable location could be selected, the quality of life of the surrounding residents and businesses could improve with the increased pedestrian and vehicular traffic that would be associated with the facility. The same considerations for maintaining the relevant architectural features of the existing facility and increasing the environmental performance of the building could be adopted in the new facility at a new location. Moving the facility to a new site would also leave the existing site open for development into a new public space or other facility for users of the convention centre to enjoy.

### 3.5.3. Refurbishment of the Existing Fredericton Playhouse

The most significant consideration for the refurbishment option is the preservation of the historical building and the character of the local area. Although the existing Playhouse is not historically or architecturally significant, the residents of Fredericton have come to view the facility as a cultural landmark in the downtown area. Refurbishment of the existing facility could preserve some of the architectural aspects of the facility while improving the operational efficiency of the building. A major refurbishment effort would reduce the energy consumption and annual maintenance costs to levels on par with a new facility (as described in Section 3.3). Rehabilitating the facility would also preserve the integration with the adjacent Fredericton Convention Centre.

### 3.5.4. Continuity of Use

The options to refurbish the Playhouse or replace the facility at the same location would have the negative effect of eliminating the use of the existing facility for performances for the duration of the construction activities. This could be in the range of 18 to 36 months depending on the scope of the final design. The construction at a new facility at a new location would ensure the continuity of use of a performance space as the existing Playhouse could be in use until the new building is completed.

### 3.5.5. Summary

At the level of detail of this report, the Envision™ Stage 1 Assessment did not provide a strong indication of a preferred alternative at both the high level and detailed level. There are opportunities to advance sustainable performance of the facility through both the replacement or refurbishment of the existing Playhouse.

# 4.0 ASSOCIATED RISKS AND CONSIDERATIONS

## 4.1 New 24,000 $ft^2$ Facility

There are risks and factors that cannot be quantified at this level of study but must be considered upon decision making. We have identified the risks and considerations to be:

- land acquisition cost: in the alternative of building a facility at a new location, the cost of acquiring land is not included in the construction cost estimates and it has been excluded from the financial analysis,
- costs of demolition, decommission and re-commissioning: the cost associated with demolition of the existing facility and any work done to the existing land has not been included in the construction cost and has been excluded from the financial analysis,
- value of land for resale: in the alternative of building a new facility at a new location, the income from selling the land at the existing facility has not been subtracted from the construction cost and has been excluded from the financial analysis,
- business interruption: in the alternative of building a new facility at the same location, a business interruption of approximately 18-36 months to the Playhouse's operations, and
- the impact on the performing arts community: previous reports addressed the need for a larger venue and indicates that a building of the same size may reduce the seating capacity. The Playhouse board, performers and patrons may not be willing to accept a facility with a smaller seating capacity. There could also be a risk if the community desires to retain the existing facility along with the new facility.

## 4.2 New 40,000 $ft^2$ Facility

In addition to the land acquisition costs, costs of demolition decommission and re-commission, value of land for resale and other risks must be taken into considerations for the larger facility.

They are:

- higher operating and maintenance cost: this has been discussed in the financial analysis but the increase in operating and maintenance may not be supported by the performing arts community or the tax base, and
- rising interest rates and construction costs: because of funding constraints and also because the Playhouse has performances scheduled 2 years in advance, the construction of the project may not occur immediately. The interest rates and construction cost could increase (or decrease).

## 4.3 Refurbishing the Existing Facility

There are greater risks associated with the rehabilitation of the existing facility. In addition to the shorter useful life on the initial investment, there are:

- building code requirements: significant renovations like this require upgrades for building code compliance. Fire safety codes and accessibility codes could impact the budget and increase space constraints, and
- contingency costs: cost could increase drastically due to unforeseen conditions (e.g. major structural deterioration similar to that encountered during the attempted rehabilitation of Moncton High School, majority of the building mechanicals are located in hard to access and abandoned steam tunnels).

## 4.4 Summary

The capital cost estimates for the construction of a new facility, either of similar size or a larger facility, have a significantly larger degree of confidence (i.e. a lower risk of cost escalations) than the cost estimate for the rehabilitation option. The rehabilitation option takes on a large risk degree for a shorter life on the capital investment.

# 5.0 CONCLUSION AND RECOMMENDATIONS

The condition assessment that was conducted during this project has identified that the existing Fredericton Playhouse is in fair to poor condition. The entire mechanical and electrical systems need to be replaced, as these systems are in poor condition and as minor upgrades to these systems would not satisfy current code requirements. The refurbishment of the Playhouse would also include work on the building's structural component, the utility tunnel, the building's accessibility and the sprinkler system. The minor rehabilitation of the Playhouse to extend its useful life by several years would be an inefficient use of resources and is not expected to reduce the high energy consumption of the facility. Based on this information, either the construction of a new performing arts facility or a complete refurbishment of the Playhouse (rather than a minor rehabilitation) is recommended.

Table 10 summarizes the full cost of ownership of each alternative as described in Section 3. The construction of a new facility of similar size is the preferred alternative as it has the lowest net present value of 50 year lifecycle cost. It should be noted that the risk of escalating the costs shown in Table 10 is significantly higher for the refurbishment option than for either of the new construction options, due to either unforeseen conditions during the refurbishment or the revision of the existing facility arrangement to optimize the distribution of usable space. This increased risk associated with the refurbishment option further supports the construction of a new performing arts facility.

Although the refurbishment cost estimate is based on a high level condition assessment, we do not anticipate that the order of preference for the alternatives analyzed will change if a more detailed condition assessment is performed (this conclusion is reinforced by information from previous studies and analyses).

Table 10 – Summary of Annual Costs

| Scenario | Initial Construction Costs | Annual Debt Payment<br>Over 20 Years | Annual Operating Cost<br>(ref. Table 9) | Total Cash Outflow<br>Over 50 years | Present Value of 50 Year Lifecycle Costs |
|---|---|---|---|---|---|
| Refurbish Existing (rebuild in 30 yrs.) | $12,300,000 | $925,204 | $438,000 | $111,156,590* | $34,734,147** |
| New 24,000 $ft^2$ Facility (50 year lifecycle) | $16,100,000 | $1,211,039 | $438,000 | $67,141,176 | $30,146,363 |
| New 40,000 $ft^2$ Facility (50 year lifecycle) | $28,000,000 | $2,106,155 | $730,000 | $113,657,090 | $51,410,605 |

*Includes construction of a new 24,000 $ft^2$ facility after 30 years

**Includes the residual value of the facility at the end of 50 years

With regards to the use of the ISO 14040/44 standards to perform life cycle cost analyses, the authors found these standards useful as guidance tools and in the identification of evaluation variables, and recommend that the use of these standards to develop formal life cycle cost analyses protocols for infrastructure projects be further explored. The methodology and tools used in this project could be adopted for this purpose. The City should develop policies to develop life cycle analyses for factors other than cost if desired (i.e. greenhouse gas emissions, waste generation, etc.).

As described in Section 3.5, the Envision™ Stage 1 Assessment did not provide a strong indication of a preferred alternative from a sustainability perspective at both the high level and detailed categories based on the level of detail in this report. It did identify some issues related to using a new facility as a catalyst for new development or continuity of use, however this did not significantly affect the selection of the construction of a new facility of similar size as the preferred alternative. The Envision sustainability rating system will be more useful in the evaluation of infrastructure projects at more granular levels of details, such as in a full feasibility assessment or a detailed design process.

# 6.0 SIGNATURE

We trust that this information will assist the City in their decision on how to proceed with the Fredericton Playhouse. If you have any questions or require further information please contact us at your convenience.

**R.V. Anderson Associates Limited**

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Hans Arisz, M.Sc.E., P.Eng.
Associate Director

# 7.0 LIST OF REFERENCES

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# Appendix A - Energy Cost Analysis Assumptions

## Introduction

This appendix summarizes the detailed calculations of the energy consumption of the proposed alternatives to either refurbish or replace the City of Fredericton's Playhouse. Section 3 of this report provides a summary of the life cycle capital costs and annual maintenance & repair costs. The following sections outline the assumptions and calculations that were made to determine the annual energy consumption (both electricity and natural gas) of the different alternatives.

## System Boundary

For the purpose of the analysis only the building is included in the analysis.

## Description of Alternatives

Two (2) Alternatives were developed, considered and analyzed:

- Alternative 1: Extensive refurbishment or new construction of a 24,000 $ft^2$ facility
- Alternative 2: New construction of a new 40,000 $ft^2$ facility

## Design Assumptions of Refurbishment & New Construction

The refurbishment or new construction of the facility is assumed to be a state of the art theater-performing arts facility. As such, the building will have an innovative, modern and energy efficient design. Some of the proposed design features are summarized as follows:

- Well insulated building roof with reflective membrane.
- Drywall finish ceilings,
- Skylit perimeter zones,
- Insulation of above and below grades in accordance with ASHRAE 90.1 – Energy Standard for Buildings.

- Improved ventilation for occupants in theater in excess of 7.48 CFM/person as per ASHRAE 62 – Acceptable Indoor Air Quality
- HVAC system: centralized parallel or series fan powered variable air unit with zone reheat. The chilled and hot water loops to have variable speed pumps so that flow can adjust to the demand. Additional heating provided in the form of baseboard heaters to all perimeter zones. All thermal zones to have their own dual thermostat. All zones are fully air conditioned. The system has a cooling tower and an enthalpy controlled economizer.
- Schedule of operation: assumed to be fully occupied everyday from 5 to 11 pm.
- High quality, occupancy sensor operated lighting with a design power density of 2-3 W/ft2.
- Blinded perimeter windows to reduced cooling load in the summer.

It is important to note that the proposed HVAC system modeled for the new buildings will improve the occupant’s building comfort as opposed to only replace the capabilities of the existing system(s).

## Energy Cost Calculation

To obtain accurate estimates of the energy costs associated with the proposed alternatives, a computer model of the buildings was developed in eQuest software. eQuest is a sophisticated, state of the art building energy analysis computer tool used for calculating the building's energy performance.

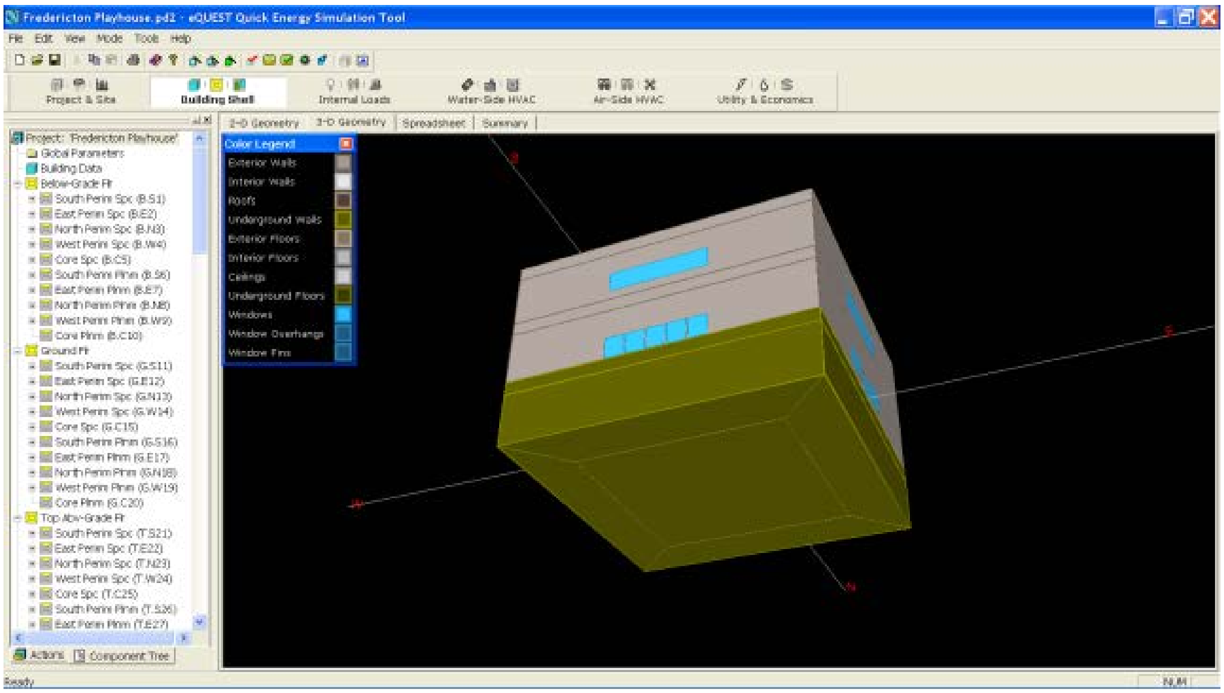


Figure 1 – Screenshot of a 40,000 ft$^2$ Building Energy Model in eQuest.

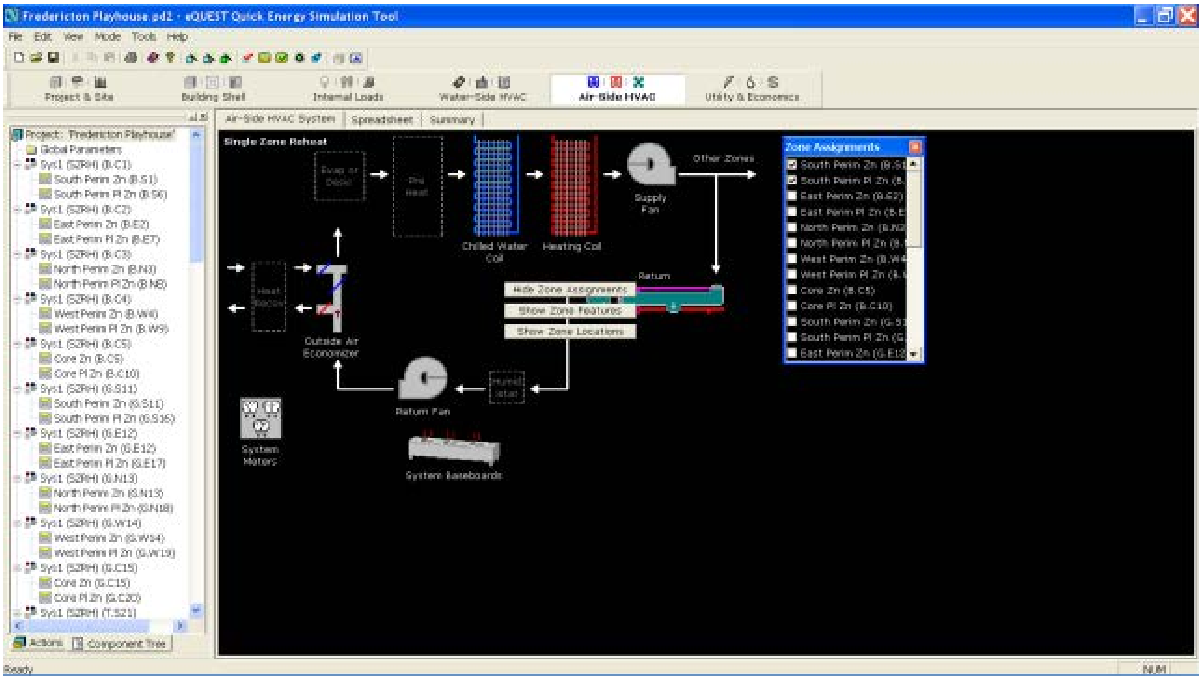


Figure 2 – Screenshot of a 40,000 ft$^2$ Building Energy Model in eQuest.

## Life Cycle Energy Results

Annual Energy Consumption – Alternative 1 (Refurbishment or New Construction of 24,000 ft$^2$ facility)

| Power | Description | Measure | Value | Cost$ | Comment |
|---|---|---|---|---|---|
| 1 | Electricity | $/kWh | $0.12 | $57,000.00 | From Computer Model |
| 2 | Natural Gas | $/m3 | $0.40 | $21,000.00 | From Computer Model |

Annual Energy Consumption – Alternative 2 (New Construction of 40,000 ft$^2$ facility)

| Power | Description | Measure | Value | Cost$ | Comment |
|---|---|---|---|---|---|
| 1 | Electricity | $/kWh | $0.12 | $90,000.00 | From Computer Model |
| 2 | Natural Gas | $/m3 | $0.40 | $40,000.00 | From Computer Model |

# Appendix B - List of Envision Credits

| Category | Sub Category | Credit | Intent | Metric |
|---|---|---|---|---|
| Quality of Life | Purpose | QL1.1 Improve community quality of life | Improve the net quality of life of all communities affected by the project and mitigate negative impacts to communities. | Measures taken to assess community needs and improve quality of life while minimizing negative impacts. |
| Quality of Life | Purpose | QL1.2 Stimulate Sustainable Growth and Development | Support and stimulate sustainable growth and development, including improvements in job growth, capacity building, productivity, business attractiveness and livability. | Assessment of the project's impact on the community's sustainable economic growth and development. |
| Quality of Life | Purpose | QL1.3 Develop Local Skills and Capabilities | Expand the knowledge, skills and capacity of the community workforce to improve their ability to grow and develop. | The extent to which the project will improve local employment levels, skills mix and capabilities. |
| Quality of Life | Wellbeing | QL2.1 Enhance Public Health and Safety | Take into account the health and safety implications of using new materials, technologies or methodologies above and beyond meeting regulatory requirements. | Efforts to exceed normal health and safety requirements, taking into account additional risks in the application of new technologies, materials and methodologies. |
| Quality of Life | Wellbeing | QL2.2 Minimize Noise and Vibration | Minimize noise and vibration generated during construction and in the operation of the constructed works to maintain and improve community livability. | The extent to which noise and vibration will be reduced during construction and operation. |
| Quality of Life | Wellbeing | QL2.3 Minimize Light Pollution | Prevent excessive glare, light at night, and light directed skyward to conserve energy and reduce obtrusive lighting and excessive glare. | Lighting meets minimum standards for safety but does not spill over into areas beyond site boundaries, nor does it create obtrusive and disruptive glare. |
| Quality of Life | Wellbeing | QL2.4 Improve Community Mobility and Access | Locate, design and construct the project in a way that eases traffic congestion, improves mobility and access, does not promote urban sprawl, and otherwise improves community livability. | Extent to which the project improves access and walkability, reductions in commute times, traverse times to existing facilities and transportation. Improved user safety considering all modes, e.g., personal vehicle, commercial vehicle, transit and bike/pedestrian. |
| Quality of Life | Wellbeing | QL2.5 Encourage Alternative Modes of Transportation | Improve accessibility to non-motorized transportation and public transit. Promote alternative transportation and reduce congestion. | The degree to which the project has increased walkability, use of public transit, nonmotorized transit. |
| Quality of Life | Wellbeing | QL2.6 Improve Accessibility, Safety and Wayfinding | Improve user accessibility, safety, and wayfinding of the site and surrounding areas. | Clarity, simplicity, readability and broad-population reliability in wayfinding, user benefit and safety. |
| Quality of Life | Community | QL3.1 Preserve Historic and Cultural Resources | Preserve or restore significant historical and cultural sites and related resources to preserve and enhance community cultural resources. | Summary of steps taken to identify, preserve or restore cultural resources. |
| Quality of Life | Community | QL3.2 Preserve Views and Local Character | Design the project in a way that maintains the local character of the community and does not have negative impacts on community views. | Thoroughness of efforts to identify important community views and aspects of local landscape, including communities, and incorporate them into the project design. |
| Quality of Life | Community | QL3.3 Enhance Public Space | Improve existing public space including parks, plazas, recreational facilities, or wildlife refuges to enhance community livability. | Plans and commitments to preserve, conserve, enhance and/or restore the defining elements of the public space. |

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| Quality of Life | Innovate | QL0.0 Innovate or Exceed Credit Requirements | To reward exceptional performance beyond the expectations of the system as well as the application of innovative methods which advance the state of the art for sustainable infrastructure. | Whether project achievement qualifies as exceptional performance or innovation. |
| Leadership | Collaboration | LD1.1 Provide Effective Leadership & Commitment | Provide effective leadership and commitment to achieve project sustainability goals. | Demonstration of meaningful commitment of the project owner and the project team to the principles of sustainability and sustainable performance improvement. |
| Leadership | Collaboration | LD1.2 Establish a Sustainability Management System | Create a project management system that can manage the scope, scale and complexity of a project seeking to improve sustainable performance. | The organizational policies, authorities, mechanisms and business processes that have been put in place and the judgment that they are sufficient for the scope, scale and complexity of the project. |
| Leadership | Collaboration | LD1.3 Foster Collaboration and Teamwork | Eliminate conflicting design elements, and optimize system by using integrated design and delivery methodologies and collaborative processes. | The extent of collaboration within the project team and the degree to which project delivery processes incorporate whole systems design and delivery approaches. |
| Leadership | Collaboration | LD1.4 Provide for Stakeholder Involvement | Establish sound and meaningful programs for stakeholder identification, engagement and involvement in project decision making. | The extent to which project stakeholders are identified and engaged in project decision making. Satisfaction of stakeholders and decision makers in the involvement process. |
| Leadership | Mangement | LD2.1 Pursue By-Product Synergy Opportunities | Reduce waste, improve project performance and reduce project costs by identifying and pursuing opportunities to use unwanted by-products or discarded materials and resources from nearby operations. | The extent to which the project team identified project materials needs, sought out nearby facilities with by-product resources that could meet those needs and capture synergy opportunities. |
| Leadership | Mangement | LD2.2 Improve Infrastructure Integration | Design the project to take into account the operational relationships among other elements of community infrastructure which results in an overall improvement in infrastructure efficiency and effectiveness. | The extent to which the design of the delivered works integrates with existing and planned community infrastructure, and results in a net improvement in efficiency and effectiveness. |
| Leadership | Planning | LD3.1 Plan Long-Term Maintenance and Monitoring | Put in place plans and sufficient resources to ensure as far as practical that ecological protection, mitigation and enhancement measures are incorporated in the project and can be carried out. | Comprehensiveness and detail of long-term monitoring and maintenance plans, and commitment of resources to fund the activities. |
| Leadership | Planning | LD3.2 Address Conflicting Regulations and Policies | Work with officials to identify and address laws, standards, regulations or policies that may unintentionally create barriers to implementing sustainable infrastructure. | Efforts to identify and change laws, standards, regulations and/or policies that may unintentionally run counter to sustainability goals, objectives and practices. |
| Leadership | Planning | LD3.3 Extend Useful Life | Extend a project's useful life by designing the project in a way that results in a completed works that is more durable, flexible and resilient. | The degree to which project team incorporates full life cycle thinking in improving the durability, flexibility and resilience of the project. |
| Leadership | Innovate | LD0.0 Innovate or Exceed Credit Requirements | To reward exceptional performance beyond the expectations of the system as well as the application of innovative methods which advance the state of the art for sustainable infrastructure. | Whether project achievement qualifies as exceptional performance or innovation. |
| Resource Allocation | Materials | RA1.1 Reduce Net Embodied Energy | Conserve energy by reducing the net embodied energy of project materials over the project life. | Percentage reduction in net embodied energy from a life cycle energy assessment. |

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| Resource Allocation | Materials | RA1.2 Support Sustainable Procurement Practices | Obtain materials and equipment from manufacturers and suppliers who implement sustainable practices. | Percentage of materials sourced from manufacturers who meet sustainable practices requirements. |
| Resource Allocation | Materials | RA1.3 Use Recycled Materials | Reduce the use of virgin materials and avoid sending useful materials to landfills by specifying reused materials, including structures, and material with recycled content. | Percentage of project materials that are reused or recycled. |
| Resource Allocation | Materials | RA1.4 Use Regional Materials | Minimize transportation costs and impacts and retain regional benefits through specifying local sources. | Percentage of project materials by type and weight or volume sourced within the required distance. |
| Resource Allocation | Materials | RA1.5 Divert Waste from Landfills | Reduce waste, and divert waste streams away from disposal to recycling and reuse. | Percentage of total waste diverted from disposal. |
| Resource Allocation | Materials | RA1.6 Reduce Excavated Materials Taken Off Site | Minimize the movement of soils and other excavated materials off site to reduce transportation and environmental impacts. | Percentage of excavated material retained on site. |
| Resource Allocation | Materials | RA1.7 Provide for Deconstruction and Recycling | Encourage future recycling, up-cycling, and reuse by designing for ease and efficiency in project disassembly or deconstruction at the end of its useful life. | Percentage of components that can be easily separated for disassembly or deconstruction. |
| Resource Allocation | Energy | RA2.1 Reduce Energy Consumption | Conserve energy by reducing overall operation and maintenance energy consumption throughout the project life cycle. | Percentage of reductions achieved. |
| Resource Allocation | Energy | RA2.2 Use Renewable Energy | Meet energy needs through renewable energy sources. | Extent to which renewable energy resources are incorporated into the design, construction and operation. |
| Resource Allocation | Energy | RA2.3 Commission and Monitor Energy Systems | Ensure efficient functioning and extend useful life by specifying the commissioning and monitoring of the performance of energy systems. | Third party commissioning of electrical/mechanical systems and documentation of system monitoring equipment in the design. |
| Resource Allocation | Water | RA3.1 Protect Fresh Water Availability | Reduce the negative net impact on fresh water availability, quantity and quality. | The extent to which the project uses fresh water resources without replenishing those resources at its source. |
| Resource Allocation | Water | RA3.2 Reduce Potable Water Consumption | Reduce overall potable water consumption and encourage the use of greywater, recycled water, and stormwater to meet water needs. | Percentage of water reduction. |
| Resource Allocation | Water | RA3.3 Monitor Water Systems | Implement programs to monitor water systems performance during operations and their impacts on receiving waters. | Documentation of system in the design |
| Resource Allocation | Innovate | RA0.0 Innovate or Exceed Credit Requirements | To reward exceptional performance beyond the expectations of the system as well as the application of innovative methods which advance the state of the art for sustainable infrastructure. | Whether project achievement qualifies as exceptional performance or innovation. |
| Natural World | Siting | NW1.1 Preserve Prime Habitat | Avoid placing the project – and the site compound/temporary works – on land that has been identified as of high ecological value or as having species of high value. | Avoidance of high ecological value sites and establishment of protective buffer zones. |
| Natural World | Siting | NW1.2 Preserve Wetlands and Surface Water | Protect, buffer, enhance and restore areas designated as wetlands, shorelines, and water bodies by providing natural buffer zones, vegetation and soil protection zones. | Size of natural buffer zone established around all wetlands, shorelines, and water bodies. |
| Natural World | Siting | NW1.3 Preserve Prime Farmland | Identify and protect soils designated as prime farmland, unique farmland, or farmland of statewide importance. | Percentage of prime farmland avoided during development. |

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| Natural World | Siting | NW1.4 Avoid Adverse Geology | Avoid development in adverse geologic formations and safeguard aquifers to reduce natural hazards risk and preserve high quality groundwater resources. | Degree to which natural hazards and sensitive aquifers are avoided and geologic functions maintained. |
| Natural World | Siting | NW1.5 Preserve Floodplain Functions | Preserve floodplain functions by limiting development and development impacts to maintain water management capacities and capabilities. | Efforts to avoid floodplains or maintain predevelopment floodplain functions. |
| Natural World | Siting | NW1.6 Avoid Unsuitable Development on Steep Slopes | Protect steep slopes and hillsides from inappropriate and unsuitable development in order to avoid exposures and risks from erosion and landslides, and other natural hazards. | Degree to which development on steep slopes is avoided, or to which erosion control and other measures are used to protect the constructed works as well as other downslope structures. |
| Natural World | Siting | NW1.7 Preserve Greenfields | Conserve undeveloped land by locating projects on previously developed greyfield sites and/or sites classified as brownfields. | Percentage of site that is a greyfield or the use and cleanup of a site classified as a brownfield. |
| Natural World | Land + Water | NW2.1 Manage Stormwater | Minimize the impact of infrastructure on stormwater runoff quantity and quality. | Infiltration and evapotranspiration capacity of the site and return to pre-development capacities. |
| Natural World | Land + Water | NW2.2 Reduce Pesticides and Fertilizer Impacts | Reduce non-point source pollution by reducing the quantity, toxicity, bioavailability and persistence of pesticides and fertilizers, or by eliminating the need for the use of these materials. | Efforts made to reduce the quantity, toxicity, bioavailability and persistence of pesticides and fertilizers used on site, including the selection of plant species and the use of integrated pest management techniques. |
| Natural World | Land + Water | NW2.3 Prevent Surface and Groundwater Contaminatio | Preserve fresh water resources by incorporating measures to prevent pollutants from contaminating surface and groundwater and monitor impacts over operations. | Designs, plans and programs instituted to prevent and monitor surface and groundwater contamination. |
| Natural World | Biodeversity | NW3.1 Preserve Species Biodiversity | Protect biodiversity by preserving and restoring species and habitats. | Degree of habitat protection. |
| Natural World | Biodeversity | NW3.2 Control Invasive Species | Use appropriate non-invasive species and control or eliminate existing invasive species. | Degree to which invasive species have been reduced or eliminated. |
| Natural World | Biodeversity | NW3.3 Restore Disturbed Soils | Restore soils disturbed during construction and previous development to bring back ecological and hydrological functions. | Percentage of disturbed soils restored. |
| Natural World | Biodeversity | NW3.4 Maintain Wetland and Surface Water Functions | Maintain and restore the ecosystem functions of streams, wetlands, water bodies and their riparian areas. | Number of functions maintained and restored. |
| Natural World | Innovate | NW0.0 Innovate or Exceed Credit Requirements | To reward exceptional performance beyond the expectations of the system as well as the application of innovative methods which advance the state of the art for sustainable infrastructure. | Whether project achievement qualifies as exceptional performance or innovation. |
| Climate and Risk | Emissions | CR1.1 Reduce Greenhouse Gas Emissions | Conduct a comprehensive life-cycle carbon analysis and use this assessment to reduce the anticipated amount of net greenhouse gas emissions during the life cycle of the project, reducing project contribution to climate change. | Life-cycle net carbon dioxide equivalent ($CO_2e$) emissions. |
| Climate and Risk | Emissions | CR1.2 Reduce Air Pollutant Emissions | Reduce the emission of six criteria pollutants; particulate matter (including dust), ground level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, lead, and noxious odors. | Measurements of air pollutants as compared to standards used. |
| Climate and Risk | Resilience | CR2.1 Assess Climate Threat | Develop a comprehensive Climate Impact Assessment and Adaptation Plan. | Summary of steps taken to prepare for climate variation and natural hazards. |

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|---|---|---|---|---|
| Climate and Risk | Resilience | CR2.2 Avoid Traps and Vulnerabilities | Avoid traps and vulnerabilities that could create high, long-term costs and risks for the affected communities. | The extent of the assessment of potential long-term traps, vulnerabilities and risks due to long-term changes such as climate change and the degree to which these were addressed in the project design and in community design criteria. |
| Climate and Risk | Resilience | CR2.3 Prepare For Long-Term Adaptability | Prepare infrastructure systems to be resilient to the consequences of long-term climate change, perform adequately under altered climate conditions, or adapt to other long-term change scenarios. | The degree to which the project has been designed for long-term resilience and adaptation. |
| Climate and Risk | Resilience | CR2.4 Prepare for Short-Term Hazards | Increase resilience and long-term recovery prospects of the project and site from natural and man-made short-term hazards. | Steps taken to improve protection measures beyond existing regulations. |
| Climate and Risk | Resilience | CR2.5 Manage Heat Island Effects | Minimize surfaces with a high solar reflectance index (SRI) to reduce localized heat accumulation and manage microclimates. | Percentage of site area that meets SRI criteria. |
| Climate and Risk | Innovate | CR0.0 Innovate or Exceed Credit Requirements | To reward exceptional performance beyond the expectations of the system as well as the application of innovative methods which advance the state of the art for sustainable infrastructure. | Whether project achievement qualifies as exceptional performance or innovation. |