Analysis and rating of the Buchanan courtyards by sustainable site initiative standards

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COMMUNITY SERVICE LEARNING PROJECT

ANALYSIS AND RATING OF THE BUCHANAN COURTYARDS BY SUSTAINABLE SITE INITIATIVE STANDARDS

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Abstract

The Sustainable Sites Initiative (SSI) aims to provide guidelines for the creation of more sustainable and environmentally friendly outdoor landscaped environments. The focus of this report is in rating the improvements in water usage (SSI Guidelines and Performance Benchmarks, 2009, Chapter 3) throughout the site. Credits 3.2 to 3.4 were omitted as they were not applicable to the site. Thus the site was rated on credits, 3.1, 3.5, 3.6, 3.7, and 3.8.

Credit 3.1 is a required component to pass the SSI water requirement rating. Its aim is to reduce the potable water usage by 50% for irrigation of the area. Following the method of calculations provided by the SSI, the reduction in potable was calculated to be around 30% for peak watering months, and thus did not meet this criterion.

Credit 3.5 focuses on managing stormwater on site. Specifically, it aims at increasing infiltration, and reducing runoff and evapotranspiration. This is achieved through a reduction in non-permeable area. Calculations were performed using a modified TR-55 method as recommended in the SSI guidelines. Ultimately, there was no reduction in permeable area, thus no credits were awarded for this section.

Credit 3.6 focused on protecting and enhancing on site water quality. Potential pollutants used in exterior construction were identified, and filtration methods were taken into account. According to the guidelines, there were only a small amount of potential pollutants present and filtration was provided by drainage holes as wells as large areas dedicated to soil and vegetation. By the rating criteria, this credit received the full 9 points.

Credit 3.7 aimed to make the water features visible and accessible from the site. Because the two water amenities were 100% visible and accessible, but not available for full human contact, 2 out of a possible 3 credits were awarded.

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Credit 3.8 was about maintaining water balance in water features from non-potable sources. This was achieved in full by relying solely on rainwater to fill both water amenities on site. An additional point was awarded by using gravity for all movement and recirculation of water. Thus, 4 out of a possible 4 points were awarded.

Out of a possible 26 points, 15 were awarded for the project. Although due to the requirement that 3.1 is passed, the project didn't technically meet the guidelines.

Introduction

The Sustainable Sites Initiative (SSI) is essentially a grading rubric that determines how "green" a newly developed site or area is. The purpose of this CSL project was to research and investigate the construction of the newly improved Buchanan Courtyards at the University of British Columbia and evaluate the courtyards on how sustainable they are according to the SSI. The courtyards were designed to implement a storm water system where rain water runoff would be collected, so the portion of the SSI that was looked at was the "Site Design – Water" section. Within this section, there are various criteria that are used to determine the sustainability of the site. Each portion of the criteria has a range of points which can be awarded depending on how well the criteria are met. The first portion of the criteria looked at the reduction of potable water use, and in order to meet the requirements, the new site had to have a 50 percent reduction in potable water use for landscape irrigation. The second portion had to do with management of storm water and points were awarded for how much reduction in runoff volume there is in the site. The third portion of the criteria involved the enhancement of on-site water resources and water quality. Points were awarded for how much of the water runoff was treated for pollutants. The fourth portion awarded points for mainly aesthetic reasons, with max points being given for rainwater features that were visible to the public and accessible for use. The final portion of the criteria for this project looked at how water features were maintained on site to conserve water and other resources. With reference to the above criteria from the SSI, it was possible to determine how much sustainability the newly improved Buchanan Courtyards achieved.

3.1 - Reduce Potable Water Use For Landscape Irrigation By 50 Percent From Established Baselines

[redacted]

The calculations for this section were done based on the statistics for both July and August as it was not clear which of the months is the peak watering month for the Lower Mainland. Statistics showed that the amount of watering for both months was very similar so calculations for each month were done separately.

The source of the non-potable water comes from captured rainwater, which overflows from the water [redacted] feature's pool, however to date it has never been used. The landscape coefficients were taken to be for medium water requirements because UBC is neither hot and dry nor cold and wet, for the entire year. An assumption was made that the plant types would require an average amount of water, for irrigation, per month. Research provided information that indicated that medium water requirements were necessary for virtually all plant species in the Lower Mainland, which is the key reason for the choice of landscape coefficients used in calculating the reduction of potable water usage.

As for the average monthly evapotranspiration, it was determined from the International Water Management Institutes (IWMI) World Water and Climate Atlas, using their synthesizer. Since data for the exact location of UBC was not on the map, and average of the three surrounding locations were taken. The average monthly rainfall, for the peak-watering month, was obtained from two sources, www.weather.com and www.vancouver.about.com, both sources gave the same results.

Statistics for both July and August were obtained for use in the calculations and are provided in the tables below. Additional information on the low quarter distribution uniformity, plant type and estimated landscape coefficients, monthly evapotranspiration and average monthly rainfall statistics can be found in the appendix.

The results below indicate that if the volume of non-potable water use is zero, then the use of potable water for irrigation is approximately 27% when July is taken to be the peak watering month, and 30% for August. This would be due to the irrigation and landscaping design strategies that were implemented when the Buchanan Courtyards was renovated. Furthermore, since the overflow from the pool has never been used, an estimate of how much non-potable water would be necessary for a 50% reduction in potable water usage was taken and the results are tabulated below. For July approximately 22,000 gallons/month would be needed and approximately 16,000 gallons/month for August. These numbers seem high, which would indicate that the project would fail this requirement and since this has to be met to comply with the Sustainable Site Initiative it would not meet the guidelines required. The area of the pool is 2,135 ft2 with a capacity of 14,400 USG and an overflow rate of 49/47 USGPM. With these specifications of the pool, it seems unlikely that the required overflow, of non-potable water (rainfall), from the pool could be met.

[redacted]

July

BLWR=ET_0 x A x C_u

ET_0 = average reference evapotranspiration (ET0) for the site's peak watering month (inches/month)

A = Area of irrigated landscape in square feet (area designed with permanent irrigation systems)

C_u = Conversion factor (0.6233 for results in gallons/month)

Table 1 – July Baseline Landscape Water Requirement

BASELINE LANDSCAPE WATER REQUIREMENT			
ET_0 (inches/month)	**Area** (ft^2)	**C_u**	**BLWR** (gallons/month)
4.50	33,750	0.6233	94,664

$DLWR_H$ = RTM x [(ET0 x KL) - Ra] x A x Cu

RTM = Run time multiplier equal to 1/low quarter distribution uniformity

ET_0 = average reference evapotranspiration (ET0) for the site's peak watering month (inches/month)

K_L = Landscape coefficient for type of plant in that hydrozone

R_a = Allowable rainfall (25% of average monthly rainfall for the site's peak watering month (inches/month)

C_u = Conversion factor (0.6233 for results in gallons/month)

Table 2 – July Designed Landscape Water Requirement

DESIGNED LANDSCAPE WATER REQUIREMENT				
ET_o (inches/month)		**R_a = Allowable rainfall = 25% of average monthly rainfall** (inches/month)		
4.50		1.40*0.25 = 0.350		
Area (ft2)	**Plant Type**	**Landscape Coefficient, K_L**	**Distribution Uniformity**	**Water requirement** (gallons/month)
3500	Perennials	0.5	0.70	5,921
7400	Shrubs	0.5	0.70	12,519
17750	Turfgrass	0.7	0.70	44,254
5100	Trees	0.5	0.90	6,711
Designed Landscape Water Requirement (gallons/month)				**69,405**

% Reduction in Potable Water Use = (BLWR – (DLWR – NPS))/BLWR

Where:

Baseline Landscape Water Requirement, BLWR (gallons/month)

Designed Landscape Water Requirement, DLWR (gallons/month)

Non-Potable Water Sources, NPS (gallons/month)

1. If NPS = 0

Table 3 – Resultant Reduction in Potable Water Use if Non-Potable Sources = 0, for July

RESULTS	
Baseline Landscape Water Requirement, BLWR (gallons/month)	94,664
Designed Landscape Water Requirement, DLWR (gallons/month)	69,405
Non-Potable Source Required For 50% Reduction in Potable Water Use (gallons/month)	0
Percentage Reduction in Potable Water Use from Baseline Case	27%

2. NPS required to reduce potable water use, for irrigation, by 50%

(BLWR – (DLWR – NPS))/BLWR ≥ 50%

∴ NPS ≥ DLWR – (0.5) x BLWR

Table 4 – NPS required to reduce potable water use, for irrigation, by 50%, for July

RESULTS	
Baseline Landscape Water Requirement, BLWR (gallons/month)	94,664
Designed Landscape Water Requirement, DLWR (gallons/month)	69,405
Percentage Reduction in Potable Water Use from Baseline Case	50%
Non-Potable Source Required For 50% Reduction in Potable Water Use (gallons/month)	22,073

August

$BLWR=ET_0 \times A \times C_u$

ET_0 = average reference evapotranspiration (ET0) for the site's peak watering month (inches/month)

A = Area of irrigated landscape in square feet (area designed with permanent irrigation systems)

C_u = Conversion factor (0.6233 for results in gallons/month)

Table 5 - August Landscape Water Requirement

BASELINE LANDSCAPE WATER REQUIREMENT			
ET_0 (inches/month)	**Area (ft^2)**	**C_u**	**BLWR** (gallons/month)
3.80	33,750	0.6233	79,938

$DLWR_H = RTM \times [(ET_0 \times K_L) - R_a] \times A \times C_u$

RTM = Run time multiplier equal to 1/low quarter distribution uniformity

ET_0 = average reference evapotranspiration (ET0) for the site's peak watering month (inches/month)

K_L = Landscape coefficient for type of plant in that hydrozone

R_a = Allowable rainfall (25% of average monthly rainfall for the site's peak watering month (inches/month)

C_u = Conversion factor (0.6233 for results in gallons/month)

Table 6 - August Designed Landscape Water Requirement

DESIGNED LANDSCAPE WATER REQUIREMENT				
ET_0 (inches/month)		**R_a = Allowable rainfall = 25% of average monthly rainfall** (inches/month)		
3.80		1.50*0.25 = 0.380		
Area (ft^2)	**Plant Type**	**Landscape Coefficient, K_L**	**Distribution Uniformity**	**Water requirement** (gallons/month)
3500	Perennials	0.5	0.70	4,737
7400	Shrubs	0.5	0.70	10,015
17750	Turfgrass	0.7	0.70	36,036
5100	Trees	0.5	0.90	5,369
Designed Landscape Water Requirement (gallons/month)				**56,157**

% Reduction in Potable Water Use = (BLWR – (DLWR – NPS))/BLWR

Where:

Baseline Landscape Water Requirement, BLWR (gallons/month)

Designed Landscape Water Requirement, DLWR (gallons/month)

Non-Potable Water Sources, NPS (gallons/month)

1. If NPS = 0

Table 7 – Resultant Reduction in Potable Water Use if Non-Potable Sources = 0, for August

RESULTS	
Baseline Landscape Water Requirement, BLWR (gallons/month)	79,938
Designed Landscape Water Requirement, DLWR (gallons/month)	56,157
Non-Potable Source	0
Percentage Reduction in Potable Water Use from Baseline Case	30%

2. NPS required to reduce potable water use, for irrigation, by 50%

(BLWR – (DLWR – NPS))/BLWR ≥ 50%

∴ NPS ≥ DLWR – (0.5) x BLWR

Table 8 – NPS required to reduce potable water use, for irrigation, by 50%, for August

RESULTS	
Baseline Landscape Water Requirement, BLWR (gallons/month)	79,938
Designed Landscape Water Requirement, DLWR (gallons/month)	56,157
Percentage Reduction in Potable Water Use from Baseline Case	50%
Non-Potable Source Required For 50% Reduction in Potable Water Use (gallons/month)	16,188

3.5 – Manage Stormwater On Site

Using a modified TR-55 methodology for modelling the hydrologic condition of the Buchanan Courtyards site, our group was able to compare the pre- and post-project conditions to establish the percent reduction in runoff volume based on the scales provided within the SSI Guidelines and Performance Benchmarks manual.

Analysis of the site via the TR-55 method yields a Curve Number (CN) that represents the water storage capacity of the area. A high CN represents a low water storage capacity, with any reduction in CN representing an increase in this quantity. An increase in water storage capacity is preferable, as it is corollary to a decrease in runoff volume. A reduction in the site's non-permeable surfaces, and an accompanying increase in permeable surfaces (such as planters, flower beds, lawns, and fields) works to increase the site's water storage capacity.

Calculated curve numbers are then compared to a chart for a given site type and climactic zone, which provides a number of points based on the initial and final CNs.

Method

We used site plans provided to us by PFS Landscape Architects to determine the relative areas of permeable and non-permeable surfaces. Areas were measured using the Area tool within Foxit PDF Reader, in which shapes are manually drawn on top of areas in the PDF document and multiplied by the scale of the document. Possible sources or error include small overlaps or gaps in adjacent drawn areas as well as differences between the drawings and the actual site conditions. We assume all errors to be minor enough as to be insignificant to the overall result.

Assumptions

The type of soil in the site is important in determining the water storage capacity and the corresponding CN. The soil types are divided into four groups and are defined as below:

Table 9 – Hydrologic soil groups

Hydrologic Soil Group	Soil Textures
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

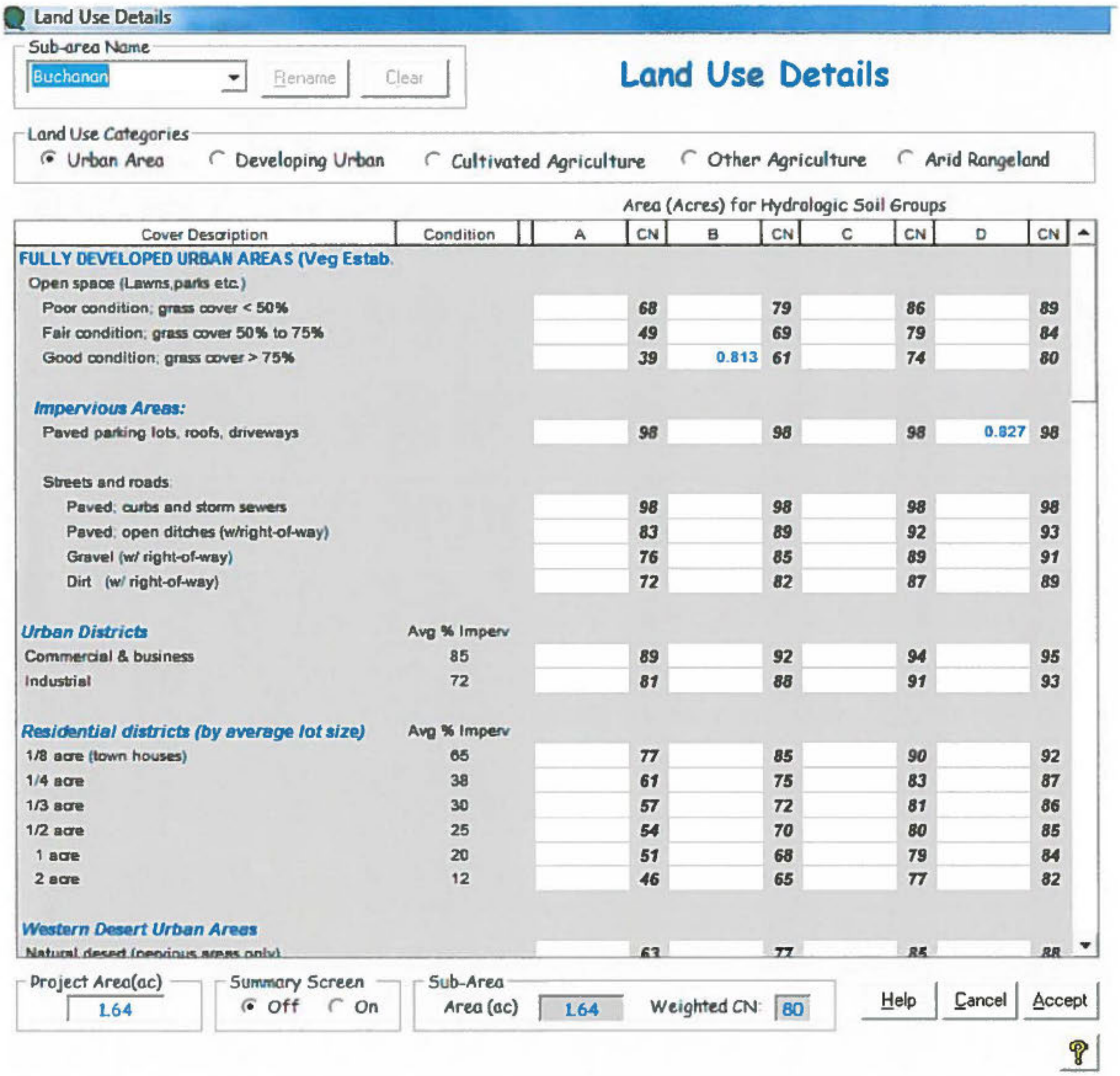
(Source: http://geology.wwu.edu/rjmitch/hydro_soil_groups.pdf , pg A-1)

We assumed that the soil on site was Group B since it fell in the middle of the range of curve numbers. [redacted] Additionally, since the site is relatively small we assumed there would only be one type of soil present making the change in curve number more important than the absolute values of the pre- and post-construction curve numbers.

For the post-construction site analysis, the stream-bed was included with adjacent areas as open space in good condition (grass cover > 75%). The area with loosely spaced pavers in the southeast end of the east courtyard was calculated as approximately 70% non-permeable, with the remaining 30% being defined as permeable area.

Results

The pre-construction site condition contained roughly equal areas of permeable and non-permeable surfaces, at 0.813 acres and 0.827 acres, respectively. The resulting initial CN was 80.



Cover Description	Condition	A	CN	B	CN	C	CN	D	CN
FULLY DEVELOPED URBAN AREAS (Veg Estab.									
Open space (Lawns,parks etc.)									
Poor condition; grass cover < 50%			68		79		86		89
Fair condition; grass cover 50% to 75%			49		69		79		84
Good condition; grass cover > 75%			39	0.813	61		74		80
Impervious Areas:									
Paved parking lots, roofs, driveways			98		98		98	0.827	98
Streets and roads									
Paved; curbs and storm sewers			98		98		98		98
Paved; open ditches (w/right-of-way)			83		89		92		93
Gravel (w/ right-of-way)			76		85		89		91
Dirt (w/ right-of-way)			72		82		87		89
Urban Districts	Avg % Imperv								
Commercial & business	85		89		92		94		95
Industrial	72		81		88		91		93
Residential districts (by average lot size)	Avg % Imperv								
1/8 acre (town houses)	65		77		85		90		92
1/4 acre	38		61		75		83		87
1/3 acre	30		57		72		81		86
1/2 acre	25		54		70		80		85
1 acre	20		51		68		79		84
2 acre	12		46		65		77		82
Western Desert Urban Areas									
Natural desert (pervious areas only)			63		77		85		88

Figure 1 - Calculation of initial CN

The post-construction site condition had a lower proportion of permeable to non-permeable areas, with each occupying 0.760 acres and 0.946 acres, respectively. This reduction in permeable area can be attributed to the increase area taken up by pavers in the east courtyard. The resulting final CN was slightly higher than the initial CN, at 82.

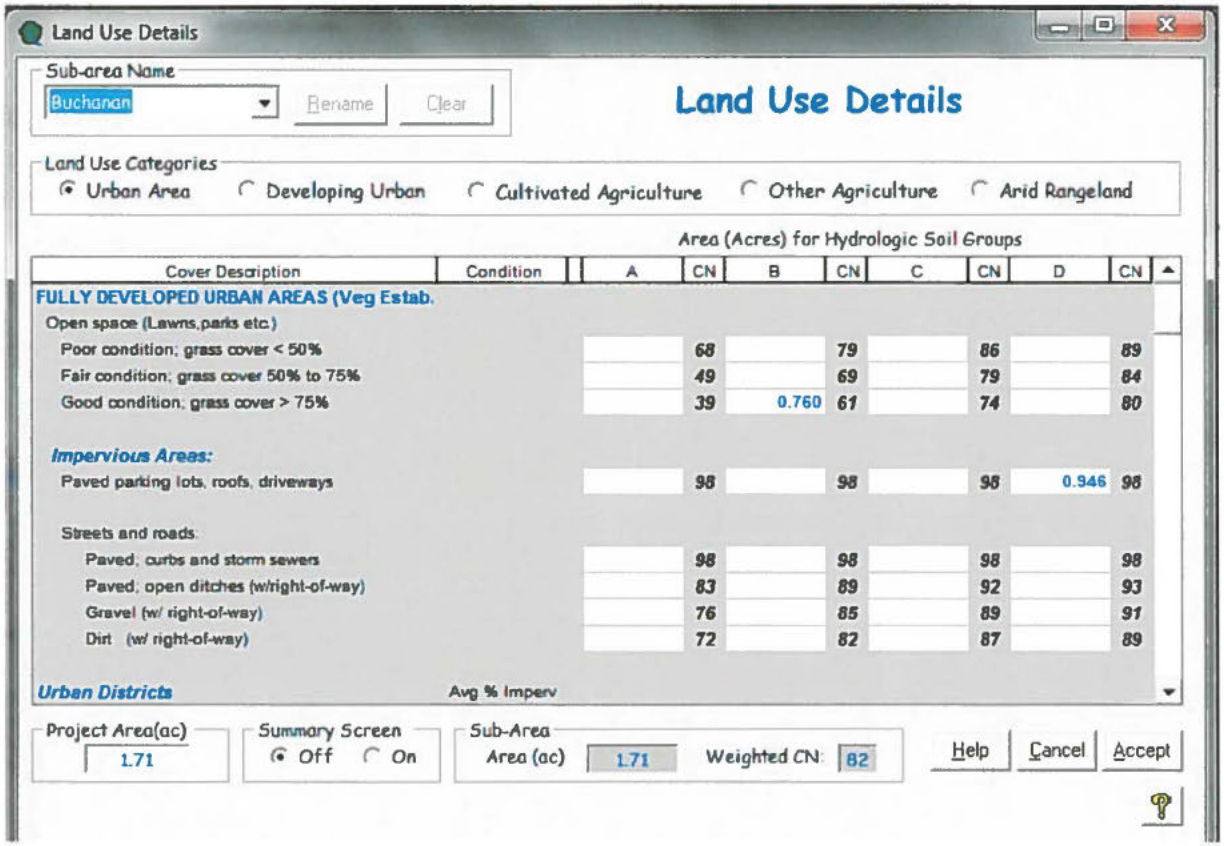


Figure 2 - Calculation of final CN

Awarding of Points

The closest climactic region to ours provided in the SSI documentation was for Portland, OR, and Buchanan Courtyards site fell under the classification of Greyfield. The target CN for this type of site is 70. For an initial CN of 80, a final CN of 77-78 would have given 5 points, 74-76 would have given 7 points, and 70-73 would have given 10 points. Since the change in CN did not hit any of these targets, no points are awarded for this credit.

[redacted]

3.6 – Protect and enhance on-site water resources and receiving water quality

This particular section of the Sustainable Sites Initiative focuses on the prevention, mobilization, and transport of common storm water pollutants of concern to receiving waters. The main components that had to be researched in order to evaluate this section were the certain exterior materials used in the construction of the site, as well as maintenance and treatment that was implemented to reduce and treat pollutants which would enter the storm water system. The reason for having to research the exterior materials was to see if they gave off pollutants which could contaminate the water.

There is a maximum of nine points which can be awarded for this section. The point breakdown goes as follows:

- 3 points – 80 percent of annual volume of runoff discharged from the newly developed portion of the site receives storm water treatment for pollutants of concern.
- 5 points – 90 percent of annual volume of runoff discharged from the newly developed portion of the site receives storm water treatment for pollutants of concern.
- 8 points – 95 percent of annual volume of runoff discharged from the newly developed portion of the site receives storm water treatment for pollutants of concern.
- Additional point – soil and vegetation based systems are implemented to treat 100 percent of the treated water volume.

The criterion for this section was researched by thoroughly reviewing a set of construction documents given to the team by a member of the architecture firm for the Buchanan Courtyards. These documents included architectural drawings as well as few civil engineering drawings. From the construction documents, a list of materials was created, which can be seen below:

Table 10 - Hazardous Materials

Material	Possible Pollutant
Concrete	No
Caulking	No
Epoxy coated bars	Yes, but not an exterior material
Zinc chromate primer	Yes
Hot dipped galvanized steel	Yes
PVC pipe	No
Additives for PVC pipe	No, approved by NSP International
Fiberglass reinforced plastic	No
Seamless copper tubing	Yes, but designed to ASTM B42 standards
Brass flanged adaptors	No

As there is a possibility for some of these materials to produce pollutants in the storm water, preventative measures were taken to reduce and even fully prevent these pollutants. A list of these preventative measures can be seen below:

- No calcium chloride was permitted in any of the concrete mixes.
- Before the storm water runoff is allowed to enter the storm manhole, it goes through a storm cleanout. Also, there is a series of sanitary sewers that are implemented to get rid of pollutants.
- All water-feature equipment is non-corrosive and long lasting.
- Excess materials were cleared away and removed from worksite after completion.
- Dirt, debris, rubbish, and grease on walls, floor and fixture were removed.
- All piping systems were flushed to remove dirt and debris.
- All pipe penetrations through walls or floor have a PVC water stop flange welded to PVC piping in center of concrete to prevent water seepage.
- For pipe joints, solders and fluxes having a lead content and self-cleaning acid type fluxes shall not be used.
- Convey storm water in swales to promote infiltration.
- Use biofiltration to provide vegetated and soil filtering.
- Evapotranspire
- Filters implemented to clean storm water to a greater degree.
- The large area of the site which is dedicated to soil and vegetation greatly reduces the pollutants from seeping into the storm water.

In respect to all of the above information, an estimate can be made on how much of the annual volume of runoff from the site receives storm water treatment for the mentioned pollutants. Since relatively all of the materials that have the potential to give off pollutants are put under some sort of treatment or preventative measure, it can be safely said that 95 percent of annual volume of runoff discharged from the newly developed portion of the site receives storm water treatment for pollutants of concern. It can also be safely said that soil and vegetation based systems are used as a majority of the area of the site is covered in vegetation. This being said, a total of nine points is awarded for this section of the Sustainable Sites Initiative.

3.7 – Design rainwater/stormwater features to provide a landscape amenity

This section deals with the rainwater/stormwater features being used as amenities on the project site. The two main criteria for the allotment of points for this section are: the visibility/accessibility of the water feature, and the use the feature is designed for.

Visibility

There are only two main features on the site: the pond, and the pool. These two features are both designed to be visible in high traffic areas. This constitutes a rating of 100%.

Accessibility

Of the two features, the pool is the most easily accessible. It can be accessed from the courtyard and the sidewalk. The pond is considered a reconstructed wetland because of its foliage. Neither of these water-holding elements has restricted access, although neither is meant for swimming. These features can be classified as allowing 'limited human contact'.

Credits

The project will be awarded two points for credit 3.7. If one feature was designed for full human contact (such as a swimming pool), the project would have received three points.

3.8 – Maintain water features to conserve water and other resources

Requirements

A site can achieve a maximum of 4 points from this section.

- All created water features will not negatively affect received waters by altering site water balance leading to detrimental impacts such as nutrient cycling, sediment transport and groundwater recharges
- Establish appropriate maintenance activities for water features to ensure that water features will not create habitats for mosquitoes; any harmful chemicals must not be used for maintenance activities.
- All created water features use a limited amount of make-up water from natural surface or subsurface resources.
    - 1 point: 50 percent of the annual make-up water comes from sustainable water sources or site water features require 10,000 gallons or less of potable water annually, whichever is less. Initial filling may be charged from potable water if under 37,500 gallons.
    - 2 point: 75 percent of the annual make-up water comes from sustainable water sources or site water features require 5,000 gallons or less potable water
    - 3 point: 100 percent of annual make-up water for water features comes from sustainable water sources.
    - Additional point: all water features use gravity for water movement and require no purchased electricity.

All water features on the courtyard use storm water as its source for make-up water. As the picture below illustrates, the storm water is collected in the reflecting pool from hard courtyard surfaces and adjacent building roofs. The storm water is transferred to the rain garden using gravity through the water channel. The rain garden is the final infiltration process of storm water. All storm water is filtered via plant materials, so no contamination leaks into the ground water table.

Points awarded: 4

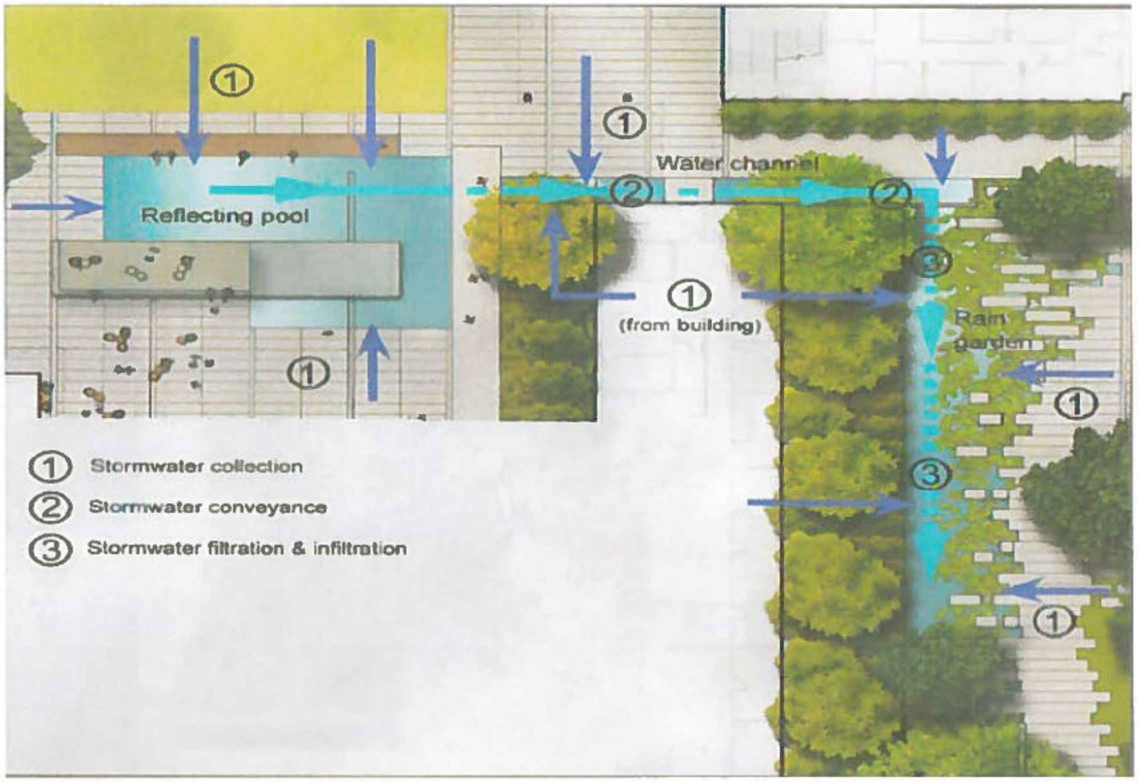


Figure 3 - Stormwater sources

Conclusion

This project has created an extremely aesthetically pleasing courtyard for the UBC community. Although, when the technical aspects of the courtyards are examined, the project is not quite so successful. The main issue with the project is the lack of potable water consumption reduction (Credit 3.1). The minimum reduction of consumption that will satisfy the SSI standards is 50%. The project as it sits has reduced the consumption by 30%. While this is a step in the right direction, it means that the project cannot be considered for SSI certification at the current time. Otherwise the courtyards scored well in most other applicable credit sections, earning a total of 15 out of a possible 26. Overall, the project does not technically meet SSI standards, although it is close. It has shown a shift in the right direction, with the possibility of meeting SSI standards after some adjustments.

Appendix A – List of References

American Society of Landscape Architects. (2009). *Guidelines and performance benchmarks 2009.*

Appendix a hydrologic soil groups. (n.d.). Retrieved from http://geology.wwu.edu/rjmitch/hydro_soil_groups.pdf

Smallenberg, Phillips. (2009). *Development Application AUDP Submission.*

World water and climate atlas. (2011, Augest 19). Retrieved from http://www.iwmi.cgiar.org/WAtlas/Default.aspx

Werner, Jon. (2007). Chapter 7 Hydrologic soil groups. In *National Engineering Handbook Part630 Hydrology* Retrieved from, http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba

Resources:

The Weather Channel, http://www.weather.com/

About.com Vancouver, http://vancouver.about.com/

RainBird irrigation systems, http://www.rainbird.com/

Appendix B – Calculations and Additional Data

Reference Data used in Credit 3.1

Table 11 - Distribution uniformity values for Rainbird sprinkler models use throughout Buchanan Courtyards

Distribution Uniformity	
Irrigation Type	**$DU_{(LQ)}$ (for sprinkler zones) or EU (for drip/micro-irrigation zones)**
Rainbird 5004-PRS Q-2.0, H-3.0 & F-6.0 Nozzle (Rotor)	70%
Rainbird 5000-MPR-25 (Rotor)	70%
Rainbird 1812 SAM-PRS Sprinkler C/W U15' Nozzle (Micro Spray)	70%
Rainbird 1812 SAM-PRS Sprinkler C/W U12' Nozzle (Micro Spray)	70%
Rainbird 1812 SAM-PRS Sprinkler C/W U10' Nozzle (Micro Spray)	70%
Rainbird 1812 SAM-PRS Sprinkler C/W U8' Nozzle (Micro Spray)	70%
Rainbird 1812 SAM-PRS Sprinkler C/W 15EST, 15LCS or 15RCS Nozzle (Micro Spray)	70%
Rainbird 1812 SAM-PRS Sprinkler C/W 15 (Micro Spray)	70%
Drip-Standard (for shrubs and grasses)	70%
Drip-Press Comp (for trees)	90%

Table 12 - Landscape coefficients for various plant types

Plant Type and Estimated Landscape Coefficient (K_L)			
Plant Type	K_L		
	Water Requirements		
	Low	Medium	High
Ground Cover	0.2	0.5	0.7
Shrubs	0.2	0.5	0.7
Trees	0.2	0.5	0.7
Turfgrass	0.6	0.7	0.8

Table 13 - Peak watering month evapotranspiration data

ET_0 = average reference evapotranspiration (ET_0) for the site's peak watering month (inches/month)					
Latitude: 49.2765			Longitude: -123.2177		
Month	ET_0 (mm/day)	ET_0 (mm/day)	ET_0 (mm/day)	**Average ET_0** (mm/day)	**Average ET_0** (in./month)
July	3.57	3.56	3.92	3.67	4.50
August	3.02	3.02	3.29	3.11	3.80

Table 14 - Average monthly rainfall data

Average Monthly Rainfall					
www.weather.com			www.vancouver.about.com		
Month	**Average Monthly Rainfall (in.)**	**R_a=Allowable Rainfall (25 % of average)**	**Month**	**Average Monthly Rainfall (in.)**	**R_a=Allowable Rainfall (25 % of average)**
July	1.40	0.35	July	1.40	0.35
August	1.50	0.38	August	1.50	0.38

Humid West Coast CN Point Distributions for Credit 3.5

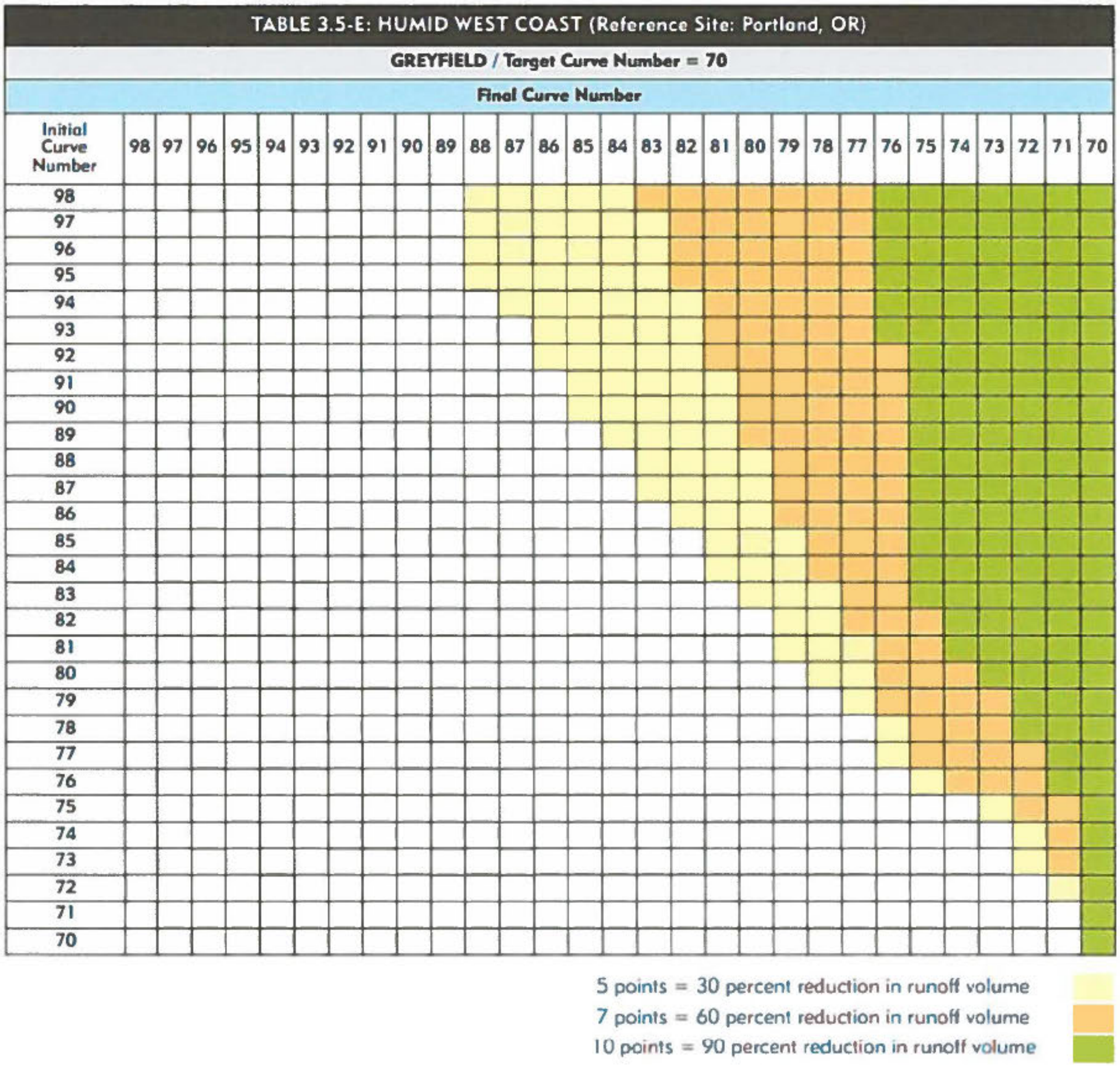


Figure 4 - Modified CN runoff reduction calculation chart for a humid west coast environment