Monitoring the Impacts of the UW Green Wall and Water Harvesting

from the UW Green Futures Research and Design Lab

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Background





The Green Wall





Interdisciplinary Cross Campus Collaboration and Education

38 students, 8+ disciplines

65+ faculty and staff across departments

Local contractor

Outdoor classroom for 8+ different courses and numerous professional tours

Widely publicized including American Airlines Magazine, Green Magazine in Taiwan, NRDC Blog

Outdoor Classroom









what we are researching

Flora - plant growth, death, maintenance



Fauna - bird and insects, habitat, urban impacts

Water - water use, water recycling, irrigation

Temperature – urban heat island effect, building performance

Green Seed Timeline

Flora -(June 2012) – September 2015

Fauna - June 2014 – July 2015

Water - August 2014 – September 2015

Temperature – August 2014 – September 2015

Data Analysis - September 2015 – June 2016

Dissemination:

- On Sustainability Conference Jan 24, 2016 in Portland OR
- Washington Society of Landscape Architects Conference April 1 2016 in Lynnwood WA
- Journal of Living Architecture Article, Submitted February 2016
- 1-2 more journal articles in progress

Water

water use, water recycling, irrigation



#1: upper flo sensor , measures amownt green walls are being irrigated#2: lower flo sensor , measures amount of potable back up water used(to determine quantity of recycled roof water, subtract #1 from #2)

Water

| Date | Sensor PFS0455 (total gallons water used in green wall by month) | Average gal/day used by month | Total Monthly Rainfall | +/- Normal | Average Temp | +/- Normal |
|----------------|--|--|------------------------------|---------------|-----------------|---------------|
| February 2014 | 381.5 | 5.7 | 6.11 | +2.61 | 41.7 | -1.7 |
| March 2014 | 473.6 | 15.3 | 9.44 | +5.72 | 48.5 | +2.0 |
| April 2014 | 536.1 | 17.9 | 4.18 | +1.47 | 52.0 | +1.7 |
| May 2014 | 670.8 | 21.6 | 3.15 | +1.21 | 59.1 | +3.1 |
| June 2014 | 464.4 | 13.3 | 0.73 | -0.84 | 62.0 | +1.1 |
| July 2014 | 207 | 7.0 | 0.77 | +0.07 | 69.2 | +3.5 |
| August 2014 | 233.5 | 7.8 | 1.81 | +0.93 | 69.1 | +3.0 |
| September 2014 | 158.9 | 5.4 | 2.23 | +0.73 | 64.8 | +3.5 |
| October 2014 | 360 | 2.1 | 6.75 | +3.27 | 58.0 | +5.2 |
| November 2014 | 425.4 | 2.6 | 4.84 | -1.73 | 46.0 | +0.6 |
| December 2014 | 88 | 2.9 | 4.79 | -0.56 | 45.3 | +4.8 |
| January 2015 | 508.3 | 16.4 | 3.66 | -1.91 | | |
| February 2015 | 816.6 | 30.3 | 5.27 | +1.77 | | |
| March 2015 | 819.1 | 27.4 | 4.47 | +0.75 | | |
| April 2015 | 1014.3 | 34.9 | 2.03 | -0.68 | | |
| May 2015 | 888.6 | 30.7 | 0.58 | -1.36 | | |
| June 2015 | 828.7 | 28.4 | 0.23 | -1.34 | | |
| July 2015 | 1829.1 | 60.3 | 0.09 | -0.61 | | |
| August 2015 | 935.3 | 32.0 | 3.28 | +2.40 | | |
| September 2015 | 618.9 | 21.6 | 0.83 | -0.67 | | |
| (20 months) | 12,258.1 | 19.2 | | | | |

How much water do green walls use?

Water

Can green walls be designed to recycle runoff? How often does back-up potable water need to be used?

| Date | Sensor PFS0455 (total gallons water used in green wall by month) | Average gal/day used by month | Sensor PFS0465 (total gallons of backup potable water entering cisterns by month | Average gal/day of backup potable water by month | Total gallons of recycled water used by month | Total Monthly Rainfall | +/- Normal | Average Temp | +/- Normal |
|----------------|--|--|--|---|---|------------------------------|---------------|-----------------|---------------|
| February 2014 | 381.5 | 5.7 | 0 | 0.0 | 381.5 | 6.11 | +2.61 | 41.7 | -1.7 |
| March 2014 | 473.6 | 15.3 | 0 | 0.0 | 473.6 | 9.44 | +5.72 | 48.5 | +2.0 |
| April 2014 | 536.1 | 17.9 | 0 | 0.0 | 536.1 | 4.18 | +1.47 | 52.0 | +1.7 |
| May 2014 | 670.8 | 21.6 | 0 | 0.0 | 670.8 | 3.15 | +1.21 | 59.1 | +3.1 |
| June 2014 | 464.4 | 13.3 | 0 | 0.0 | 464.4 | 0.73 | -0.84 | 62.0 | +1.1 |
| July 2014 | 207 | 7.0 | 0 | 0.0 | 207 | 0.77 | +0.07 | 69.2 | +3.5 |
| August 2014 | 233.5 | 7.8 | 25.6 | 0.8 | 207.9 | 1.81 | +0.93 | 69.1 | +3.0 |
| September 2014 | 158.9 | 5.4 | 0 | 0.0 | 158.9 | 2.23 | +0.73 | 64.8 | +3.5 |
| October 2014 | 360 | 2.1 | 0 | 0.0 | 360 | 6.75 | +3.27 | 58.0 | +5.2 |
| November 2014 | 425.4 | 2.6 | 0 | 0.0 | 425.4 | 4.84 | -1.73 | 46.0 | +0.6 |
| December 2014 | 88 | 2.9 | 0 | 0.0 | 88 | 4.79 | -0.56 | 45.3 | +4.8 |
| January 2015 | 508.3 | 16.4 | 0 | 0.0 | 508.3 | 3.66 | -1.91 | | |
| February 2015 | 816.6 | 30.3 | 0 | 0.0 | 816.6 | 5.27 | +1.77 | | |
| March 2015 | 819.1 | 27.4 | 0 | 0.0 | 819.1 | 4.47 | +0.75 | | |
| April 2015 | 1014.3 | 34.9 | 0 | 0.0 | 1014.3 | 2.03 | -0.68 | | |
| May 2015 | 888.6 | 30.7 | 0 | 0.0 | 888.6 | 0.58 | -1.36 | | |
| June 2015 | 828.7 | 28.4 | 1334.2 | 44.5 | -505.5 | 0.23 | -1.34 | | |
| July 2015 | 1829.1 | 60.3 | 1837.1 | 59.3 | -8 | 0.09 | -0.61 | | |
| August 2015 | 935.3 | 32.0 | 731.6 | 23.6 | 203.7 | 3.28 | +2.40 | | |
| September 2015 | 618.9 | 21.6 | 0 | 0.0 | 618.9 | 0.83 | -0.67 | | |
| (20 months) | 12,258.1 | 19.2 | 3,928.5 | 6.4 | 8,329.6 | | | | |





What are the irrigation challenges and opportunities with watering green walls?

Temperature

urban heat island effect, building performance



Temperature

What are the potentials for green walls to address the urban heat island effect?



Vegetation can provide up to 8°C of shade Temperature behind wall up to 17°C less than in full sun on hot summer days

Temperature

What are the potentials for green walls to increase building performance?



Consistent 0.5 degrees C difference (0.9 degrees F)

Fauna

bird and insects, habitat, urban impacts



Birds + Insects

of Shifts / Hours of Documentation: 765 # of Birds + Insects Documented: 2,410 Shifts with "no activity": 197, or 25.75% Adjusted Avg # of Birds+ Insects / Shift: 4.24 # Birds + Insects "interested in wall": 1,466 or 66%

Total # of birds documented: 1,137

Total # of birds "interested in the wall" : 568 # of bird species documented: 20

Most common interacting with wall (#, % of encounters)

Large Birds: American Crow (20, 4%) American Robin (26, 5%) Stellar's Jay (5, 1%) Northern Flicker (5, 1%) Sea Gull Small Birds: Anna's Hummingbird (100, 18%) Ruby Throated Hummingbird (1, <1%) Black Capped Chickadee (79, 14%) Dark-Eyed Junco (318, 56%) Barn Swallow Bewick's Wren (2, <1%) Bushtit (2, <1%)

House Finch (6, 1%) House Sparrow (2, <1%) Purple Martin Song Sparrow Spotted Towhee Swallow White Breasted Nuthatch Unidentified Bird (2, <1%)



Total # of insects documented: 1,068

Total # of insects "interested in the wall": 899

Groupings of insects documented:

Bee (32, 4%) Bee / Wasp (23, 3%) Bumble Bee (30, 3%) Honey Bee (136, 15%) Wasp (90, 10%)

Moth (34, 4%) Dragonfly (12, 1%) Fly (197, 22%) Spider (35, 4%) House Fly (5, 1%)

Butterfly (9, 1%) Gnat (293, 33%) Ladybug (2, <1%) Mosquito (1, <1%)



















of nests laid (2 seasons): estimated 4-7 # of nests that formed eggs (2 seasons): 2-3

of successful broods (1 season): 2 (est.)













Birds, Insects + Vegetation Symbiosis

Green Walls: catalyzing + perpetuating mutually beneficial life support systems for urban wildlife

Plants Insects Birds Elements (e.g. wind, sun etc.)

Pollination Pathways?

Fun Facts

11% of bird activity was interactions back and forth from yews below



65% of bird activity + 94% of insect activity was interaction with plants

23% of bird activity was with water infrastructure elements



12% of documented bird activity was with perching spots

Flora

plant growth, death, maintenance

Plants

of plants: 500 - 528

of plant species: 22 – 24

% plants native: 61 – 66% -as low as 38% lower wall -up to 86% upper wall

% of species native: 50 – 59% -as low as 29% lower wall -up to 73% upper wall

Plants

Native Plants: Kinnickinick Spleenwort Wild Ginger Lady Fern Creeping Oregon Grape Deer Fern Bunchberry Dogwood Slough Sedge

Non-Native Plants: Painted Fern Alpine Water Fern Beetlemania Sedge Orange New Zealand Sedge Autumn Fern Epimedium/ Fairy Wings Purple Coral Bells Peppermint Coral Bells Salal Pacific Coast Iris Redwood Sorrell Licorice Fern Sword Fern Alaskan Fern Oregon Stonecrop Evergreen Blueberry

<u>Volunteer Plants:</u> Canadian Dogwood (Bunchberry) Piggyback Plant Miner's Lettuce Lady Fern

Sweet Tea Foamy Bells Big Blue Lily Turf Lemon Beauty Honeysuckle Silver Beauty Honeysuckle Green Mondo Grass Black Mondo Grass Tassel Fern Takesimense Stonecrop London Pride Saxifrage



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| | LR | LR | LR | CT | CT | 05-12 CT | OP | | cc | OP: | AF | AF | | | | | |
| | LR | LR | 02-11 CT | 03-11 CT | CT | | | | | AF | AF | | | | | SE. | |
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| | 85 85 | CT | cian CT | CT | CT | 5.68 PM | 08-08 PM | PM | CS.03 PM | 00-20 80 | 19.00 80 | 11.08 80 | 12.08 HS | 15.68 HS | 14.08 HS | 19-38 DE | | | 0.CH (| 0.08 0 CT 4 | 0.08 CT | aan o | CT I | 6-08 0 PM F | 1.08 00 M P | 1.08 B | 1.08 O | 100 1 100 8 | 100 H | 5 H | 48 15 15 Hi | 14.0 5 HS | 8 15.08 DE | | 00.0 | T 01.3 | CO.ET | 0.07 LS | 04.07 EP | PM | 98.07 PM | et.et PM |
| | SE SE | 01.00 CT | | 55.09 PM | 36.00 PM | 5.00 PM | 06.00 PM | etas PM | 08-09 OP | IN SH | 10.00 | 100 | 12.00 | 13.00 DE | 16.00 DE | 15-35 DE | - | 1 | 0.00 0 CT 4 | 0.00 0 CT | CT I | AND D | -m 6-35 0 M 1 | -m P 1.00 0 PM 1 | -ve C | 108 0 | | | 10 H | 0 0 8 10 8 14 | 4 D 8 D | 5 144 E D4 | 0 15.09 | | | 8 81.0 8 81.0 | 02.03 | 996 03.08 | PM 04.08 | 05.08 | PM D | PNI FLOS |
| | GT 85.13 677 | 01.0 | PM 03.10 | PW | PM | PM 05-10 INM | ST 06.10 | 0P 00 | 0P 08-10 | 165 | DE | 11.10 14.10 | 12.10 DE | 13-10 DE | P5 14.10 DE | 15-10 DE | | | CT 4 | CT 1 | PM 0 | PNA P 8.100 D | PM 8 | PM 0 | L 10 0 | A 19 | | | 0E E | E D | E D | E PE | 0 15.10 DE | | 51 CT | CT 0.01 | PM | PM | PM 04.00 | PM 05.09 | PM 05.00 | IX. |
| | 80.m | 97.10 97.10 | PW | - 191 30-11 | 91 8-11 | 91 8.11 | 08.11 | 00 | 08-TI | 00.11 | 13.11 | 11.0 | 13.11 | 10.11 | 14.11 | 15.11 | | 1 | CT | PM 1 | PM F | PM 8 | 6.11 | 51 C | ap C | 1999 1.11 B | 45 I 8.m 9 | | 0E 0 | e P | 1 11 | 5 P5 | PS | | CI | CT 0 01.5 | PM | PM 53.13 | PM SL12 | PM 03-10 | IX MIN | 1X |
| | 61 85.0 | P16 | PW | P191 | 9T | 611 67 | 0P | OP III.C | C& T | 09-13 09-13 | 10.13 | PS 11.10 | P\$ | 13-12 | PS 14.12 BR | 15.12 | 100 | 0 | CT 6.12 0 | PM 8 | PM P (3.12 B | PM 8 | 97 - 1 6.13 - 0 | 817 4 6.13 0 | DP 0 | 0P (| DE I | ME 0 | DE P | 5 P | 5 PS | 5 PS | 88 2 15.12 | | CT | PM | PM | PM | PM | IX. | IX. | IX IX |
| | PM | PM 05.10 | PM | PM | 8T | 0P | 0P | OP IT.II | 06.13 | DE | P5 | PS | P\$ | 88 13-13 | 16.13 | 18.11 | See and | | PM 1 | PM 8 | PM P | PM 8 | ST C | OP C | op c | 9 9 (| DE E | HE P | 15 P | 8 P | 8 83 10 10 | 8 84 | 88 | | CT | PN | PM | PM | 04.10 1X | 05.13 IX | 06.10 (X | DE |
| | 00.15 PM | 95.15 PM 95.14 | PM | 815 8T | 810 8T | 0P | 08.15 OP | DE DE | 08-18 DE 08-16 | 09-15 PS | 10.10 PS | 11.10 88 | 13.15 BS | 13-18 85 13-14 | 14.15 BS | 15.15 88 | | | ans a | PM | PM 3 | 8.11 B 87 B | 6.11 0 57 0 | OP C | an a | | LIS O DE 1 | 115 1 15 F | 11 15 15 | 11 11 8 8 | 10 10 18 B | | BB | | Ph | e personale personal Personale personale perso | PM CO.W PM | ST SLH PM | 101. 54.54 817 | UX 05.14 UX | DE IX | DE |
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| Max Max <td>PM P</td> <td>M P</td> <td>M P</td> <td>M 7</td> <td>भी है। बाह्य</td> <td></td> <td></td> <td>BR SO</td> <td>8R 90</td> <td>CO Martin</td> <td>C0</td> <td>CO</td> <td>CT</td> <td>CT</td> <td>46 1940</td> <td>88</td> <td></td> <td>PA</td> <td>A Ph</td> <td>4 PN</td> <td>03 00.0 VI PN</td> <td>A A</td> <td>T BA</td> <td></td> <td>88</td> <td>90</td> <td>C</td> <td>C</td> <td>0 00</td> <td>CT</td> <td>CT</td> <td>AC PV</td> <td>85</td> <td></td> <td>PM</td> <td>PM</td> <td>PM</td> <td>AT</td> <td>BR</td> <td>6.62 0 BR</td> <td></td> <td>ĉ</td> | PM P | M P | M P | M 7 | भी है। बाह्य | | | BR SO | 8R 90 | CO Martin | C0 | CO | CT | CT | 46 1940 | 88 | | PA | A Ph | 4 PN | 03 00.0 VI PN | A A | T BA | | 88 | 90 | C | C | 0 00 | CT | CT | AC PV | 85 | | PM | PM | PM | AT | BR | 6.62 0 BR | | ĉ |
| All All <td>00 F</td> <td>M P</td> <td>M P</td> <td>MP</td> <td>M P</td> <td>MA</td> <td>a i</td> <td>88</td> <td>BR 90</td> <td>BR SO</td> <td>80</td> <td>co</td> <td>VO</td> <td>VO</td> <td>VO</td> <td>PV</td> <td></td> <td>00</td> <td>P</td> <td>N PN</td> <td>M Ph</td> <td>I PN</td> <td>A PI</td> <td>AT</td> <td>88</td> <td>80 90</td> <td>010 01 01 01 01 01 01 01 01</td> <td>80</td> <td>00</td> <td>VO</td> <td>VO</td> <td>VO</td> <td>PV</td> <td></td> <td>PM</td> <td>91.00 PM</td> <td>PM PM</td> <td>PM</td> <td>AT</td> <td>BR</td> <td>a di DR B</td> <td></td> | 00 F | M P | M P | MP | M P | MA | a i | 88 | BR 90 | BR SO | 80 | co | VO | VO | VO | PV | | 00 | P | N PN | M Ph | I PN | A PI | AT | 88 | 80 90 | 010 01 01 01 01 01 01 01 01 | 80 | 00 | VO | VO | VO | PV | | PM | 91.00 PM | PM PM | PM | AT | BR | a di DR B | |
| All All <td>0000</td> <td>0 0</td> <td>10 P</td> <td>AR CE M P</td> <td>M P</td> <td>M P</td> <td>M F</td> <td>PM</td> <td>PM</td> <td>BR SO</td> <td>VD</td> <td>vo Vo</td> <td>GS CS</td> <td>VO</td> <td>14.05 1 VO</td> <td>NO.</td> <td></td> <td>00</td> <td></td> <td>0</td> <td>o PR</td> <td>e sta e PN</td> <td>a ca.c A Pi</td> <td>a sea d PN</td> <td>PM</td> <td>e osc Ph</td> <td>0 00.0 A 89 90</td> <td>VC</td> <td>vo</td> <td>GS</td> <td>10-00 VO</td> <td>VO VO</td> <td>15.05 VO</td> <td>i i</td> <td>EL.</td> <td>91.51 PM</td> <td>LL DSI 1</td> <td>PM I</td> <td>PM I SLOE C PM</td> <td>PM F 3.64 0 PM -</td> <td>M P</td> <td>M 01</td> | 0000 | 0 0 | 10 P | AR CE M P | M P | M P | M F | PM | PM | BR SO | VD | vo Vo | GS CS | VO | 14.05 1 VO | NO. | | 00 | | 0 | o PR | e sta e PN | a ca.c A Pi | a sea d PN | PM | e osc Ph | 0 00.0 A 89 90 | VC | vo | GS | 10-00 VO | VO VO | 15.05 VO | i i | EL. | 91.51 PM | LL DSI 1 | PM I | PM I SLOE C PM | PM F 3.64 0 PM - | M P | M 01 |
| All A | æ ő | | 0 0 | 10 P | 00 00 M P | 00 05 M P | M F | PM | PM | PM | 10.00 GS | 05 05 | 12.08 GS | 13-08 GS | 14.00 T | 10 | | 0 | i oo | 0 00 | 0 | o PN | a 00.0 | e ses d PN | e ene PM | P | e Pi | W GS | GS | GS GS | GS | GS III. | 15.08 VO | | UX IX | UL. 91.05 | LL. | PM | PM 0 | PM F | M PI | M |
| All A | | c d | 0000 | л (s | at 10 | 81 (S 0 0 | ior a P | nar MM | PM | PM | 10.01 PM | nar PM | t241 GS | 13-87 GS | 14.07 1 68 1 | 10 | | 0 | | 0 000 J 0 | | 0 00 | | 0 | er.e PM | Ph | r ca.s | 111.0 PW | 11.00 PM | GS | 13-07 GS | 14-27 GS | 15.0P VO | | IX IX | IX. SLOP | LL 1208 | LL | | | LL PI | or M M |
| All A | | | | | | e o | | 0.08 | 00 | 08-08 PM | 10.0K | 15.08 PM | 12.68 GS | 13-38 GS | 14.08 1 GS 1 | 1.00 | | 80 | | | | - 0. - 110 | | 8 853 P 04 | | | 00.0 0 P4 | 8 13.0 6 PA | | 10.00 | 13.08 68 | 966 11.22 0.5 | 15.08 GS | al sha | IX. | DK. | CK. | LCR C | LL | LL | | Ľ |
| All Lik L | CT 0 | 100 T | | .T C | | | 1P C 100 00 100 0 | 0.09 0.09 0.09 | OP 000 | 00 08-08 PM | PM 10.00 PM | P.M 15.00 P.M | PM 12.00 PM | PM 1535 GS | GS 1 GS 1 | 100 | | C1 | F C1 | r C | T C | T 0.0 | | 1 0F | OP 01.0 | 0 08.0 | 0 000 | 0 13.0 | 6 PM | 10.00 | PM 13-09 | 68 1439 | GS 15.09 | | NO. | araa VQ | ix. | 10.09 10 | ж.сэ IX | 1X | | 8 |
| All Lik Lik <td>LR I 6.13 07</td> <td>.R (</td> <td>2T C</td> <td>10 Ca</td> <td>T C</td> <td>C C</td> <td>10 8</td> <td>0.10</td> <td>OP (8-10</td> <td>AF 08-10</td> <td>AF</td> <td>PM 9.10</td> <td>PM 12.10</td> <td>PM 13-10</td> <td>PM 1</td> <td>38</td> <td></td> <td>0.1</td> <td>t Li</td> <td>R C</td> <td>T C</td> <td>T C1</td> <td>0.</td> <td>0.</td> <td>0.0</td> <td>0 08.1</td> <td>0 (0).1</td> <td>AI</td> <td>PM</td> <td>PM</td> <td>PM 18.10</td> <td>PM 14.10</td> <td>GS 15.10</td> <td></td> <td>NO NO</td> <td>ana VO</td> <td></td> <td>90 90 90</td> <td>96.10 C</td> <td>03 (510 0 OJ 1</td> <td>L10 07.</td> <td>0 40 5</td> | LR I 6.13 07 | .R (| 2T C | 10 Ca | T C | C C | 10 8 | 0.10 | OP (8-10 | AF 08-10 | AF | PM 9.10 | PM 12.10 | PM 13-10 | PM 1 | 38 | | 0.1 | t Li | R C | T C | T C1 | 0. | 0. | 0.0 | 0 08.1 | 0 (0).1 | AI | PM | PM | PM 18.10 | PM 14.10 | GS 15.10 | | NO NO | ana VO | | 90 90 90 | 96.10 C | 03 (510 0 OJ 1 | L10 07. | 0 40 5 |
| | LR 1 | .R 1 | RC | T C | T C | то | φP 1 | 01P 12-10 | CC RT | 0P | AF 13.11 | AF | PM | PM | PM 1 | PIM D | H | | L LI | | R C | r ci | c | 08 | 0. | 0. | 0 | A | AP. | PN | PM | PM | PM | | 00 T | 00 | 000 00.11 | 8.11 MO | 96.11 36.11 | 90 (5.11 0 | L 10 | 4 41 |
| REG REG LIR LIR LIR CT | as . | G. | | Ц | 5 | T C | TT C | OP | OP | OP 08-12 | OP 10-12 | AF | AF | PM | PM 1 | PM 5.12 | | 80 | | t L | RL | | C (201 | T C1 | OP | 0 | P OF | OP | AP | AF | PM | 16-52 PM | PM | | 98 00:00 | 68 81.13 | 68 | 68 8.17 | GS 31.17 | VO 1 | /O 10 | 4 |
| | | 8 1 | RL | RL | RC | TC | TO | CT | СТ | OP | OP | OP | AF | PM | PM I | M | | 8 | 5 88 | s u | R L | | (C | r 000 | CT | ¢ | 0 | 0 | OP | AP | PM | PM | PM | | BP | BP | GS ID ID | GS 8-13 | 65 31 U | VO 1 | /O VI | 0 |

- ry 19, 2015 - tried a new type of water saving irrigation but tops of walls too dry
 - drip emitters + quantity now

PM PM IX.

> PM PM GS 15.10 PM GS | C S

> > GS

18.01 8U

80

5.15 14.15 14.19 BS BP BP

PS BP

14.12 15.12 PS PS PS DE DE 1409 15.09 DE DE 15.08 DE

15.05 PM

16.00 15.00 PM PM

14-02 15-03 PM PM

14.01 15.01 PP PM

13.54 PM

PM PM 10.62 13.62 PP PM

PP

PP PP 13.01 PP 13.80 PP 14:00 15:00 PP PP

GS GS GS GS GS GS

12.00 13-00 14.00 TM SU SU

05 05 13-05 VO vo vo

VO. U0 13.04 VO 811 CC CT SU SU 1343 CT PV CT 1241 1931 PV PV

PS 10.16 PS 19-19 DE

10-12 15-12 DE DE

BR 10.87 15.01 BR BR BR PM PM BR BR

- water off for extended periods doubled on tops of walls
- -white worm on heucheras

- winter freeze/thaw tied to

automatic irrigation w/ soil

moisture sensors

- mostly species specific death

- white worm on heucheras

| | Green Wall Plant Death Documentation | | | | | | | | | | | | | |
|--|--------------------------------------|----------------------|--------------|----------|------------------------------------|----------------------|----------|----------------------|--------------------|--|--|--|--|--|
| | Originally Planted | Plant Death as of | % Species | Replants | Plant Death + Aesthetic Removal | % Species Death + | Replants | Plant Death as of | % Species Death | | | | | |
| Plant Name | 7/13/12 | 5/2/2013 | Death 0% | Update | as of 6/11/2014 | Removal | Update | 1/19/2015 | 0% | | | | | |
| (spleenwort) | 3 | | 0% | | | 0% | 5 | | 0% | | | | | |
| asarum caudatum (wild ginger) | 13 | 3 | 23% | 13 | 13 | 100% | 0 | | | | | | | |
| athyrium filix-femina 'lady in red' | 8 | | 0% | 8 | 4 | 50% | 7 | 7 | 100% | | | | | |
| (lady tern) athyrium niponicum | | [| | | | | 9 | 9 | 100% | | | | | |
| (painted fern) berberis repens | 18 | | 0% | 18 | 2 | 11% | 31 | 2 | 6% | | | | | |
| (creeping oregon grape) | | | | | | | 24 | 46 | 6720/ | | | | | |
| (alpine water fern) | | | | | | | 24 | 16 | 67% | | | | | |
| blechnum spicant | 44 | 17 | 39% | 44 | 42 | 95% | 4 | 3 | 75% | | | | | |
| carex caryophyllea 'the beatles' | 17 | 17 | 100% | 0 | | N/A | 0 | | | | | | | |
| (beatlemania sedge) cornus canadensis | | | | | | | 14 | 6 | 43% | | | | | |
| (bunchberry dogwood) | 12 | 14 | 109% | 12 | 11 | 95% | 2 | | 0% | | | | | |
| (slough sedge) | 13 | 14 | 10876 | 15 | 11 | 85% | 2 | | 078 | | | | | |
| carex testacea (orange new zealand sedge) | 53 | 30 | 57% | 53 | 36 | 68% | 17 | 12 | 71% | | | | | |
| dropteris erythrosora | 27 | | 0% | 27 | 3 | 11% | 37 | 8 | 22% | | | | | |
| Epimedium, evergreen var. | | | | | | | 8 | 2 | 25% | | | | | |
| (fairy wings) gaultheria shallon | 19 | 1 | 5% | 19 | 1 | 5% | 31 | 18 | 58% | | | | | |
| heuchera micrantha 'palace purple' | 19 | 1 | 5% | 19 | 19 | 100% | 0 | | | | | | | |
| (purple coral bells) heucherella 'sweet tea' | 15 | 9 | 60% | 16 | 6 | 38% | 17 | 17 | 100% | | | | | |
| (sweet tea foamy bells) iris x 'meadows pastel' | | | | | | | 35 | 6 | 17% | | | | | |
| (pacific coast iris) liriope muscari 'big blue' | 13 | | 0% | 13 | 13 | 100% | 0 | | | | | | | |
| (big blue lily turf) | | | | | - | | | | | | | | | |
| beauty' | | | | | | | 18 | 12 | 67% | | | | | |
| (lemon beauty honeysuckle) | | | | | | | 18 | 7 | 39% | | | | | |
| (silver beauty honeysuckle) | 0 | | N/A | 19 | 16 | 80% | 2 | | 0% | | | | | |
| (green mondo grass) | 0 | | N/A | 18 | 16 | 89% | 2 | | 0% | | | | | |
| ophiopogon planiscapus 'nigrescens' | 37 | 1 | 3% | 36 | 36 | 100% | 0 | | | | | | | |
| oxalis oregana | 15 | | 0% | 15 | 15 | 100% | 0 | | | | | | | |
| (redwood sorrell) polypodium vulgare | 5 | | 0% | 5 | 3 | 60% | 4 | | 0% | | | | | |
| (licorice fern) | 117 | э | 20/ | 117 | 7 | 6% | 100 | 50 | /10/ | | | | | |
| (sword fern) | 11/ | ۷. | 2/0 | / | , | 078 | 123 | 50 | 41/0 | | | | | |
| polystichum polyblepharum (tassel fern) | 18 | | 0% | 18 | 2 | 11% | 25 | 2 | 8% | | | | | |
| polystichum setiferum P. angulare | 27 | | 0% | 27 | 14 | 52% | 15 | 8 | 53% | | | | | |
| (alaskan fern) sedum oreganum | 27 | 5 | 19% | 26 | 26 | 100% | 0 | | | | | | | |
| (oregon stonecrop) sedum takesimense | 8 | | 0% | 8 | 6 | 75% | 2 | 2 | 100% | | | | | |
| saxifraga x urbium 'london pride' | | | | | | | 22 | 4 | 18% | | | | | |
| (london pride saxifrage) | 10 | | 0% | 10 | | 40% | 20 | 11 | 38% | | | | | |
| (evergreen huckleberry) | 10 | | 0% | 1 10 | 4 | 40% | 29 | 11 | 30% | | | | | |
| TOTALS | 528 | 100 | | 528 | 279 | | 499 | 202 | | | | | | |
| overall % dieback | | 19% | | | 53% | | | 40% | | | | | | |

Highest Performing Plants:

Spleenwort Oregon Grape Salal Sword Fern Tassel Fern Saxifrage Evergreen Blueberry Licorice Fern Iris Species

Poor Performing Plants:

Painted Fern Lady Fern Blechnum Species Carex Testacea + Obnupta * Heuchera Species Aslaskan Fern Sedums Black and Green Mondo Grasses Redwood Sorrell

Thoughts and Tidbits

Infrastructure as habitat

Nesting source and destination

Maintenance schedule vs. habitat schedule

Green technologies as people attractors

Researcher experiences and education

Sustainability IS maintenance

Monitoring the Impacts of the UW Green Wall and Water Harvesting

from the UW Green Futures Research and Design Lab

Many Thanks!!

Seed Fund s Sustainability Fund Futures Research + Design Lab of Built Environments a Systems Ashley Powell Amos Chan Matt MacDonald Evan Henrich 29 volunteer researchers Co-Pl's: Nancy Rottle Leann Andrews