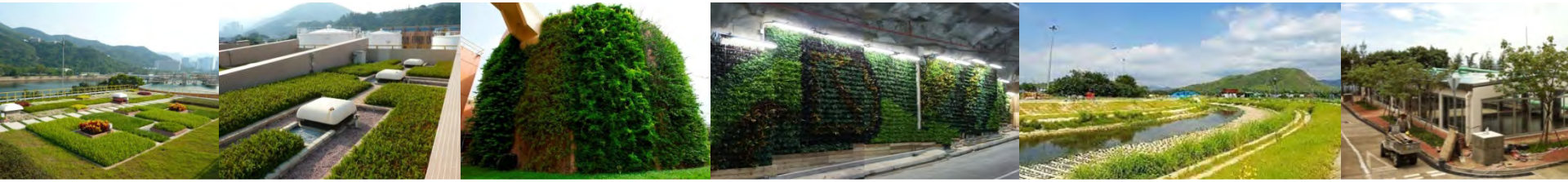
DSD R&D related to Green Infrastructure

LA2/Headquarters, DSD
Ms. Elly LEUNG (梁曉心)
15 August 2013



DSD R&D related to Green Infrastructure

1. **R&D Study of Vertical Greening:**
   a) Climbing Plant Species at Shatin STW
   b) Indoor vertical greening systems at Stanley STW in cavern

2. **R&D Study of Green Roofs at Shatin STW**

3. **The Way Forward – Reduce waste and carbon footprint for sustainable landscape management**

DSD R&D Works:

Hydrology and Hydraulics	Treatment Process	Sustainable Urban Drainage System	Climate Change	Asset Management	Design and Materials

1. R&D Study of Vertical Greening:

a) Climbing Plant Species at STSTW




Study Sites at Shatin Sewage Treatment Works (STSTW)

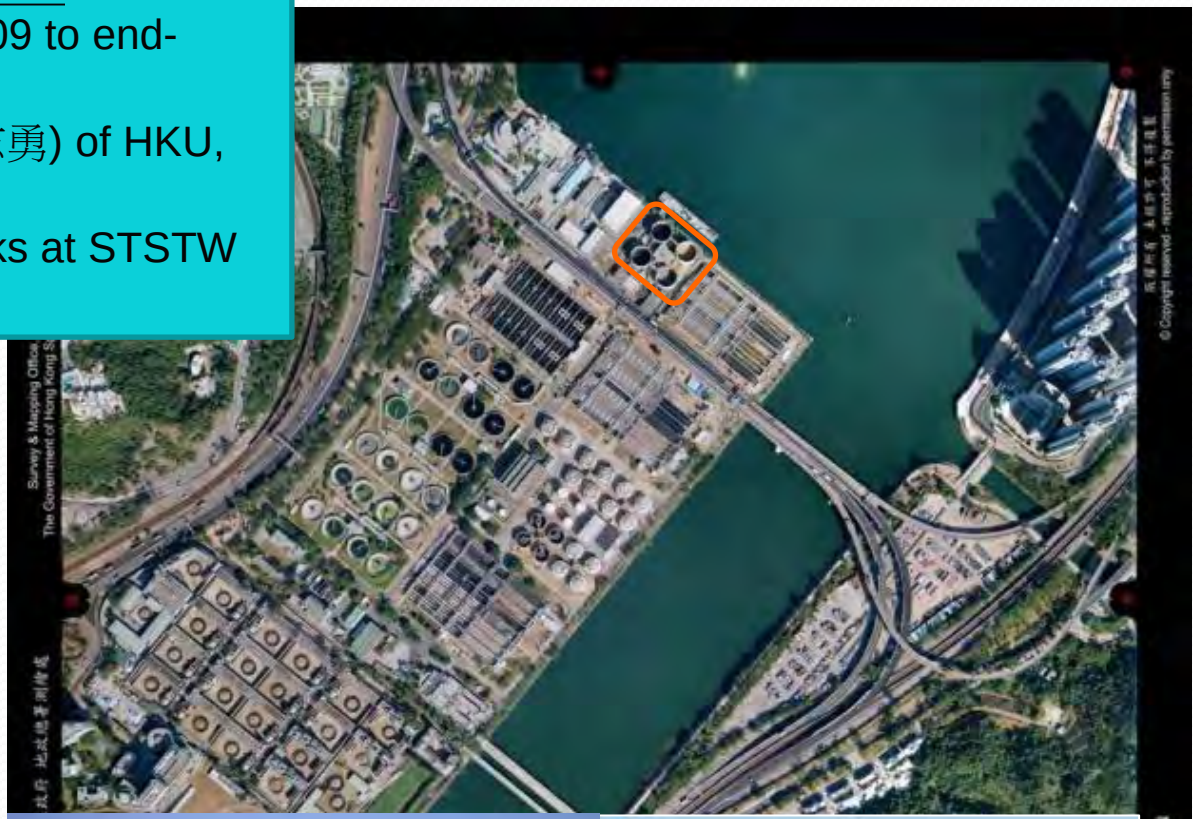
R&D Study of Climbing Plant Species:

Study period: 40 mths (from mid-2009 to end-2012)

Consultant: Prof. JIM Chi-yung (詹志勇) of HKU, Dept. of Geography

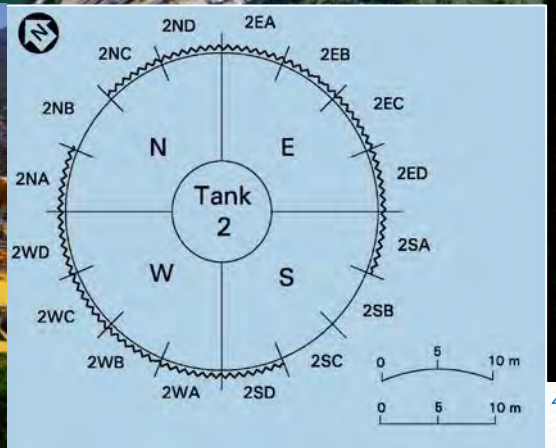
Study location: Sludge Storage Tanks at STSTW

Status: Final report completed



Study Objectives:

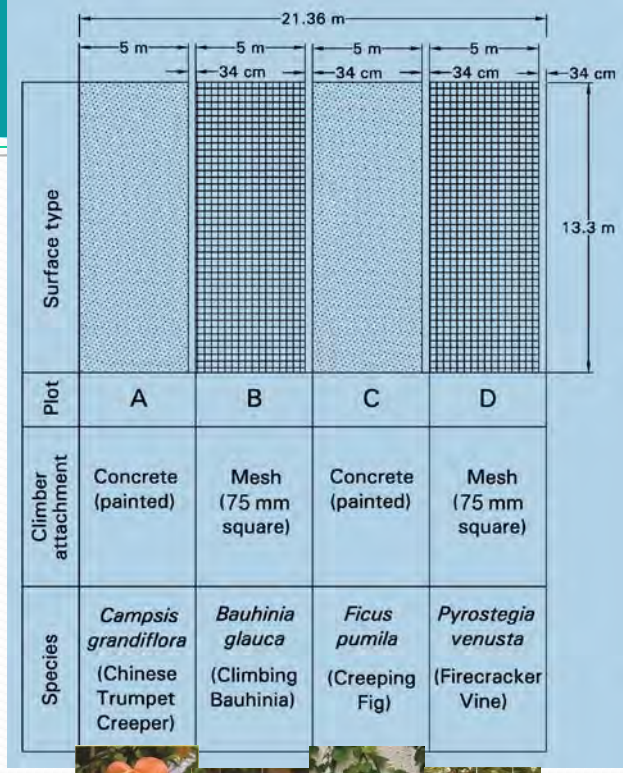
- Carry out a literature review on selection and identification of climber plant species
- Monitor the cooling effect of the vegetated by field temperature sensors and data loggers
- Design and implement a vertical greening trials at STSTW
- Evaluate the performance of selected climber plant species with pertinent growth parameters



Experiment I – Site Factor Effect(Tanks2&4)

Test Site Factors:

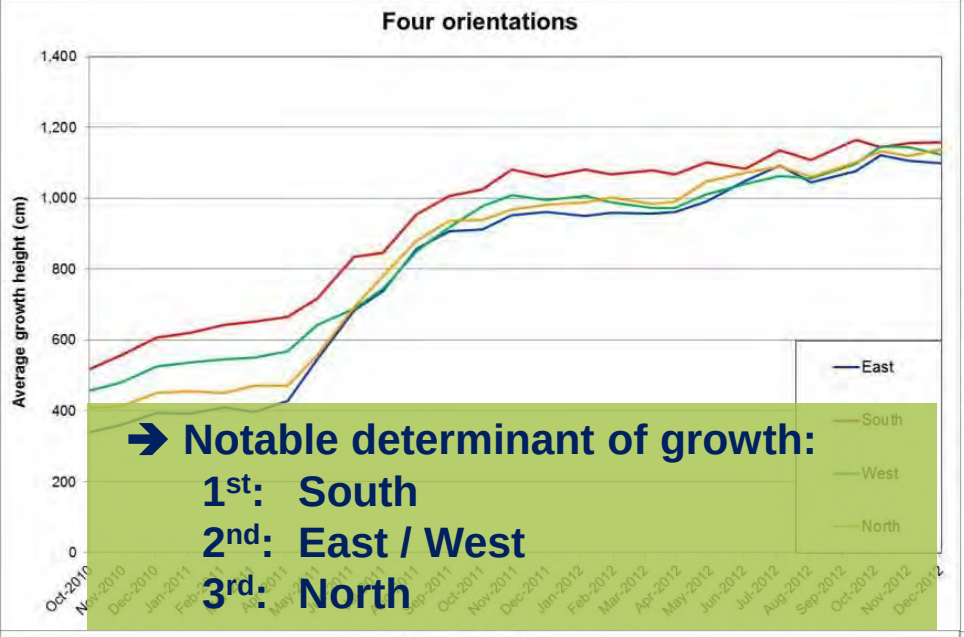
- Climbing Modes & Species
- Soil quality
  - Original soil : Tank 2
  - Replaced : Tank 4
    - Planting strip 2 m wide and 0.6 m deep
    - Both soil types treated with fertilizer in top 30 cm
- Orientation
  - 4 quarters = four cardinal compass directions



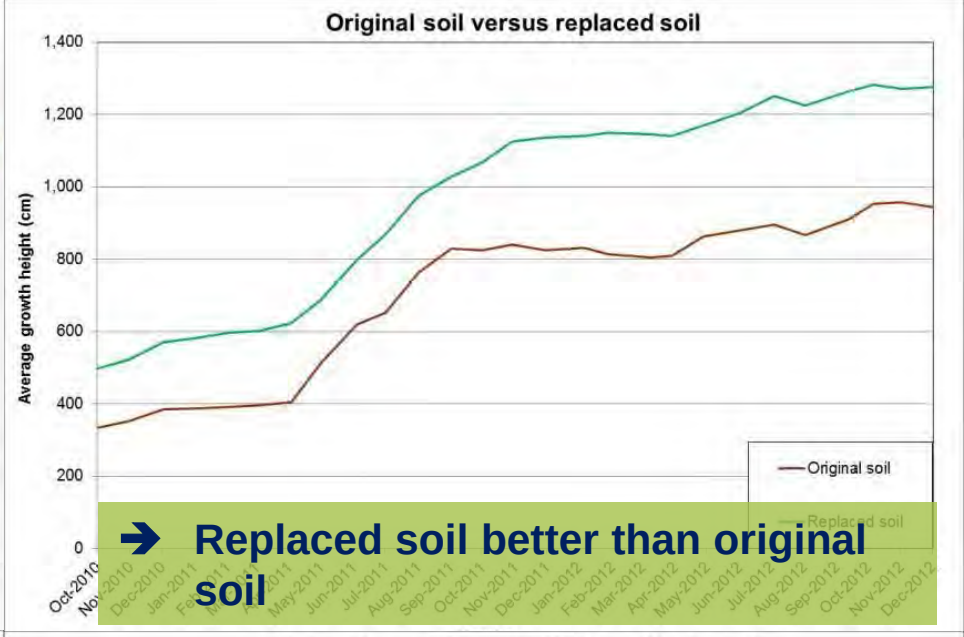
Combined Assessment:

- Growth height
- Growth density
- Gap between stems
- Vigor

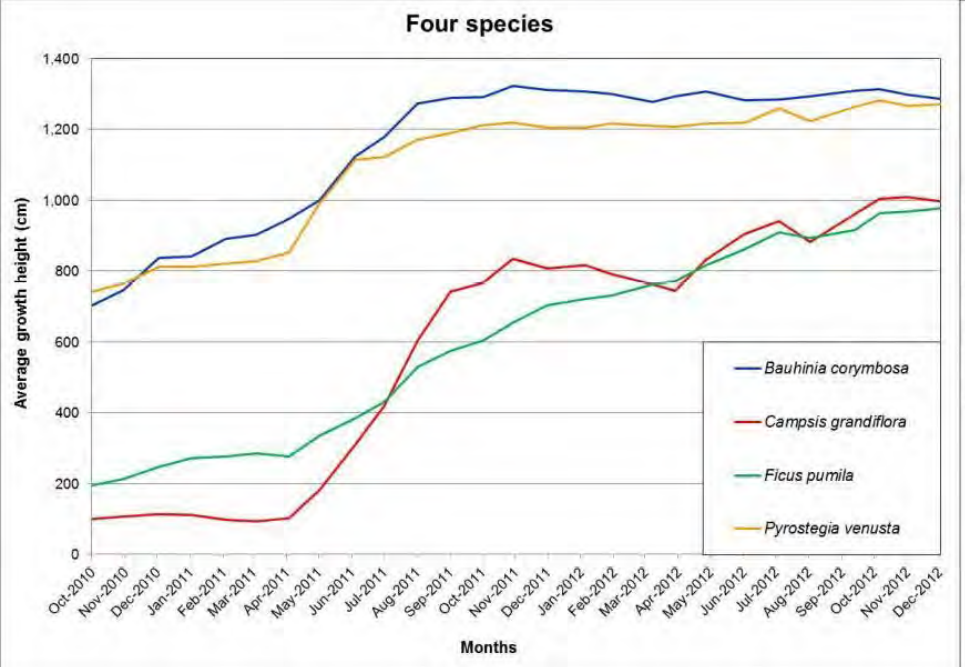
Experiment I – Site Factor Effect (Tanks 2 & 4)

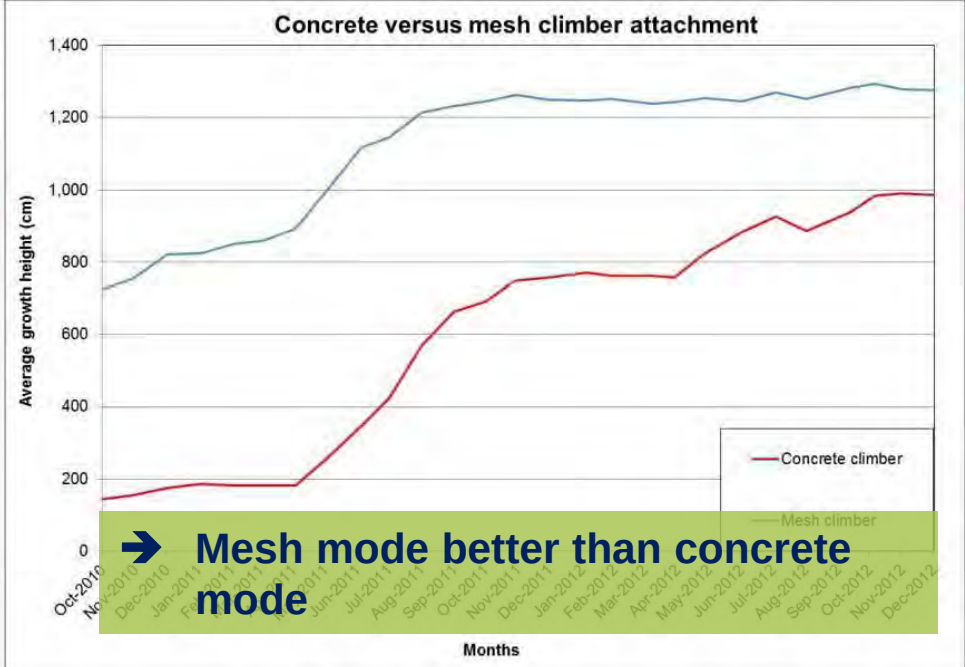


➔ **Notable determinant of growth:**
- **1st: South**
- **2nd: East / West**
- **3rd: North**



➔ **Replaced soil better than original soil**

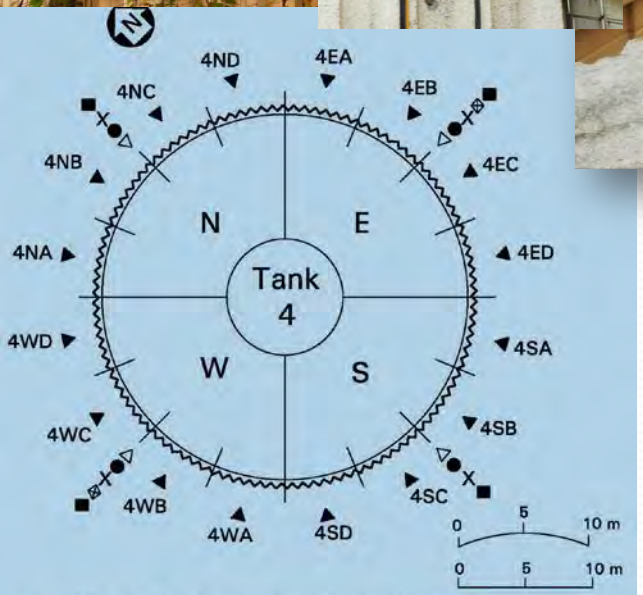




➔ **Mesh mode better than concrete mode**

Experiment II – Cooling Effect (Tank 4)

Setup of Environmental Sensor

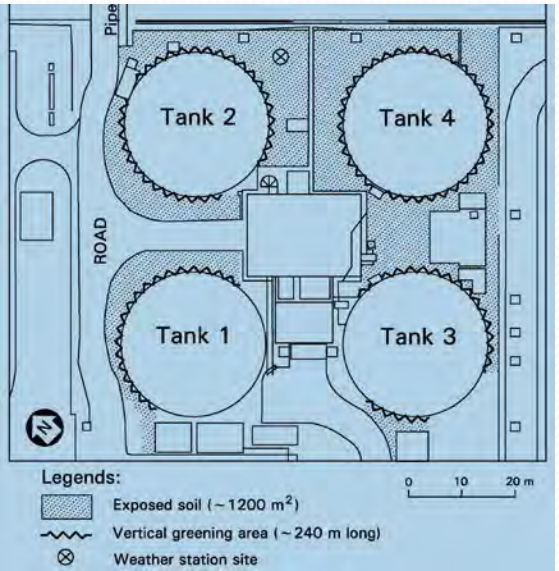


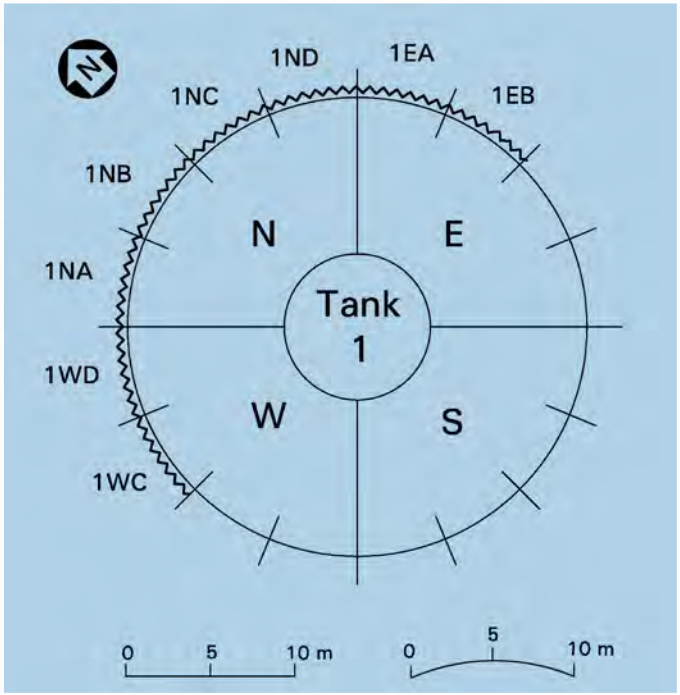
Results of Cooling effect:

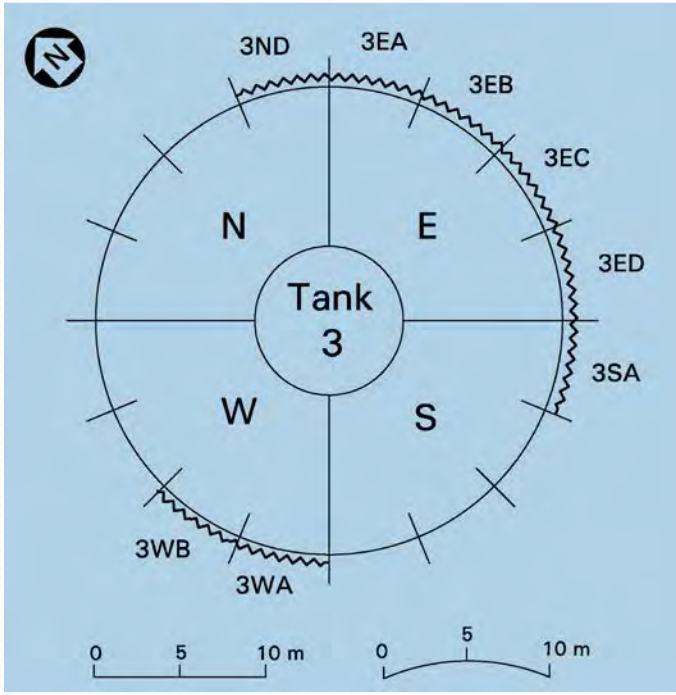
- **More prominent in summer than in winder**
- **More prominent on sunny and rainy days than on cloudy days**
- **Surface temperature reduction:**
  ↓ 7°C in summer
  ↓ 2°C in winter

Experiment III – Climber Species Performance (Tanks 1&3)

- **16** available experimental plots
  - Test **20** climber species
    - **Tank 1:** 8 plots, 8 species, mesh, replaced soil
    - **Tank 3:** 8 plots, 8 species, concrete, replaced soil
    - **Tanks 2 & 4:** 4 species (from Experiment I)







Experiment III – Climber Species Trial

Quisqualis indica
Chinese Honeysuckle

使君子

使君子科
Combretaceae

使君子原產於東南亞，為木質藤本。枝葉茂密，花多艷麗。花初放時為粉白色，後漸變紅。相傳古時有位叫郭使君的醫生以此植物治病，功效顯著，故稱它為使君子。

花期：夏季
果期：秋季

Antigonon leptopus
Coral Vine

珊瑚藤

蓼科
Polygonaceae

珊瑚藤原產於墨西哥，為半落葉藤本。莖前端具卷鬚，枝條蔓延力強。花果期長，夏至秋季最盛，盛開時串串粉紅色的花苞晶瑩美豔，絢麗奪目。

花期：8至12月
果期：8至12月

Vitis vinifera
Grape

葡萄

葡萄科
Vitaceae

葡萄原產於亞洲西部，為落葉藤本，可攀達三十五米高。全球約有六十種，其中有分觀賞品種、釀酒品系和食用品系等。其營養價值極高，可製成葡萄乾、葡萄汁和葡萄酒等。

花期：4至5月
果期：6至10月

Pseudocalymma alliaceum
Garlic Vine

蒜香藤

紫葳科
Bignoniaceae

蒜香藤原產於巴西。其花和葉均帶有濃烈的大蒜味，故稱為蒜香藤。花初開時為粉紫色帶紅，受粉後漸變為淡紫，花形密集呈串。

花期：3至5月
果期：2月

Experiment III – Climber Species Trial

Podranea ricasoliana
Pink Trumpet Vine

紫雲藤

紫葳科
Bignoniaceae

紫雲藤原產於非洲南部。花期甚長，花冠呈鈴形，花瓣為粉紅色至淡紫色，並有紫紅色條紋，具芳香。

花期：春、秋和冬季
果期：—

Bougainvillea spp.
Bougainvillea

簕杜鵑

紫茉莉科
Nyctaginaceae

簕杜鵑原產於熱帶美洲。花色豐富，曾被稱為七姊妹，現多被稱為簕杜鵑。其花由三塊色彩斑斕的苞片及三朵小花芯組成。由於花苞如紙般薄，所以也有「紙花」(Paper Flower)之稱。

花期：春季和冬季
果期：—

Wisteria sinensis
Chinese Wisteria

紫藤

豆科
Fabaceae

紫藤原產於中國，為落葉藤本，成株蔓延力強。花呈蝶形，初放時帶紫色，後漸變為淡藍色。其花可提煉芳香油，莖皮可解毒或製成驅蟲劑，種子也可作防腐、止痛劑用。

花期：4至5月
果期：5至8月

Lonicera japonica
Honeysuckle

金銀花

忍冬科
Caprifoliaceae

金銀花又名忍冬，為本地原生常綠蔓性藤本。花初放時帶銀白色，後漸變為金黃色，故稱金銀花。金銀花是常用的清熱解毒藥，為五花茶的材料之一。

花期：4月
果期：9月

Experiment III – Climber Species Trial

Climber species on Mesh mode at Tank no.1	• ***M1:*** *Lonicera japonica* (金銀花) • ***M2:*** *Quisqualis indica* (使君子) • ***M3:*** *Antigonon leptopus* (珊瑚藤) • ***M4:*** *Vitis vinifera* (葡萄) • ***M5:*** *Pseudocalymma alliaceum* (蒜香藤) • ***M6:*** *Podranea ricasoliana* (紫雲藤) • ***M7:*** *Bougainvillea spp.*(簕杜鵑) • ***M8:*** *Wisteria sinensis* (紫藤)
Climber species on Concrete mode at Tank no.3	• ***C1:*** *Parthenocissus dalzielii* (異葉爬山虎) • ***C2:*** *Hedera helix* (常春藤) • ***C3:*** *Philodendron scandens* (蔓綠絨) • ***C4:*** *Ficus pumila cv. Variegata* (花葉薜荔) • ***C5:*** *Epipremnum aurenum* (綠蘿) • ***C6:*** *Syngonium podophyllum* (合果芋) • ***C7:*** *Hedera nepalensis var. sinensis* (中華長春藤) • ***C8:*** *Trachelospermum jasminoides* (絡石)

Climber Species on Concrete Mode

Integrated Climber Performance (Grades A – E):

- Establishment rate
- Growth rate
- Growth density in the lower and upper half
- Flower attractiveness and quantity

Experiment III – Grade A Species in mesh mode

	11 August 2010	8 February 2011	12 August 2011	10 January 2012	7 June 2012
Quisqualis indica 使君子					
Wisteria sinensis 紫藤					
Lonicera japonica 金銀花					

Results and Recommendations

- Prominent environmental benefits of Vertical Greening (VG) obvious
- DSD shall promote the installation of more VG in existing facilities and new projects
- Recommend using these two modes in general application, due to relatively low initial and maintenance cost:
  - *Mesh with climbing mode <$1000/$m^2$*
  - *Self-climbing mode <$500/$m^2$*
- High initial and maintenance cost:
  - *Modular system range from $5000 to 13000/$m^2$*

➔ **Final Report to be uploaded to DSD website**

Grading of Climber Species in the Experiments

Scientific name	Common name	Chinese name	Family (Latin)	Seasonality	Flower colour	Establishment rate [a]	Growth rate [b]	Growth density lower [c]	Growth density upper [d]	Flower score [e]	Performance score [f]	Performance grade [g]
(a) Mesh climber:												
Antigonon leptopus	Coral Vine	珊瑚藤	Polygonaceae	Semi-deciduous	Rose-pink	5	5	1	5	3	3.8	B
Bauhinia corymbosa	Camel's Foot Vine	首冠藤	Caesalpiniaceae	Evergreen	White	3	5	2	4	4	3.6	B
Bougainvillea spp.	Bougainvillea	九重葛	Nyctaginaceae	Evergreen	Multi-colour	2	5	5	5	5	4.4	B
Lonicera japonica	Japanese Honeysuckle	金銀花	Caprifoliaceae	Semi-deciduous	Yellow or white	5	5	5	5	3	4.6	A
Podranea ricasoliana	Pink Trumpet Vine	紫雲藤	Bignoniaceae	Evergreen	Pinkish red or light violet	2	5	3	3	4	3.4	C
Pseudocalymma alliaceum	Garlic Vine	蒜香藤	Bignoniaceae	Evergreen	Purple	3	5	1	3	4	3.2	C
Pyrostegia venusta	Firecracker Vine	炮仗花	Bignoniaceae	Evergreen	Orange-red	3	4	1	1	5	2.8	C
Quisqualis indica	Chinese Honeysuckle	使君子	Combretaceae	Semi-deciduous	white to pink to red	5	5	5	5	5	5.0	A
Vitis vinifera	Grape Vine	葡萄	Vitaceae	Deciduous	yellowish green	3	5	4	2	2	3.2	C
Wisteria sinensis	Chinese Wisteria	紫藤	Fabaceae	Deciduous	violet, white or blue	5	5	5	5	5	5.0	A
(b) Concrete climber:												
Campsis grandiflora	Chinese Trumpet Creeper	凌霄	Bignoniaceae	Deciduous	Orange to red	1	5	2	2	5	3.0	C
Epipremnum aureum	Devil's Ivy	黃金葛	Araceae	Evergreen	Creamy white or green	1	1	1	1	2	1.2	E
Ficus pumila	Creeping Fig	薜荔	Moraceae	Evergreen	(not visible)	1	2	4	2	1	2.0	D
Ficus pumila cv *variegata*	Variegated Creeping Fig	花葉薜荔	Moraceae	Evergreen	(not visible)	1	1	1	1	1	1.0	E
Hedera helix	English Ivy	洋常春藤	Araliaceae	Evergreen	Creamy white	1	1	1	1	2	1.2	E
Hedera nepalensis var. *sinensis*	Marbled Dragon Ivy	中華常春藤	Araliaceae	Evergreen	Pale yellowish white	1	1	1	1	2	1.2	E
Parthenocissus dalzielii	Virginia Creeper	異葉爬山虎	Vitaceae	Deciduous	Yellow	5	5	5	5	2	4.4	B
Philodendron scandens	Heart Leaf Philodendron	圓葉蔓綠絨	Araceae	Evergreen	Green	1	1	3	1	2	1.6	E
Sygonium podophyllum	Arrowhead Vine	合果芋	Asclepiadaceae	Evergreen	white	1	1	5	3	2	2.4	D
Trachelospermum jasminoides	Star Jasmine	絡石	Acanthaceae	Evergreen	white	1	2	1	1	2	1.4	E

Grade A | Grade B | Grade C | Grade D&E

Literature Review on Suitable Climber Species

They are screened according to five cardinal criteria:

1) **Perennial life cycle**
2) **Evergreen growth habit**
3) **Attractive flowers**
4) **Woody**
5) **Ability to grow up to the top of the tanks (13 m tall)**

Table 5. Botanical information on climber plant species for potential application to vertical greening up to 10 m tall in humid-tropical Hong Kong.

Climber attachment	Climber species[1]	Common name	Seasonality
Species for			
Mesh	*Bauhinia glauca*	Climbing Bauhinia	Evergreen
Mesh	*Pyrostegia venusta*	Firecracker Vine	Evergreen
Concrete	*Campsis grandiflora*	Chinese trumpet creeper	Deciduous
Concrete	*Ficus pumila*	Creeping Fig	Evergreen
Species for			
Mesh	*Antigonon leptopus*	Coral Vine	Deciduous
Mesh	*Bauhinia corymbosa*	Butterfly Vine	Evergreen
Mesh	*Bougainvillea spp.*	Bougainvillea	Evergreen
Mesh	*Lonicera japonica*	Honeysuckle	Deciduous
Mesh	*Mucuna sempervirens*	Evergreen Velvet Bean	Evergreen
Mesh	*Quisqualis indica*	Chinese Honeysuckle	Evergreen
Mesh	*Thunbergia grandiflora*	Large-flower Thunbergia	Evergreen
Mesh	*Wisteria sinensis*	Chinese Wisteria	Deciduous
Concrete	*Campsis radicans*	Trumpet Creeper	Deciduous
		Variegated Creeping Fig	Evergreen
		Common Ivy	Evergreen
		Mabled Dragon Ivy	Evergreen
		Diverse Leaf Creeper	Deciduous
		Heart Leaf Philodendron	Evergreen
		Star Jasmine	Evergreen
		Grape Vine	Deciduous
Substitute			
Mesh	*Ampelopsis cantoniensis*	Canton Grape Vine	Evergreen
Mesh	*Ipomoea cairica*	Morning Glory	Evergreen
Mesh	*Ipomoea horsfalliae*	Prince's Vine	Evergreen
Mesh	*Ipomoea pes-caprae*	Beach Morning Glory	Evergreen
Mesh	*Macfadyena unguis-cati*	Cat's Claw Vine	Evergreen
Mesh	*Merremia tuberosa*	Wood Rose	Evergreen
Mesh	*Mucuna birdwoodiana*	Birdwood's Mucuna	Evergreen
Mesh	*Mucuna macrocarpa*	Long Fruited Mucana	Evergreen
Mesh	*Passiflora coccinea*	Red Passion Flower	Evergreen
Mesh	*Passiflora edulis*	Passion Fruit	Evergreen
Mesh	*Passiflora quadrangularis*	Giant Granadilla	Evergreen
Mesh	*Petrea volubilis*	Sandpaper Vine	Evergreen
Mesh	*Wisteria floribunda*	Japanese W	
Concrete	*Hylocereus undatus*	Dragon Fruit	
Concrete	*Monstera deliciosa*	Split Leaf Ph	
Concrete	*Parthenocissus heterophylla*	Varied Leaf	
Concrete	*Parthenocissus quinquenfolia*	Virginia Cree	
Concrete	*Parthenocissus semicordata*	Himalayan C	
Concrete	*Parthenocissus tricuspidata*	Japanese Cr	
Concrete	*Scindapsus aureus* cv *All Gold*	All Gold Que	
Concrete	*Scindapsus aureus* cv *Marble Queen*	Marble Quee	
Concrete	*Trachelospermum jasminoides* var. *variegata*	Variegated S	

Use of species (not tested in the study) for future trial if available in the market

1. R&D Study of Vertical Greening:

b) Indoor Vertical Greening Systems at Stanley STW

Study Objectives

- Investigate any implications on the change of indoor air quality
- Monitor and evaluate the performance, energy and maintenance requirements of

  - 5 types of indoor vertical greening systems
  - different indoor planting species
- Conclude the worthiness and recommend the way forward on introducing indoor vertical greening systems for other DSD facilities, especially the potential STWs built in caverns

Study Location:

R&D Study of Indoor Vertical Greening Systems at Stanley STW in cavern:

Study period: 15 mths (from mid-2013 to end-2014)

Consultant: Prof. CHU Lee-man (朱利民) of CUHK, School of Life Sciences

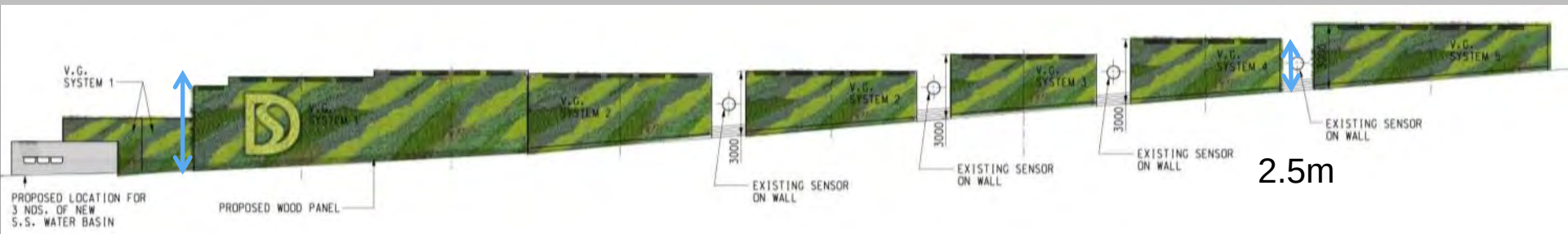
Study location: Along vehicular access of Stanley STW

Status: Commence in Aug 2013

Layout for Five Vertical Greening (VG) Systems

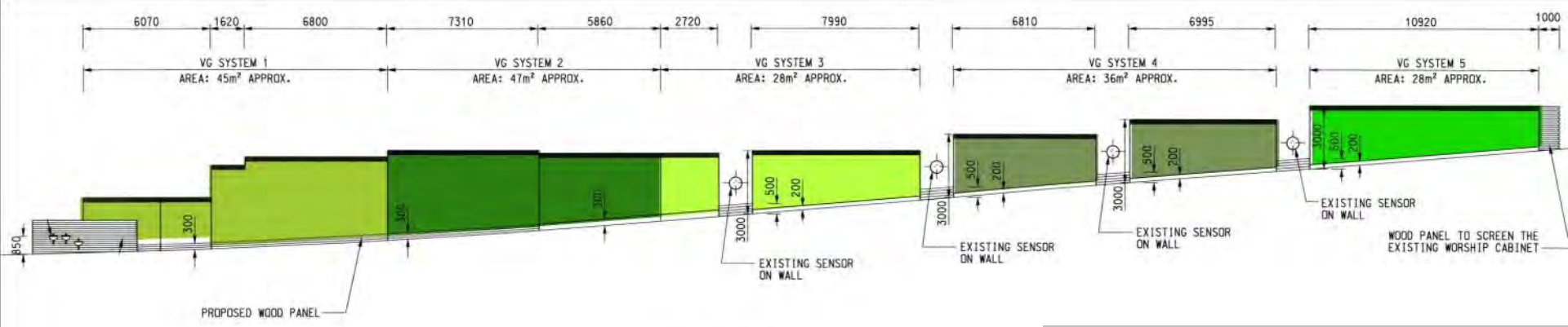
Total: 64m long

Approx: 30-40m.sq. per system



ELEVATION

VG 1: Planting Grid (Soilless)	VG 2: Planting Cup	VG 3: Soil Cube	VG 4: Planter Carrier	VG 5: Planting Fabric (Soilless)

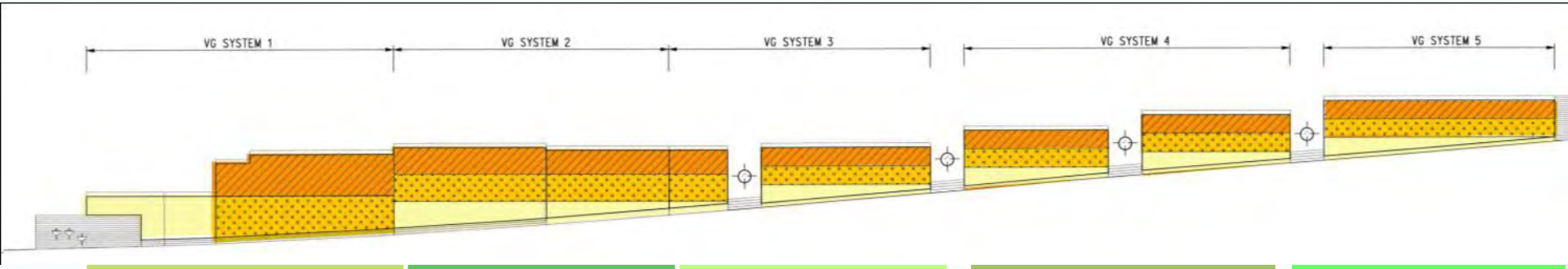


ELEVATION

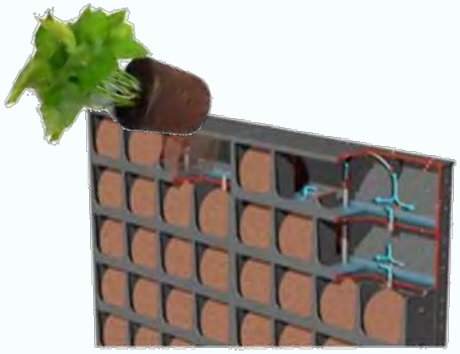
Total planting area: ~ 160 m.sq.

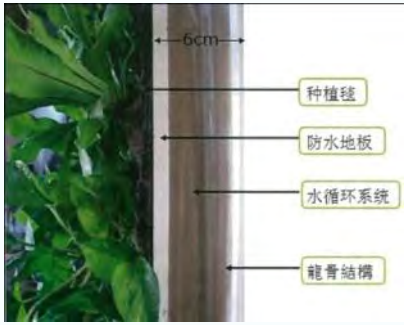
Major growth parameter

Lux level requirement: Min. lux level: 300 Recommended lux level: 700 1500



VG 1: Planting Grid (Japan)	VG 2: Planting Cup (HK)	VG 3: Soil Cube (Australia)	VG 4: Planter Carrier (Taiwan)	VG 5: Planting Fabric (Guangzhou)






Before
20
CH 90
CAUTION
WET FLOOR
小心地滑


After

2. R&D Study of Green Roofs at STSTW

Study Sites at Shatin Sewage Treatment Works (STSTW)

R&D Study of Green Roofs:

Study period: 39 mths (from end-2010 to mid-2014)

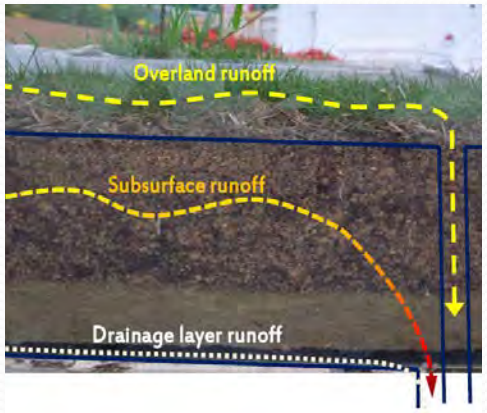
Consultant: Prof. WAI Wing-hong, Oynx (韋永康) of PolyU, Dept. of Civil and Environmental Engineering

Study location: Sludge Thickening House and its Extension at STSTW (1,300m.sq.)

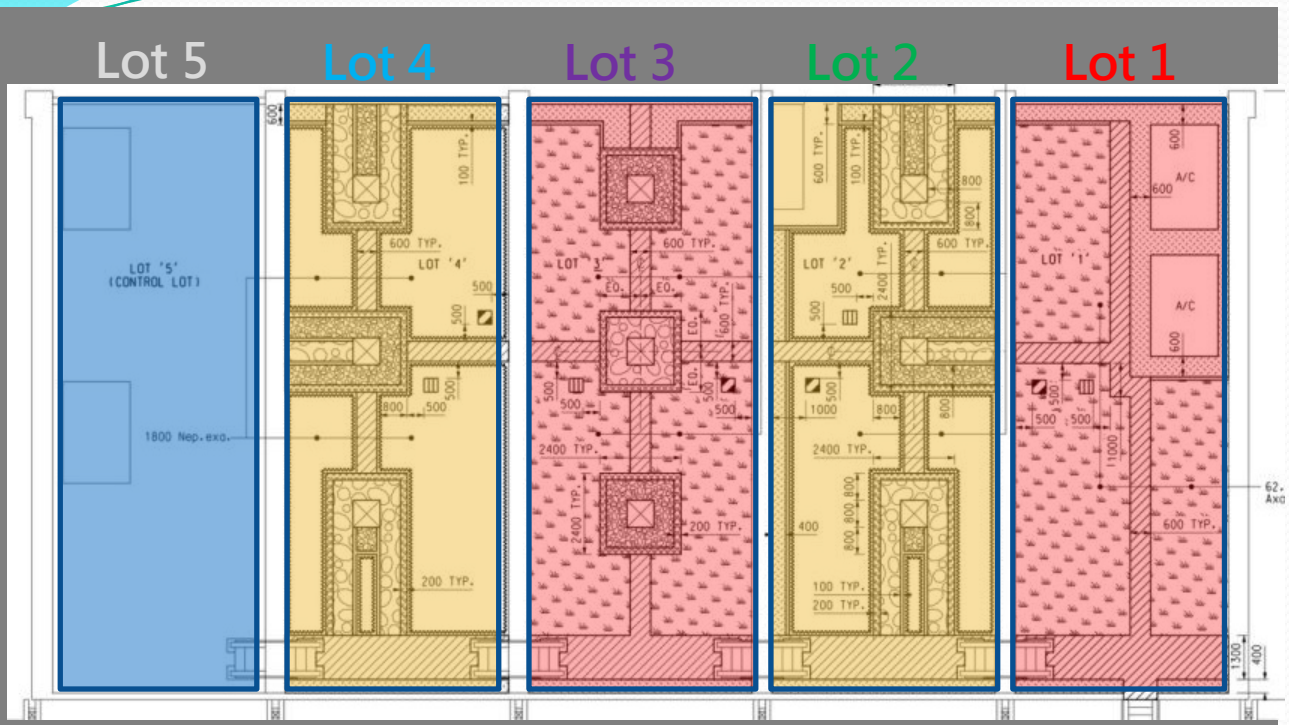
Status: Interim report

Study Objectives

- To study cooling / insulation effect due to the presence of green roofs at STHE
- To study the benefits of green roofs in peak runoff mitigation and runoff water quality improvement.
- To study the impact of strong wind on green roof
- To develop guidelines for green roof based on field data



Design of Green Roof Trials at Sludge Thickening House & its Extension



Control Lot (original roof unchanged)

Green Roof Soil thickness: 150mm

Green Roof Soil thickness 100mm

Lot 1 and 3

***Axonopus comperssus* 地毯草**

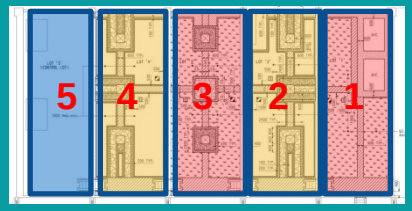
(Carpet Grass)

Lot 2 and 4

***Nephrolepis exaltata* 劍蕨**

(Boston Fern)

Trial 1：Study of Cooling Effect



Soil Temp Control Roof
Soil Temp Lot1 (100mm soil)
Soil Temp Lot2 (100mm soil)
Soil Temp Lot3 (150mm soil)
Soil Temp Lot4 (150mm soil)

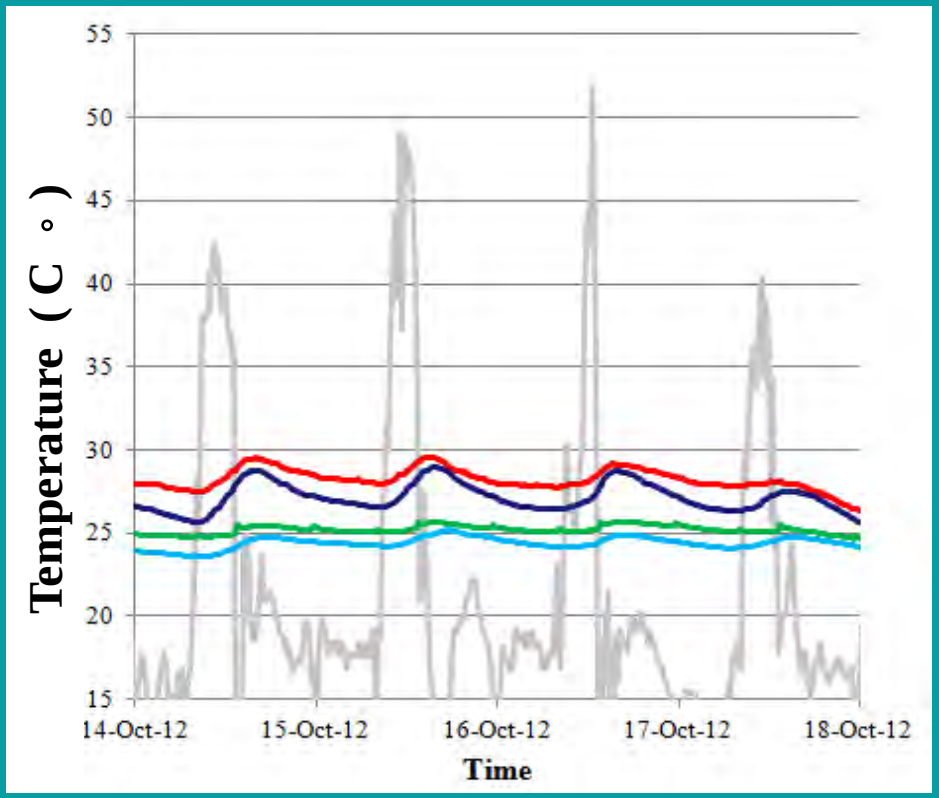
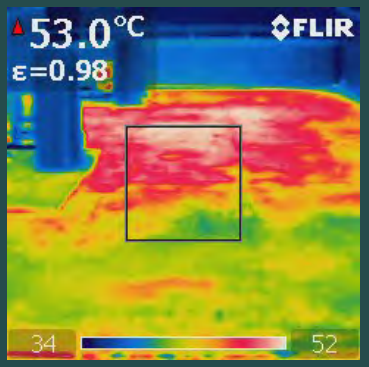


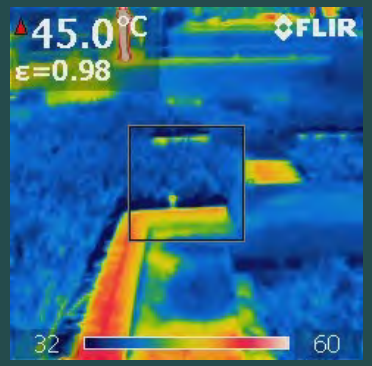
Diagram 1: Temp. Comparison between Soil and Control Roof Highlight - Heating of the roofs during sunny days

Diagram 2: Thermo-camera Images (9 May 2012, 12:39pm, Ambient temp 32.3°C)

Lot 5 (control)

Lot 2 (fern w/ 100mm soil)





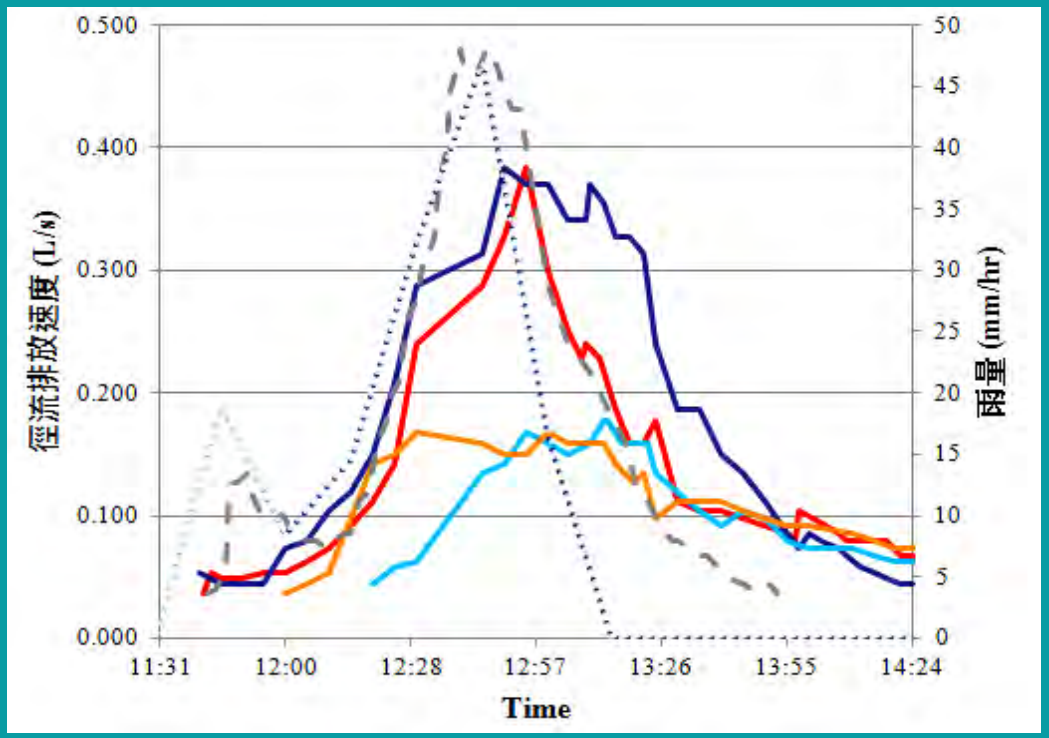
Noticeable difference between fern and lawn on:

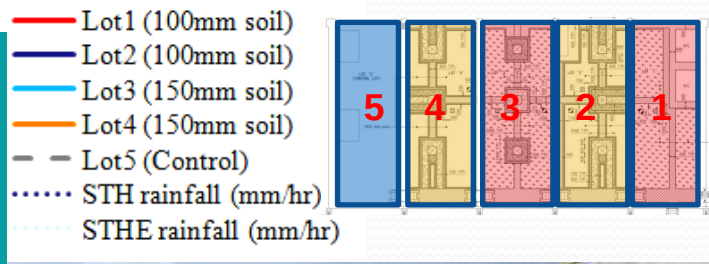
➔ Heat reduction effect

➔ Temperature fluctuation reduction effect

Trial 2：Study of Runoff Reduction of Green Roofs

Diagram 3: Runoff Measurement
(27 July 2012 ~ After Typhoon)





Each green roof lot is connected to the corresponding V-notch chamber through an individual downpipe

Peak Discharge:

Lot 5 = 0.481 L/s

Lot 1 = 0.38 L/s (↓20%)

Lot 2 = 0.384 L/s (↓20%)

Lot 3 = 0.178 L/s (↓63%)

Lot 4 = 0.168 L/s (↓ 65%)

➔ Noticeable difference between 100mm & 150mm soil on peak runoff reduction and retention

Trial 3: Runoff Water Quality Analysis

V-notch chamber receiving runoff from a green roof

- To compare the difference between the runoffs from the green roofs and the conventional roof
- Also, to examine the chemical characteristics of the runoff as effluent (purifying or polluting)

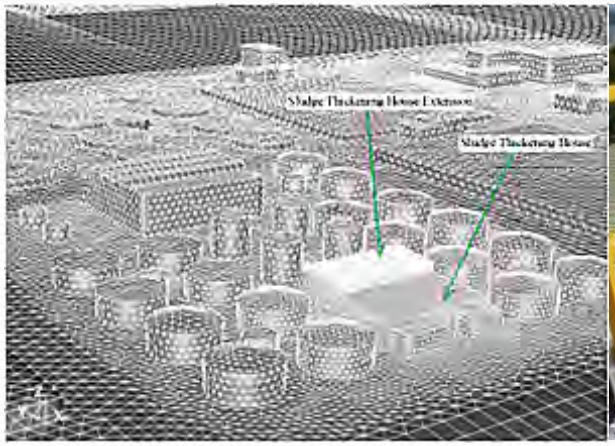
➔ Preliminary runoff analysis implied quality improvement effects

Runoff Analysis and Preliminary Results:

Parameter	Inflow (Irrigation water)	Effluent (Runoff)
Total Suspended Solid (mg/L)	0.65	4.10
BOD (mg/L)	0.41	0.42
pH	7.47	7.19
Total Chlorine Residual (mg/L)	1.36	0.02
Ammonia Nitrogen (mg/L)	0.11	0.90
Nitrite Nitrogen (mg/L)	0.006	0.006
Nitrate Nitrogen (mg/L)	1.6	0.90

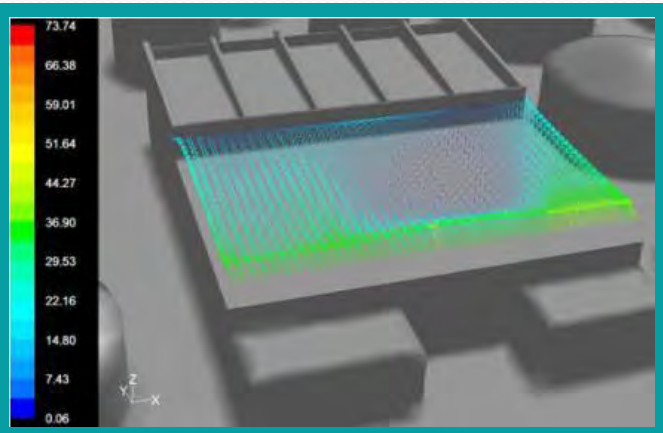
Trial 4: Wind Field Study at STH Green Roof

- A numerical model (FLUENT) is constructed to simulate the wind field of the STH and STHE green roofs from 8 directions
- Study the impact of strong wind in green roof

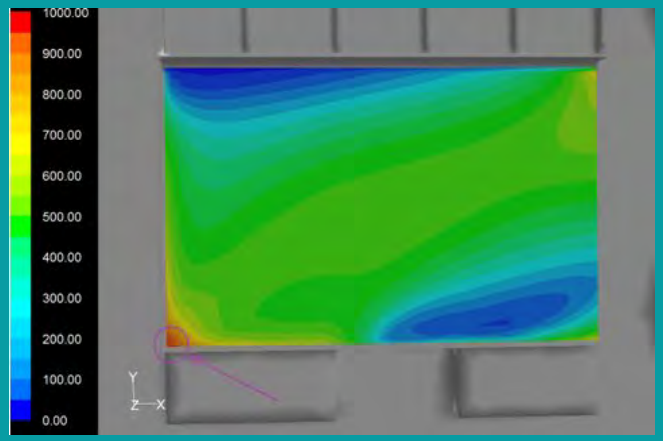


Model mesh of STSTW and its surrounding

3D anemometer (wind speed measurement)



Velocity vectors at Z=17m (2m above the roof)



Visualization of max. suction pressure showing region over design limit (in red)

Final Stage of the Study:

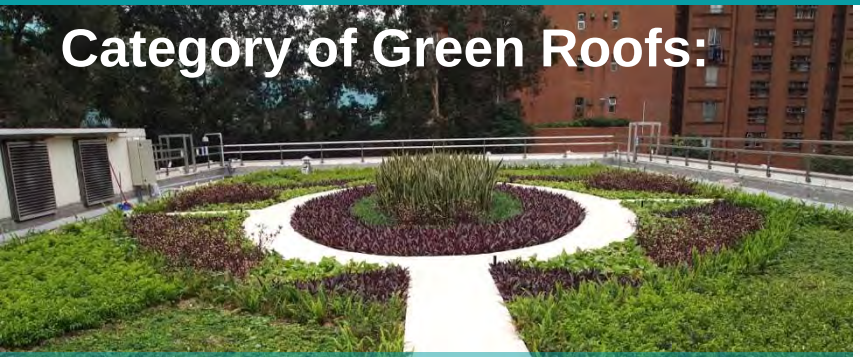
- ➔ Comparable study among green roof guidelines and present project in HK
- ➔ Establish relation between runoff treatment effect and green roof configuration
- ➔ Further modeling will be applied in runoff quality, quantity and heat aspects

3. The Way Forward – Reduce waste and carbon footprint for sustainable landscape management

(a) Low maintenance green roofs (*Sedum*)
(b) Naturally succeeded green roofs
(c) Composting of green wastes

Review on Existing Maintenance Strategy

Category of Green Roofs:



1) For Beautification and aesthetic purpose

2) For Demonstration and education purpose

3) For Greening and environmental improvement purpose

All Require Intensive Maintenance:

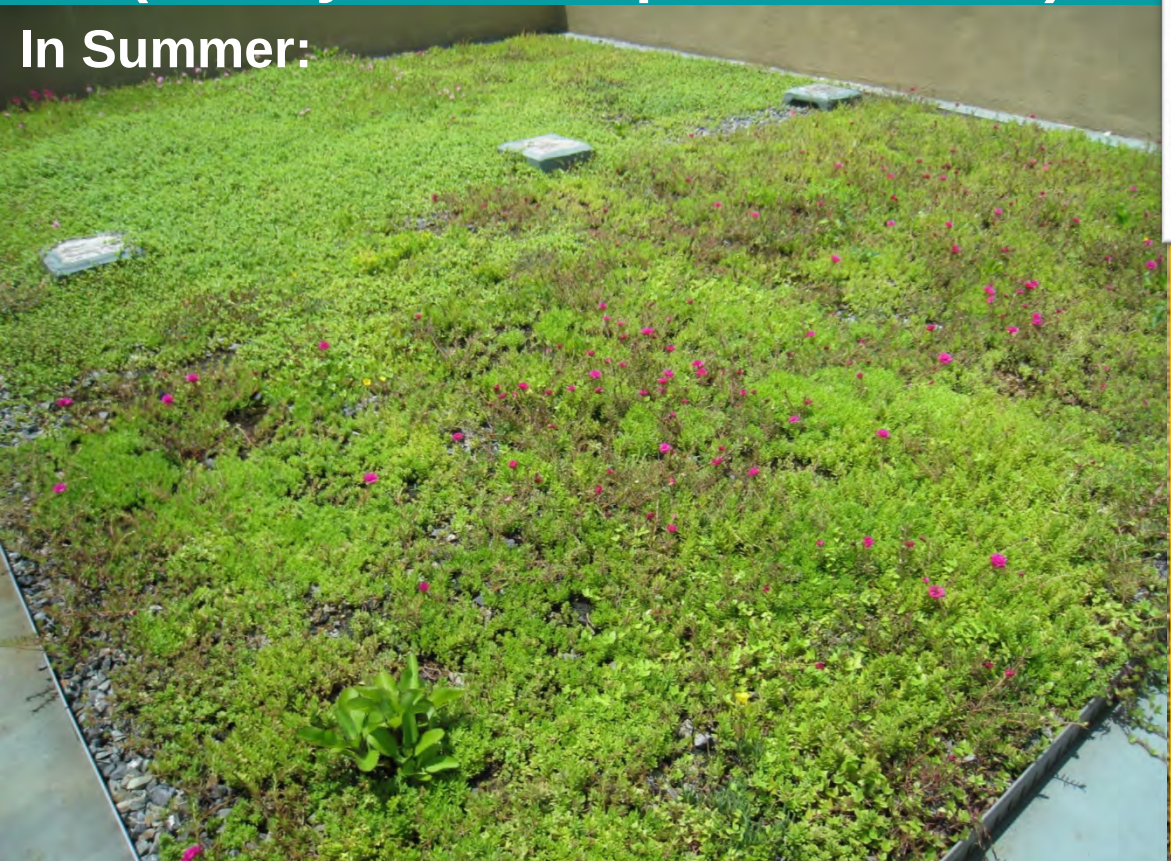
- > 90% groundcover & herb

- For green roofs of 500 ~ 800m.sq.
  - ➔ Require at least 1 worker for one full day work per week

- Maintenance operations mainly include:
  - ➔ Weekly manual weeding
  - ➔ Periodic pruning & thinning of groundcover & herb
  - ➔ Quarterly fertilizing
  - ➔ Bi-weekly checking of automatic irrigation

a) Low Maintenance Green Roofs (mainly *Sedum* species 佛甲草)

In Summer:



Benefit:

- ➔ Minimal loading requirement
- ➔ Minimal depth of growing medium
- ➔ Minimal irrigation
- ➔ Minimal inspection
- ➔ Minimal weeding / pruning
- ➔ Nil herbicide / fertilizer

b) Naturally Succeeded Green Roofs

Weedy condition

Failure:

- ➔ Stoppage / error of automatic irrigation
- ➔ Lack of inspection
- ➔ Lack of frequent manual weeding
- ➔ Can be out of control quickly within 3~4 weeks

➔ Herbicide

➔ Re-connect irrigation

➔ Monthly grass cutting

Naturally Succeeded Wild Species observed after 2 months


Epaltes australis (鵝不食草)


Spermacoce latifolia (闊葉豐花草)

- Meet the greening and environmental purpose
  - Greening effect and micro-climate improvement
  - Naturally succeeded by wild species nearby

- Can prioritize the green roof according to the specific functions
  - Better use and allocation of resource


Cardamine flexuosa (碎米薺)


Synedrella nodiflora (金腰箭)

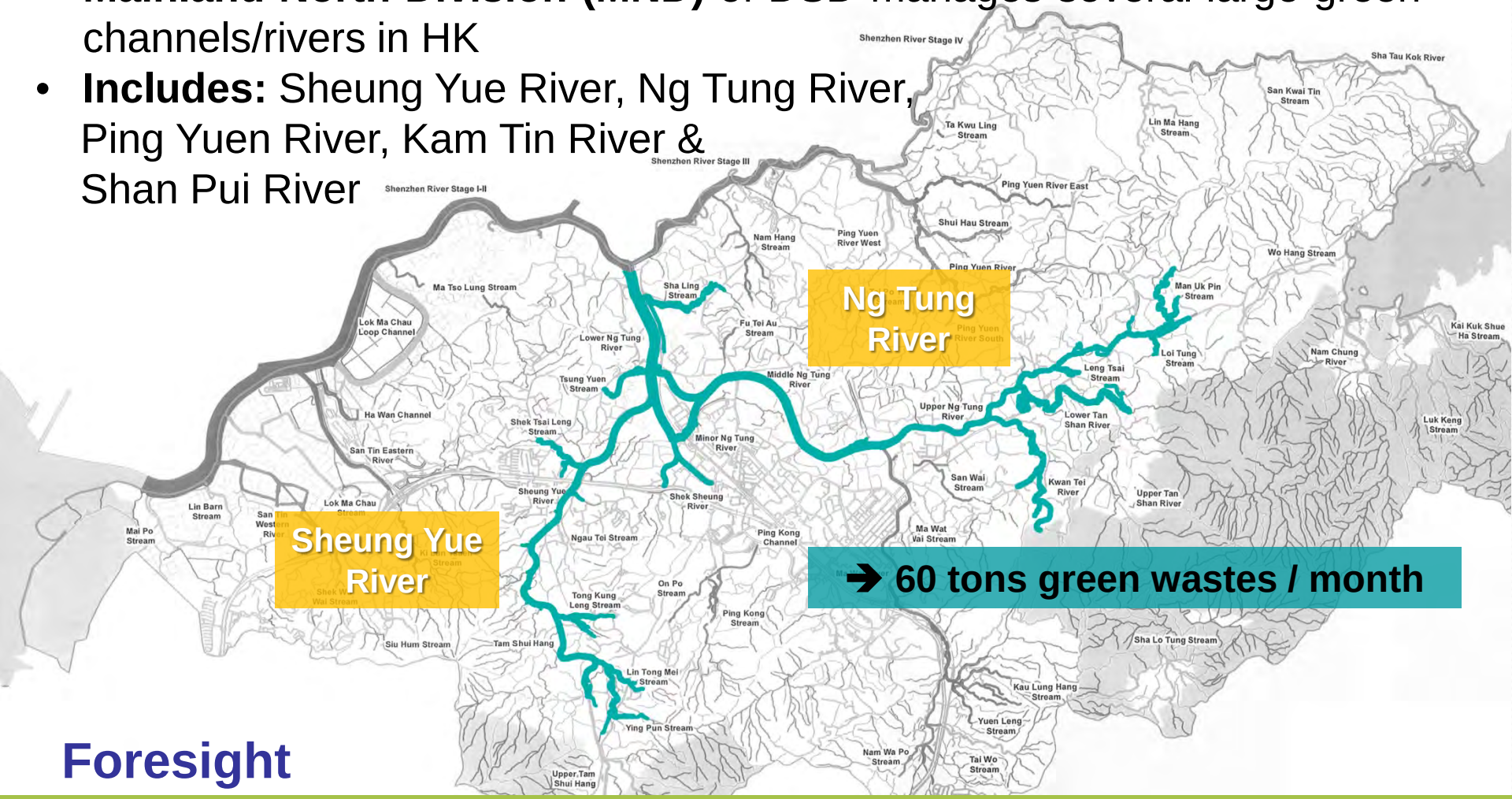

Youngia japonica (黃鶴菜)

- Low carbon approach
  - Minimize use of chemicals e.g. herbicide and fertilizer
  - Minimize use of machine and fuel
  - Reduce transportation and carbon footprint

(c) Composting of green wastes

Background

- **Mainland North Division (MND)** of DSD manages several large green channels/rivers in HK
- **Includes:** Sheung Yue River, Ng Tung River, Ping Yuen River, Kam Tin River & Shan Pui River



Ng Tung River

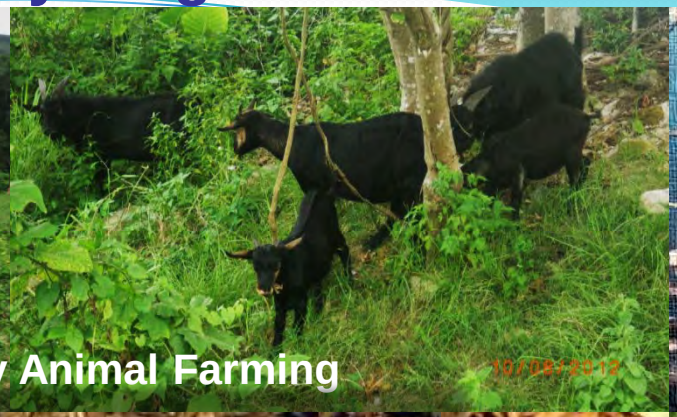
Sheung Yue River

➔ **60 tons green wastes / month**

Foresight

- More green channels/rivers to enhance aesthetic & ecological value
  - ➔ Regular horticultural maintenance to ensure efficient flow of channels/rivers
  - ➔ Care to environment & waste reduction
  - ➔ Reuse / recycle the green wastes and return to the Nature

Options for Recycling of Green Wastes

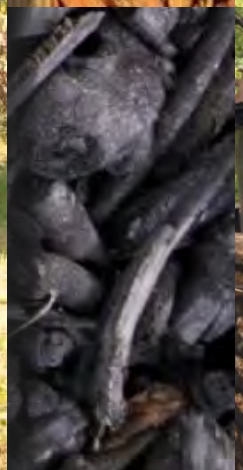


Consumption by Animal Farming

Consumption by Aquaculture

Open Bin Composting

Recycling Wood as Mulching



Recycling Wood as Biochar

Composting of Green Wastes

Principle of Composting:

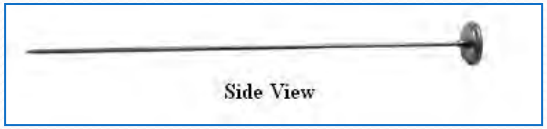
- Mixing organic waste under proper C:N ratio
  ➔Ideal temperature to undergo aerobic digestion
- Green / organic waste decomposed chemically
  ➔Heat, carbon dioxide and ammonium
- Ammonium converted biologically into plant-nourishing nitrites / nitrates through nitrification

Criteria for ideal composting:

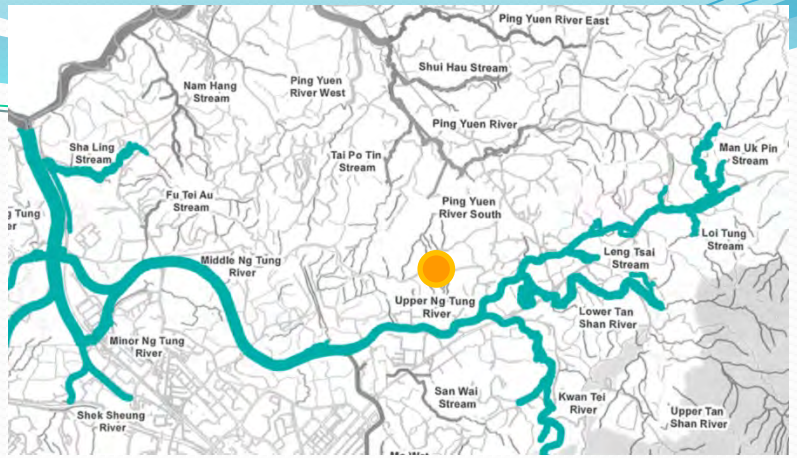
- C:N ratio = **20~30:1**
- Temperature: **50~60 ºC**
- Volume of organic wastes mixtures = **> 1m^3**
- Size of raw material = **< 5cm for each piece** (e.g. wood chip)
- Adequate oxygen, water and appropriate micro organism

Temperature change in composting

- **Middle Temperature Period:**
  25 - 45˚C
- **High Temperature Period:**
  50 - 60˚C
- **Mature Period:**
  below 45˚C and become steady



Site Trial of Open Bin Composting at Kwan Tei Depot



Location:

- Away from local village houses
- Near river channel
- Higher ground to avoid flooding
- Easy access by truck
- Regular water supply

Use of minimum extra resource:

- Reuse of construction materials
- 1 staff for recording temperature
- 2 workers for adding of water and turning mixture per 3~7 days

Compost Mix:

Green Waste Source:

- C:N ratio of grass = 25:1

Preliminary results:

1st Winter Trial: 5 months

2nd Summer Trial: 2.5 months





Further Study on Composting of Green Wastes & Sludge

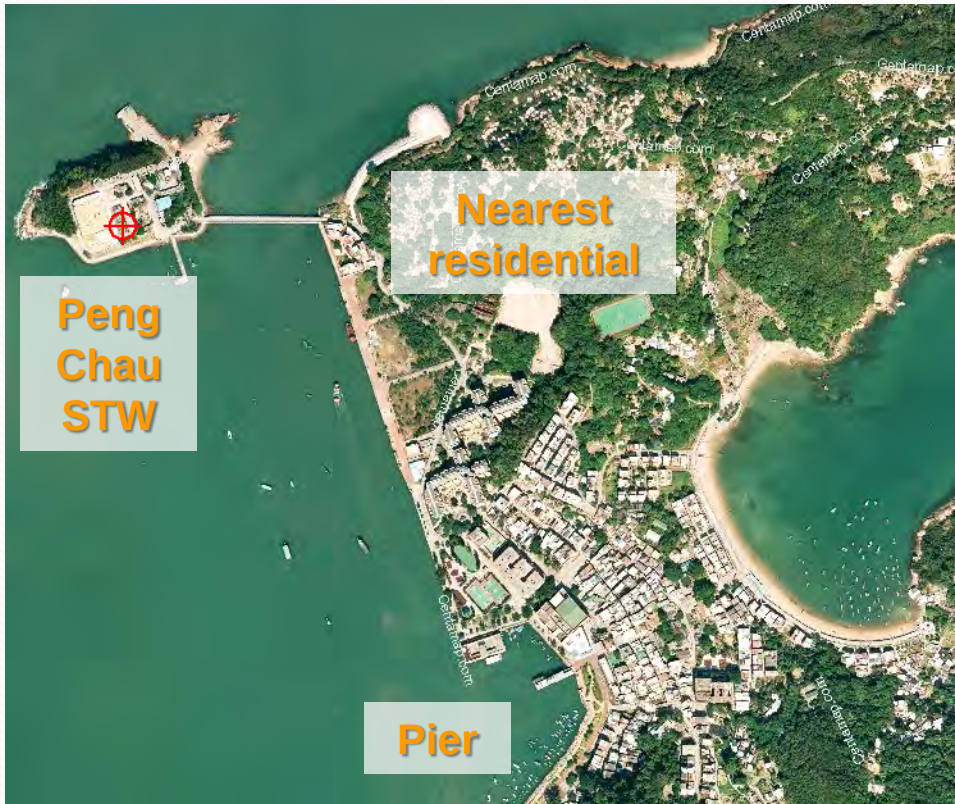
Potential of Sewage Sludge:

- Sewage sludge enriched of nitrogen and phosphorus compound
- Further reduce the waste disposal to landfill

Constraint:

- High level of chloride in flushing toilet water
- High level of heavy metals due to industry in urban area
- Odor problem

Site Trial at Peng Chau STW:



Site Trial at Peng Chau STW

Carbon Source:

- C:N ratio of green waste = 40:1

Nitrogen Source:

- C:N ratio of sludge examined = 2.5:1

For achieving C:N ratio of 30:1,

➔ Ratio between sludge and green waste = 1 : 3.75

Setup of site trial just completed in early Aug 2013:

➔ Evaluate the feasibility & cost involved

➔ Examine the quality and performance of compost generated

Compost and Soil Conditioner Quality Standard

香港有機資源中心
HONG KONG ORGANIC RESOURCE CENTRE

Test parameters:

1) Compost Maturity
2) Compost Quality
3) Seed Germination Index
4) Nutrient Content

Compost Maturity		Products must pass one of the tests from Group A **AND** one of the tests from Group B		
		Group A 1. Ammonia conc. ≤ 700 mg/kg dw 2. Ammonia: nitrate ratio ≤ 3 3. Volatile organic acids conc. ≤ 500 ppm dw	Group B 1. Carbon to nitrogen ratio ≤ 25 2. Oxygen demand ≤ 0.4 g O_2/kg TS/hr 3. Carbon dioxide evolution ≤ 2 g C/kg VS/day	
Compost Quality	Foreign Matter	Stones larger than 5mm ≤ 5% dw Man-made Foreign Matters include glass, plastic and metal larger than 2mm ≤ 0.5% dw		
	Heavy Metal	Unit：mg/kg dw		
		Organic Farming Arsenic ≤ 10 Cadmium ≤ 1 Chromium ≤ 100 Copper ≤ 300 Mercury ≤ 1 Nickel ≤ 50 Lead ≤ 100 Selenium ≤ 1.5 Zinc ≤ 600	General Agricultural Use Arsenic ≤ 13 Cadmium ≤ 3 Chromium ≤ 210 Copper ≤ 700 Mercury ≤ 1 Nickel ≤ 62 Lead ≤ 150 Selenium ≤ 2 Zinc ≤ 1300	Non-Agricultural Use Arsenic ≤ 41 Cadmium ≤ 39 Chromium ≤ 1200 Copper ≤ 1500 Mercury ≤ 17 Nickel ≤ 420 Lead ≤ 300 Selenium ≤ 36 Zinc ≤ 2800
	Physicochemical Properties	pH 5.5 – 8.5 Organic matter > 20% dw Moisture 25 – 35%		
	Pathogen	*Salmonella sp.* ≤ 3 MPN/4g *E. Coli* ≤ 1000 MPN/g		
		Dilution：solid to water ratio of 1:5 (wet weight) Seed Germination Index ≥ 80%		
		Total N + Total P + Total K ≥ 4% dw		

Compost and Soil Conditioner Classification

Class \ Test		Compost Maturity	Compost Quality	Seed Germination Index	Nutrient content
Good Quality	Compost used as Fertilizer	✓	✓	✓	✓
	Compost used as Soil Conditioner	✓	✓	✓	
Pass	Compost used as Fertilizer		✓	✓	✓
	Compost used as Soil Conditioner		✓	✓	

Notes:

- **Pass / Immature:** Can be used with moderate amount for specific purpose or used under instructions.

Major Limitations

- Unstable supply of green wastes other than grass
- Carbon footprint for transportation of green wastes and dispatch of composts
- Occupation of extensive area
  - ➔ Better performance in sheltered location
  - ➔ Accessible by truck
  - ➔ Away from residential

Further Inspiration on Composting

- ➔ Further explore on sludge composting in **urban areas**?
- ➔ Mulch / soil conditioner for **DSD venues** e.g. STW, SPS?
- ➔ Mulch / soil conditioner for **soil mix of new projects**?
- ➔ Mulch / soil conditioner for **local organic farm**?
- ➔ **Regional or district basis** to minimize the carbon footprint for transportation?
- ➔ Invest on **wood chipper machine** & **biochar kiln**?

Thank You

Q&A Session