STORMWATER VICTORIA

Melbourne Water
Enhancing Life and Liveability

WSUD asset audit guidelines

Dale Browne
15 March 2016

E2DESIGNLAB

Why do we audit WSUD assets?

- Understand condition and functional performance
- Inform works and budgets
- Learning



WSUD assets covered

Raingarden

Bioretention basin

Tree pit

Wetland

Swales

Gross pollutant trap*

Porous pavement

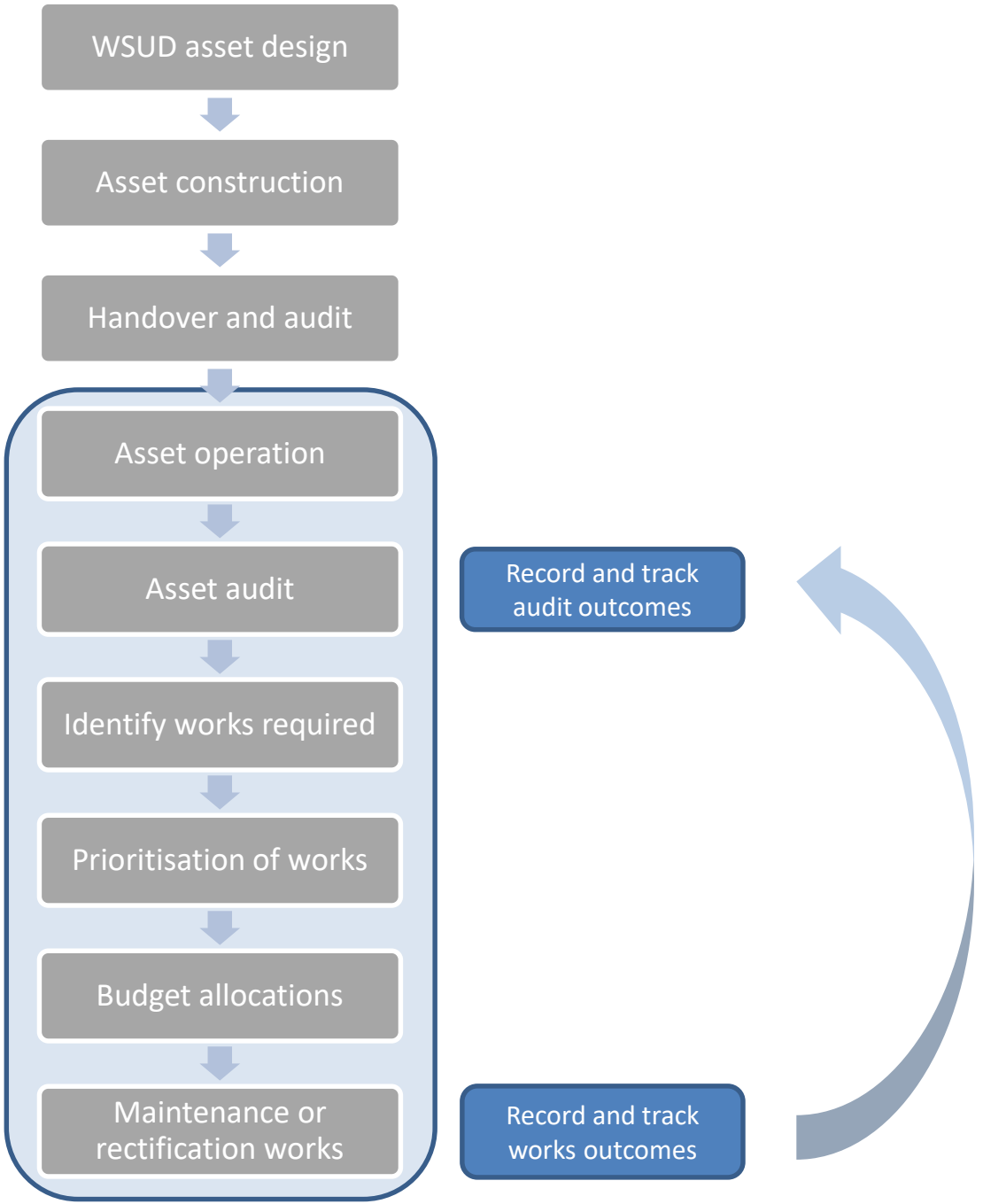
Infiltration trench / basin

E2DESIGNLAB

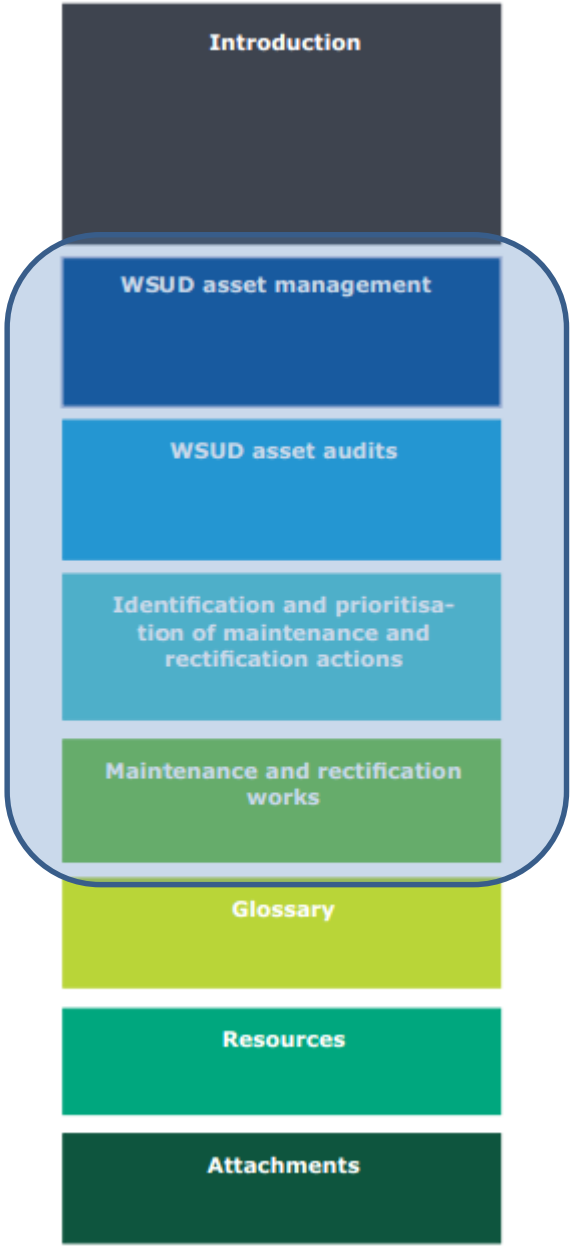
STORMWATER VICTORIA

Melbourne Water
Enhancing Life and Liveability

WSUD asset lifecycle



WSUD Audit Guidelines



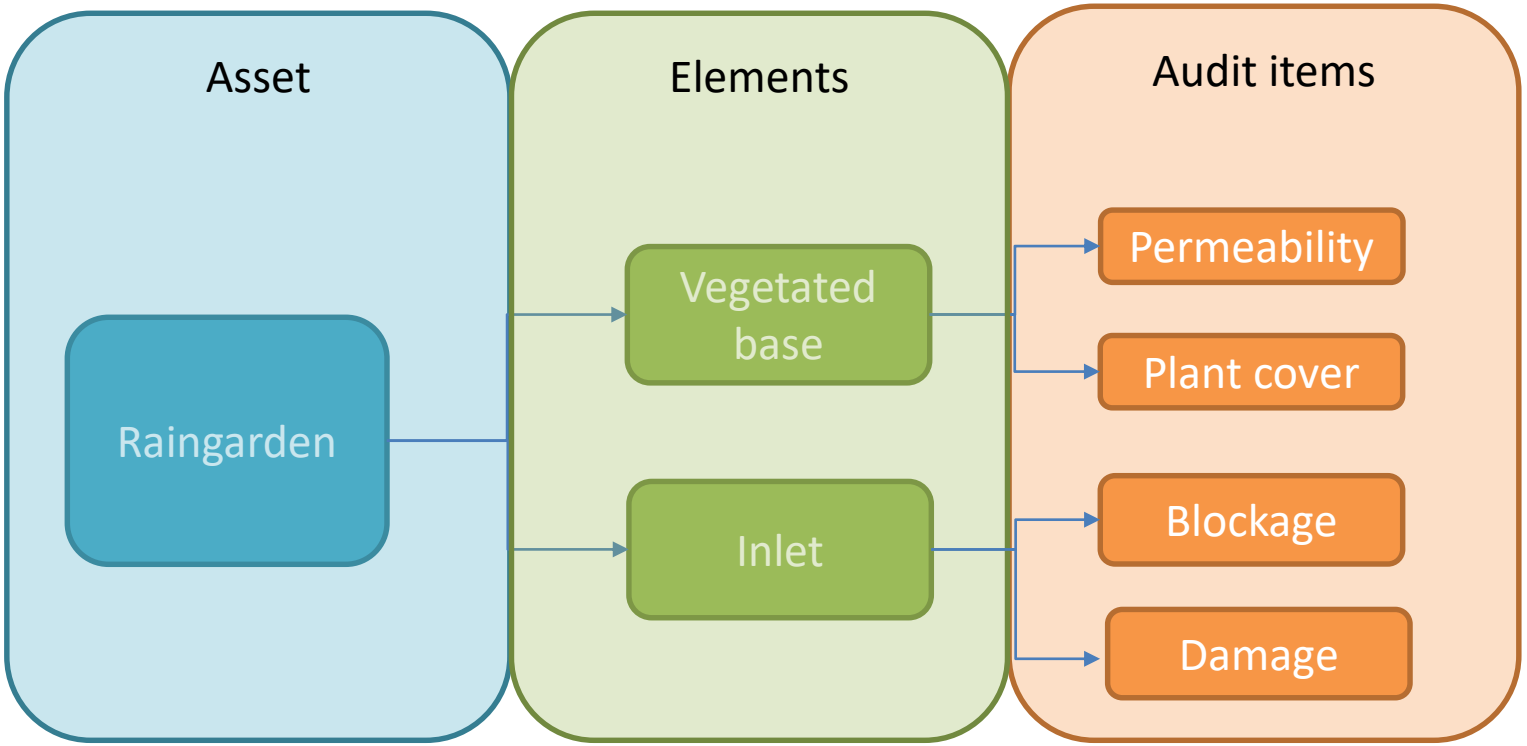
STORMWATER VICTORIA

Melbourne Water
Enhancing Life and Liveability

E2DESIGNLAB

WSUD AUDITS

WSUD asset audits



A consistent and systematic approach to audits to understand condition against performance targets and corresponding works

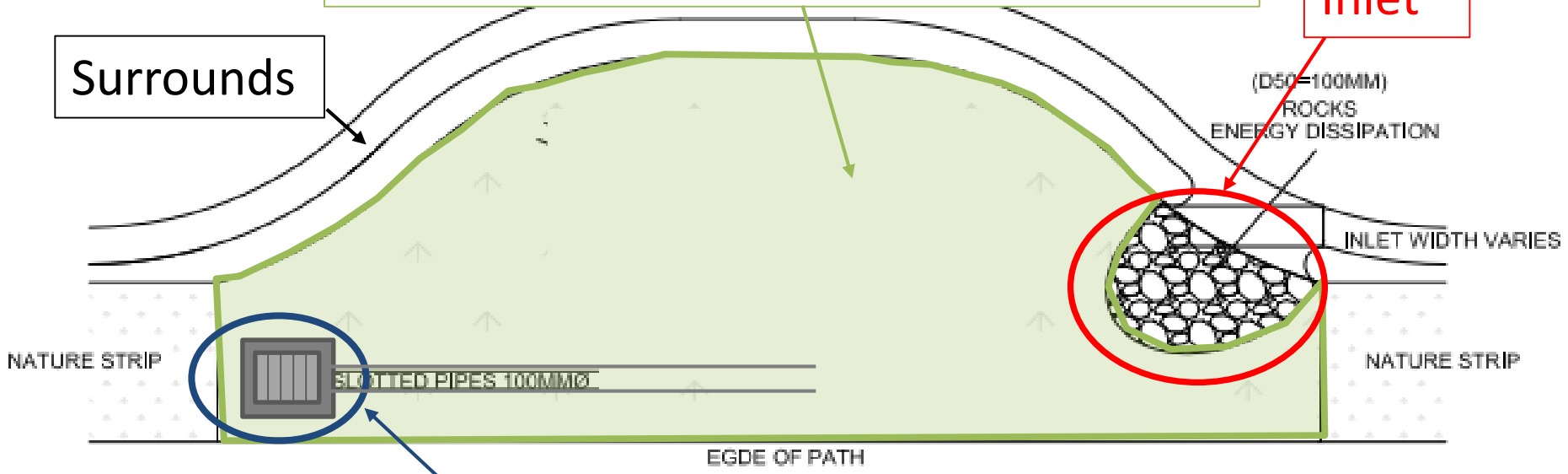
Elements

Filter media – permeable vegetated base

Note: no batters

Surrounds

Inlet



Outlet and underdrainage

Audit items

- Sediment accumulation
- Erosion
- Blockage
- Permeability and clogging
- Damage or removal of structures
- Vehicle or pedestrian damage
- Surface levels
- Water levels
- Rubbish
- Plant cover
- ….

Sediment accumulation

Sediment accumulation in WSUD assets can change the profile of the asset, cause bypass, redirection and short-circuiting of flows, smother vegetation and clog filter media.

Audit Criteria

Condition rating	Criteria	Maintenance requirements
Performance target	• No accumulated sediment impeding flows or vegetation growth	
Good condition	• No accumulated sediment	None
Moderate condition	• Some accumulated sediment (covering less than 50% of surface) • Causing some redirection of flows through the system	Maintenance
Poor condition	• Accumulated sediment covering more than 50% of the surface • Impeding or significantly redirecting flows • Smothering vegetation	Rectification

Example Images

Condition rating	Example images
Moderate condition	
Poor condition	

Audit templates

Raingarden audit checklist

Date	9/08/2016	Site address	**Carroll Crescent, Malvern**
Weather	Rainy	Site ID	2
Date of last rainfall	8/07/2016	Asset name	**Carroll Street Raingarden**
WSUD Type	Bioretention	Asset ID	10202
Inspected by	**Dale**		

Add inspection data

Task Item	Performance target	Good condition	Moderate condition	Poor condition		Condition summary
		(1 point)	**(2 points)**	**(3 points)**		
		No works	*Maintenance*	*Rectification*		
Surrounds						
Damage or removal of structures	No damage, erosion or issues / removal of structures	Stable structures No vandalism impacting amenity No safety risks	Minor damage Does not pose risk to structural integrity or asset function	Major damage Poses risk to structural integrity, public safety or asset function	2	Repair two damaged bluestone kerb stones
Rubbish	No litter present	No litter present	Some litter present Diminished aesthetics and /or causing some visible blockage	Large amount of litter present Heavily impacting aesthetics and/or blocking flows	1	
Inlet						
Erosion	Minor erosion that doesn't pose public safety risk and would not worsen if left unattended	No erosion	Minor erosion Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows)	Major erosion Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows)	1	
Blockage	No blockage	No blockage	Partial blockage of inlet causing some bypass of flows or restricted inflows	Blockage of inlet causing significant bypass or restriction of inflows	2	Clear minor sediment from sediment forebay and clean out sediment sump
Damage or removal of structures	No damage, erosion or issues / removal of structures	Stable structures No vandalism impacting amenity No safety risks	Minor damage Does not pose risk to structural integrity or asset function No safety risks	Major damage, poses risk to structural integrity, public safety or asset function	1	

Audit - inlet

Condition rating

Note

	Inlet						
Civil	**Erosion**	Minor erosion that doesn't pose public safety risk and would not worsen if left unattended	No erosion	Minor erosion Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows)	Major erosion Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows)	1	
Civil	**Blockage**	No blockage	No blockage	Partial blockage of inlet causing some bypass of flows or restricted inflows	Blockage of inlet causing significant bypass or restriction of inflows	2	Clear minor sediment from sediment forebay and clean out sediment sump
Civil	**Damage or removal of structures**	No damage, erosion or issues / removal of structures	Stable structures No vandalism impacting amenity No safety risks	Minor damage Does not pose risk to structural integrity or asset function No safety risks	Major damage, poses risk to structural integrity, public safety or asset function	1	

Audit – permeable vegetated base

Audit – permeable vegetated base

	Permeable vegetated base						
Civil	Sediment accumulation	No accumulated sediment	No accumulated sediment	Some accumulated sediment (covering <50% of surface) Causing some redirection of flows through the system	Accumulated sediment covering >50% of the surface Impeding flows Smothering vegetation	1	
Civil	Erosion	No erosion	No erosion	Minor erosion Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows)	Major erosion Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows)	1	
Civil	Permeability and clogging	Infiltration / hydraulic capacity of the system is preserved	Dry Conditions: Water poured on surface infiltrates almost immediately , minimal fine sediment accumulation. Wet Conditions: Surface ponding (100 - 300mm) for bioretention systems is drawn down over 1 - 3 hrs after inflow to the system has stopped following rainfall.	Dry Conditions: Water infiltrates surface slowly but ponding clears within minutes, some fine sediment accumulation. Wet Conditions: Surface ponding observed for longer than normal (more than 3 hours).	Dry Conditions: Water ponds with minimal infiltration, significant fine sediment accumulation. Wet Conditions: Surface ponding (100 - 300mm) remains more than 12 hrs after inflow to the system has stopped following rainfall.	1	
Civil	Vehicle or pedestrian damage	No compaction, plant loss, vandalism impacting system function	No compaction, plant loss, vandalism impacting system function	Minor compaction, plant loss Does not pose risk to structural integrity or asset function	Significant compaction, plant loss Poses risk to structural integrity, public safety or asset function	1	
Civil	Surface levels	Even surface with no depressions or mounds	Even surface with no depressions or mounds	Some small depressions or mounds present Limited impact on flows through the asset	Level of surface is impacting flows through the asset (e.g. short circuiting flows, blocking flows and / or reduced extented detention depth) Isolated pools created in the surface	1	
Civil	Extended detention depth	Designed extended detention depth provided	Design extended detention depth provided	At least 50% of design extended detention provided	Less than 50% of design extended detention depth provided	3	Scrape surface 100mm from surface and regrade batters to provide an extended detention depth of 100 mm
Landscape	Rubbish	No litter present	No litter present	Some litter present Diminished aesthetics and /or causing some visible blockage	Large amount of litter present Heavily impacting aesthetics and/or blocking flows	1	
Landscape	Leaf litter	No accumulated leaf litter causing blockages or impeding flows or vegetation growth	Minimal leaf litter present or covers less than 20% of surface	Some wet and decaying leaf matter present (covering 20-40% of surface) Aesthetic issue Some obstruction of flow paths	Large amount wet and decaying leaf matter present (covering >40% of the surface) Impacting vegetation growth Obstructing flow paths and blocking inlets or outlets	1	
Landscape	Plant health	Good vegetation health	Healthy vegetation	Vegetation is stressed Poor health (signs of disease, pests) in less than 20% of plants	Vegetation is dying back Poor health (signs of disease, pests) in more than 20% of plants	1	
Landscape	Plant cover	Good vegetation densities covering >80% of the planted surfaces	Good vegetation cover in planted areas (>80% cover / >6 plants per m2)	Moderate vegetation cover in planted areas (50-70% cover)	Poor vegetation cover in planted areas (<40% cover)	3	Remove, replace and infill planting with design species as required
Landscape	Weeds	Limited weed cover with no declared noxious weed species	Limited weed cover (<10%) and no declared weed species	Low/Moderate weed cover (20-30%) and no declared weed species	High weed cover (>50%) and/or declared weed species present	1	
Landscape	Nuisance fauna	No nuisance fauna	No nuisance fauna	Some nuisance fauna but limited impact on aesthetics, water quality and/or vegetation growth	Significant nuisance fauna issues Heavily impacting aesthetics, vegetation growth and/or water quality	1	

Identify works

Identify works required

Planned maintenance

Regular planned activities to maintain system function

4.2 LEAF LITTER REMOVAL

Leaf litter accumulation on a significant scale was observed at a number of sites within the City of Port Phillip. Where leaf litter posed a threat to WSUD asset function, it was primarily from Plane Trees (both overhead trees as well as from leaves washing in from the upstream catchment). Leaf litter can accumulate and become saturated within a WSUD asset. Breakdown of the leaves in saturated conditions can produce fine organic matter that can cause clogging of the filter media surface (eventually) and leach nutrients into waterways. A heavy leaf litter load can impede drainage through the filter media as well as restricting the growth and spread of desired plants in the WSUD asset.

INSPECTION

Check the following for leaf litter:

- On the filter media surface
- Across the canopy of the plants within the WSUD asset
- Surrounding kerbs and channels
- Inlet (where water enters the raingarden from kerb or pipe)
- Outlet/overflow structures

TRIGGER

- Wet and decaying leaf matter present
- Aesthetic issue
- Obstructing flow paths

MAINTENANCE ACTION

Remove leaf litter from the surface of the filter media (including around inlet areas and between plants) using rakes or other appropriate hand tools. Remove leaf litter from hard surfaces using appropriate hand tools. Leaf litter must be removed from the site and composted or disposed of appropriately.

Rectification

One-off activities to restore system function

5.3 LARGE SCALE PLANT LOSS

ISSUE: Plants are a critical component of the functional performance of raingardens, especially in terms of stormwater treatment performance. They are also critical for long term raingarden aesthetics – an important factor for inner city and suburban streetscape raingardens. High plant densities significantly reduce the impacts (and therefore maintenance requirements) of leaf litter accumulation, weed growth and clogging as a result of clay or fine sediment build-up.

LIKELY CAUSES: Unsuitable species selection, inadequate planting, poor establishment phase maintenance, unsuitable filter media material (low water holding capacity), monoculture design, poor quality plant stock.

POSSIBLE MITIGATION MEASURES:

- Replanting and providing establishment phase program including monitoring, weeding, infill planting and irrigation if required
- Amendment of filter media to increase water holding capacity where soil moisture is identified as being deficient (the most common cause of large scale plant loss)
- Redesign of outlet structures to create a submerged zone, increasing water available to plants
- Review of plant species selection for given site conditions and hydrology
- Increase plant species diversity to provide a more robust design.

Identify works required

Planned maintenance

- Repair damaged bluestone kerb stones in surrounds
- Clear minor sediment from sediment forebay and clean our sediment sump

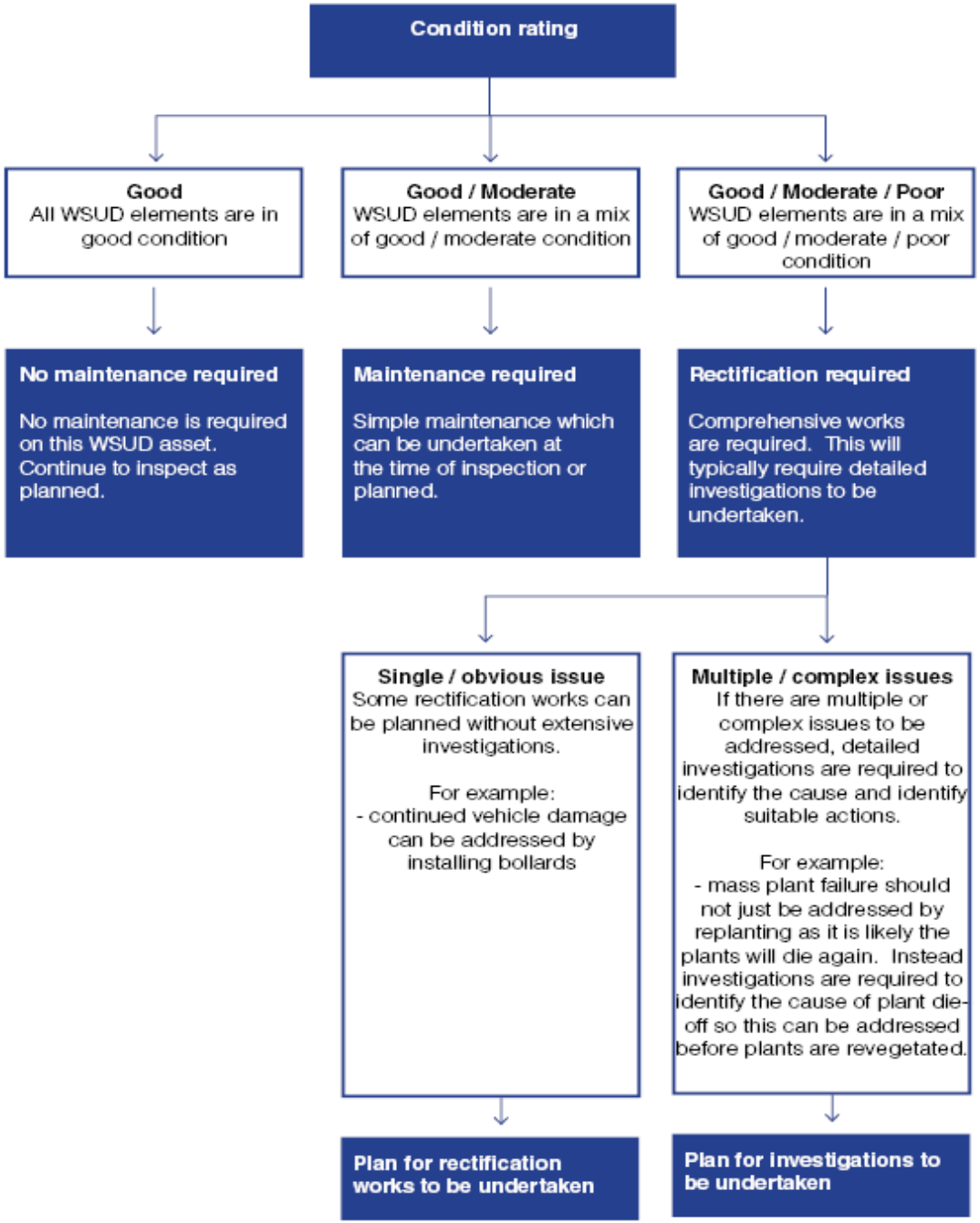
Rectification

- Scrape surface 100mm from surface and regrade to provide an extended detention depth of 100mm
- Remove, replace and infill planting with suitable species

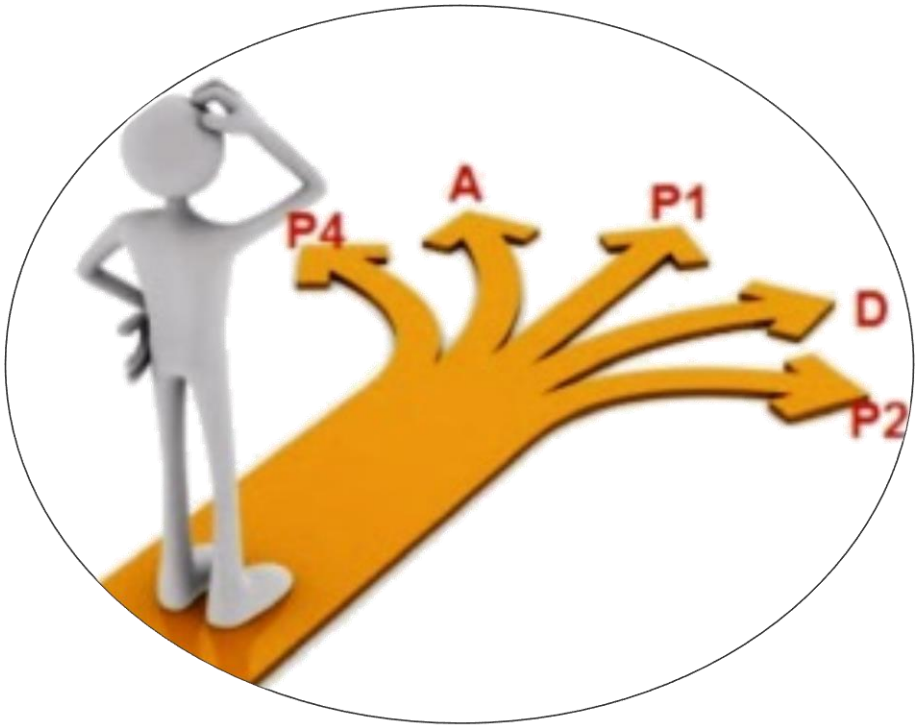
E2DESIGNLAB

STORMWATER VICTORIA

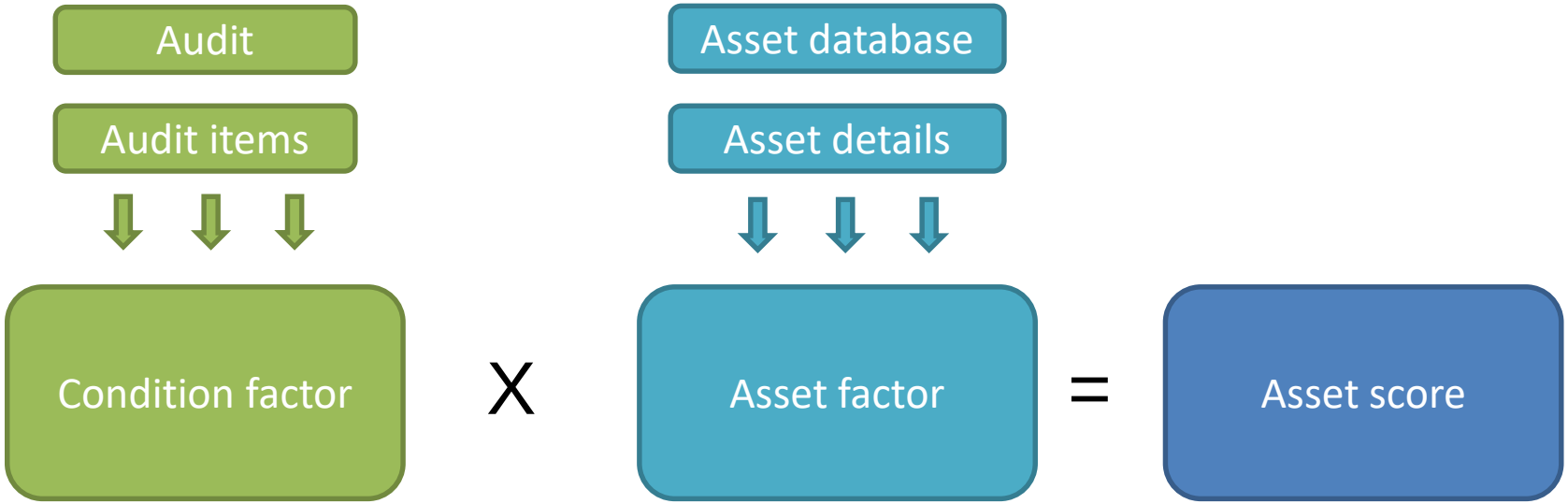
Melbourne Water
Enhancing Life and Liveability



Prioritise works



Prioritisation of works



- Function and water quality treatment
- Risk (public health and safety, continued damage, flooding, local environment)
- Amenity
- Significance of asset
- Catchment and downstream environment
- Visibility

Prioritisation of works

- Prioritisation guided by:
  - Asset score
  - What was the determining factor?
    - Condition factors
    - Asset factors
  - Potential to improve outcomes (function, risk, amenity)
  - Estimated costs and resources available

Allocation of budgets

- Template spreadsheet for budgeting
  - First pass overall budget estimate
  - Costing of identified works

Asset No.	Asset Name	Asset Type	Condition score	Priority of works (1-3)	Corrective Actions Required	Time Req. / Task	Staff	Rate	Area	Volume	Rate	Labour cost	Materials cost	Cost Estimate / Task	Timing of works	Total Costs
9	Sediment pond A	Sediment ponds			Stablise steep slope near outlet between footpath and culvert with concrete.	16	2	$ 200		1	$ 300	$ 6,400		$ 6,400		$ 6,400
4	Bioretention C	Bioretention			Scrape surface 50 mm to remove accumulated sediment including site setup.	32	2	$ 200	500	25	$ 400	$ 12,800	$ 10,000	$ 22,800	Works to occur only after construction is near complete	$ 50,200
					Replace filter media as needed.	16	2	$ 200	500	50	$ 100	$ 6,400	$ 5,000	$ 11,400		
					Replant with recommended species at density of 8 plants/m².				500		$ 4	$ -	$ 16,000	$ 16,000		
					Construct gate to restrict access to maintenance track								$ -	TBC		
					Rectification works to batter to provide effective maintenance access								$ -	TBC		
7	Wetland A	Wetland and sediment pond			Install an outlet pit, pipe and headwall to replace the porous rock weir while retaining the existing structure as an overflow weir, see Melbourne Water's Constructed Wetlands Design Manual, Part A2, 2015 for details on the design of this type of connection. The decision to recommend a submerged pipe connection rather than a submerged weir is based on consideration of minimising litter flow through to the wetland and lake.	80	2	$ 200				$ 32,000		$ 32,000	Long term	$ 32,000

Products of systematic audit process

- Prioritised works programs
- Documentation of condition
- Budget planning
- Database of issues and works
- Learnings and feedback
  - Design
  - Construction and handover
  - Continual improvement of audits and works

Concluding comments

- The next step in the evolution of WSUD asset management
  - Guidance on effectively managing WSUD assets
  - New set of audit templates – consistent and systematic
  - Initial guidance on prioritisation
  - Time to recognise WSUD as assets

- Better results for less long term cost


Thank you
dale@E2Designlab.com.au