
water NEW ZEALAND

Stormwater Education, Training & Sector Development

PART 2: TOOLKITS



DRAFT report for industry comment

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How to use this Plan

This Plan is based on a lot of work carried out over several years. It proposes a lot more work for the sector – work the sector wants, much of which it is itself best placed to deliver.

To keep core information ready to hand for those who will step up to this work, the Plan is in three parts:

- a short **Plan**
- this set of **Toolkits** with practical detail for working groups implementing the Plan
- a short set of **Appendices** for other information collected as part of this process.

A great deal of other work is going on, so working groups will be supported with several key documents referenced in the Plan, especially the 2018 WSUD report, ongoing work by the Ministry for the Environment and the Auditor-General's December 2018 report on Managing stormwater systems to reduce the risk of flooding.

This Plan can only be implemented by the kind of ongoing communication and collaboration that characterises the stormwater sector. An exciting time lies ahead.

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Toolkit 1 Industry suggestions for stormwater-related training needs

Table 1 lists all of the information from all of the survey and engagement sources more or less under the headings in **Table 3** of the Stormwater Education and Training **Plan**. Due to multiple suggestions made under most headings, only comments with more detail are included.

Working Groups will need to use this list to help ensure they cover off all the training content within a given training topic.

While there is some crossover amongst the topics, training suggestions have been broadly grouped into phases of the development lifecycle, as follows:

- planning: policy, principles (as Water Sensitive Design Part 1), flooding/risk/resilience, costs and benefits of WSD
- assessment: catchment and asset management, hydrology and hydraulics, environmental aspects such as water quality, multi-criteria options analysis
- design: WSD Part 2, stormwater design, design of other aspects of wellbeing and amenity such as landscape
- construction: translating design into construction, sequencing and device installation, erosion and sediment control
- operation and maintenance
- monitoring and evaluation: compliance monitoring, outcome monitoring, review and learning.

Table 1 Detailed list of stormwater-related training needs

Source Reports in s1.1.1 of Task 1; 2016 & 2018 surveys; 2018 industry forum; input from Subgroup members

Planning
Policy, planning, standards, consenting and compliance
<ul style="list-style-type: none"> • an integrated approach is now required and a real appreciation of what this means is called for. Policy development and planning are important but vary in each regional council area • WSD design: there aren't any training programmes which combine the regulatory needs with the technical design aspects. We need collaboration with regional/local Councils so that training is tailored to regional needs and character. • need for "holistic" approaches. In former years "Drainage" was the issue. More recently "waterways quality". Now "integrated water management" • stormwater practitioners need to have a stronger understanding of freshwater management principles to understand the basis of WSD • https://regenesishgroup.com/ • align construction and development priorities with urban expansion and urban renewal rather than allow local government politics influence decision making • integration with land use and development planning • training for planners on stormwater-related issues • changes in policy could also help put more responsibility on dischargers to meet water quality requirements through consents. • urban development/city planning to lessen imperviousness and promote water sensitive design • require WSD as a non-negotiable application to reduce impacts of impervious surfaces • conversations early in the project/ development planning stage • WSUD is critical as it is not just a technical discipline but also a planning issue. Stormwater infrastructure sits at the intersection of planning and technical design. Storm water design requires

a strong bond between urban planning and engineering. This is a team playing exercise which cannot be trained in a course alone

- understanding of the wider statutory framework e.g. CDEMA, NZCPS
- integrating WSUD with the NPS-FM etc: NPS-FM, NPS-FW & NES requirements and how they will change current practices
- application of the NPS for Freshwater Management to stormwater industry Integrating better outcomes for people/communities into stormwater design (e.g. landscape, urban planning considerations)
- integrated planning (land use; housing typology; WSUD etc)
- local, regional, national and international good practice – policy-wise
- relationship with policy/ issues with policy including case studies
- not so much training but much better industry consultation from regulatory bodies about the policies they want to adopt before they adopt them
- better understanding of local authority requirements
- better planning and consistency of outcomes across different authorities
- communication between council planning and Engineering departments
- local government signoff and vesting assets process that access WSUD as defective assets
- there is a gap between design and operation / maintenance / monitoring of WSUD. Councils are in danger of ending up with green infrastructure that does not actually work as intended, due to a lack of consultation with those on the ground
- Auckland Unitary Plan Stormwater provisions; policy, interpretation, rules, consenting, stormwater design requirements and specification
- planning for and implementation of WSUD, for both new developments and retrofitting existing areas
- understanding the implications of changing stormwater management practices and direction in the Auckland region
- better understanding of stormwater-related consents generally
- consenting options for stormwater treatment; re-use; discharge
- remote sensing
- big data
- a lot of stormwater emanates from building and building consents. Most stormwater professionals including managers focus on their favourite work area, but need a much stronger connect with building activities, subdivisions etc. And quality infrastructure. Industry needs more improved management rather than fuzzy delegation, management of Excel spreadsheets, and dubious asset management
- global approvals
- who is going to own the asset down the track and is it practical to maintain
- making clear the responsibilities of the device owners, that it's not a stick it in and forget about it. rule framework also needs to be clear about this, and the consequences of it
- educate compliance engineers at Councils
- development of better compliance systems
- enforcement of developments
- on site systems and the mechanism by which private individuals know that they have an obligation to maintain something and then 'how' (whether contracting someone).
- accountability for bad work: no feedback or accountability for design construction and operation. Bad BMP's being signed off. No maintenance being enforced. If people are not corrected when they make a mistake, how can they learn the correct way?
- training programmes are not the solution. The industry we operate within needs to better transfer/accumulate/value knowledge. This can only be achieved through better accountability enforced through stronger compliance processes/systems

Principles/overview/basics/case studies (WSD Part 1)

- understand the "why": good summary of why its relevant - I work on a range of projects not just stormwater so a good summary/introductory to its relevance would be a good solid foundation
- trans-disciplinary and multi-disciplinary skill are needed to integrate multidisciplinary approaches
- understanding of the interfaces between the different disciplines to enable integrated, multi-disciplinary design
- understand the context of stormwater infrastructure design in its environment/surroundings
- focus on best practice examples of interdisciplinary design approach to WSD/storm water design
- there is a real need for stormwater to move more into the forefront of thinking for any infrastructure project. This requires a broader appreciation of stormwater management across local authority departments and industry
- cultural value of water: how Maori see water and how that aligns with WSD, policy and how we can incorporate that into engineering design

- more needs to be done to integrate cultural values and Tangata whenua's historical understanding of environmental degradation (especially of our freshwater and estuarine environments) in how councils progress towards more water sensitive urban environments
- more training on basic design principles: overall basic understanding of concepts and that design is all theoretical principles
- multiple objective stormwater solutions i.e. creating amenity value, considerations in the design that caters to the flourishing of flora and fauna
- how has stormwater developed over the years in terms of design and council expectations from engineers and developers
- something that would cross the boundaries between stormwater/ecology/landscaping and other water-related disciplines.
- bring more ideas about restorative approach when dealing with stormwater
- lessons/showcases from the most innovative solutions/interesting projects in the world
- examples may include industries as a whole in Europe, including the UK. No one is perfect, but there is a lot we can learn from others who have had to go through the urbanisation challenges we face today, decades earlier
- a set standard so everyone has a basic understanding/qualification about stormwater as people's knowledge on it varies
- more holistic less focused on the assets
- focus on water from all sources not just urban stormwater assets
- Capacity and Austroads alignment
- understand current NZ technique and comparisons to international standards

Iwi and community engagement

- recognising the importance of the community in stormwater management
- Iwi perspectives (cultural)
- cultural aspects of stormwater management
- Iwi related training with regard to freshwater management and the disposal of stormwater
- mana whenua liaison
- community engagement on waterways
- public-facing skills in engagement with stakeholders and communities on communicated and negotiating levels of service and factoring in consequences of more extreme events e.g. flooded roads

Water sensitive (green, or low impact) design (WSD) Part 2

- stormwater is perceived as the softer of the 3 waters infrastructure. But this fails to recognise that it is the most complex
- people still view stormwater management as an isolated (as opposed to integrated) approach and fail to understand cumulative or multi-disciplinary needs
- involve other disciplines in the conversation: One of the key issues in stormwater is the need to address it as a multidisciplinary activity. Any training offered will need to address this matter. It cannot simply be an engineering, science, planning, landscape or urban design led activity. I particularly like the Christchurch CC 6 values approach: ecology, landscape, recreation, heritage, culture, drainage – different applications will have different priority orders for the values.
- integration with other industries, e.g. solid waste, wastewater, urban design, pedestrian/cycle access etc
- principles and integration: covered as much as can be in part of Allan Leahy's two 1-day training workshops for Engineering New Zealand
- WSUD training like that of water & wastewater principles & trends, I don't think we tend to focus on this area as a Council mainly left to on the job training
- integrating cultural values / mana whenua liaison
- inclusion of cultural knowledge to be more mainstream
- some people currently in the stormwater industry lack adequate baseline knowledge
- many people in parallel industries e.g. roading, buildings, lack adequate baseline knowledge
- recognise that not all stormwater people are engineers e.g. when working with Engineering NZ
- understanding the principles, purpose and outcomes of stormwater management
- integrated Design for Social & Cultural values
- industry lessons learnt. Success stories and failed designs
- training in best practice Water Sensitive Devices: specific design, not general concepts; Practical technical workshops - WSD, culverts, etc
- how stormwater BMPs work for non-engineers
- WSUD/LID and stormwater quality
- stormwater treatment
- stormwater re-use; soakage/infiltration, groundwater recharge with stormwater and discharge
- Water harvesting

- Design + actually implementing low impact design, construction, operation and maintenance
- cost effective approaches
- WSUD/Low impact design that links to NPS freshwater "direction"
- pitfalls in bioretention practice
- practical application of water sensitive design.
- better understanding of stormwater related new technologies such as siphonic roof systems etc

Risk and resilience

N.B This is a broader topic beyond just stormwater. MfE have released guidelines and run workshops. We need further consideration on how best to integrate it.

- risk management in a changing climate
- flood hazard assessment incorporating climate change
- sustainability and resilience in stormwater design: how to take into account more intense rainfall, sea level rise and climate change
- climate change will effectively change our methods of building (including the need for a revisit of the "100-year event" theory as more of these events occur in both scale and magnitude.
- building resilient communities that approach stormwater as one of a multiple of natural hazards to be considered in good environmental design. Integrating a strong built environment with the natural environment
- how and when to adapt existing (legacy) stormwater systems (urban, peri-urban and OSW's) to a changing climate and ongoing development pressures e.g. transition from gravity to pumped systems (esp. coastal areas), rising groundwater, more intense urban flash flooding
- greater adoption of an adaptive, systems approach to changing climate, needs and development
- infrastructure resilience focused on stormwater
- climate risk and impact
- climate risk and adaptation and adaptation
- climate change and its influence on WSUD best practice regarding selection of rainfall data for stormwater design
- climate change modelling, standardisation of practices

WSUD Part 2 Costs and benefits of WSD and its alternatives

- explain difference between WSUD costs and benefits and BPO/MCA
- cost benefit analysis and BPO determination
- cost of unintended consequences. In the example of WSD, e.g. more and more privately-owned and operated systems which will potentially fall back on the public sector to remedy. Cost implications of directing (narrowing) policy to this end-future outcome without realising the consequences of far-future impact
- greater understanding of implementation aspects and costs of water sensitive design
- 101 on Stormwater Design Economics
- better understanding of the operation, maintenance and life cycles of green infrastructure.
- cost and benefit training
- benefits/ costs of Low Impact Design
- use of sustainable systems - design, construction and maintenance
- improved awareness of whole of life value for money solutions that are functionally reliable, resilient, and safe (people, plant, environment)
- knowledge of benefits across the four wellbeings (social, cultural, environmental, economic)
- making this available to developers and investors would also be beneficial
- long term effectiveness of low impact disposal systems
- better training on the lifespan of different assets available, especially with treatment products
- important to consider the lifecycle of assets (planning, design, construction, handover, operational delivery (monitoring and maintenance), and disposal (cradle to cradle)
- understanding optimal whole of life asset solutions and Cost/Benefit realisations
- understanding of improved accounting for sustainability - see <http://pureadvantage.org/news/2016/10/11/capital-gains-real-returns-investment-restoring-waters/>
- need to raise the level of understanding within local government organisations. Those in the field know lots but there is little knowledge outside this - usually accountants and CEOs just look at stormwater as a cost to avoid
- cost/benefits for water sensitive design over conventional infrastructure
- training in how to better quantify the benefits of the green environment and management of stormwater through the use of water sensitive design
- developers seek least cost solutions that are not best for the community. Such substandard outcomes present future developments that will not satisfy the needs of future generations. Councils need to strengthen the rules that prevent inappropriate designs.
- better and more consistent approach to developing inventories of system attributes (otherwise risk/benefits difficult to quantify)

- knowledge of benefits across the four wellbeings (social, cultural, environmental, economic)
- lack of Social / Cultural exposure to back up Economic / Environmental well beings
- roading engineer /narrow-planning and KPIs blocking water sensitive design integration UP FRONT as the broader benefits aren't considered in narrow upgrade and replacement projects
- understanding whole of life costs and coming up with optimal solutions considering the whole asset lifecycle
- negative opinions regarding the maintenance of vested low impact design stormwater solutions versus traditional 'hard' engineering solutions, and a specific focus on detention only (lack of focus on landscape/treatment/cultural/heritage values)
- people do not appreciate the importance of stormwater and the water quality implications and liveability opportunities. You have all sorts of developers and other so called professionals undertaking designs & construction that do not have the right qualifications, experience and understanding to do so
- educate decision-makers of the risks of not improving (e.g. as with leaky homes)

Assessment

Catchment and asset management

- <http://www.lgnz.co.nz/our-work/our-policy-priorities/1-infrastructure/>
- need for "holistic" approaches. In former years "Drainage" was the issue. More recently "waterways quality". Now "integrated water management" [also in WSD]
- stormwater practitioners need to have a stronger understanding of freshwater management principles to understand the basis of WSD
- stream and river management
- asset management
- catchment analysis
- flood mapping and processing of model data, GIS
- floodplain management planning
- flood forecasting/flood hazard analysis and planning
- graphic presentation of complex data
- understanding the development of Integrated Catchment Management Plans
- using geospatial tools for asset management and catchment analysis
- how to measure 'state and trends' performance related to stormwater influenced catchments (hydrology and water quality, i.e. is your stormwater management getting better or worse?)
- limit setting and modeling
- definitely how services fit into the overall networks and systems that make up a community
- better understanding of flood interpretation
- knowledge of extreme events and how systems cope beyond the nominated LOS
- understanding the stormwater network
- asset management practices around (particularly new and LID) stormwater infrastructure
- understanding the implications of changing stormwater management practices and direction in the Auckland region and how this will change in monitoring the asset base that forms the stormwater system. This will change to more private assets and green infrastructure (natural assets) that need to be monitored and maintained as part of an over-arching system

Hydrology

- hydrology training is greatly lacking
- new hydrology methods
- annualised losses comparison
- hyetograph shapes
- rainfall runoff guidance: we need the rainfall/runoff work
- flood frequency estimation techniques
- rainfall analysis
- rainfall radar
- more accurate reporting of rainfall data
- rainfall analysis/ hyetograph shapes etc
- rainfall runoff guidance - when to use what technique/data
- rainfall, radar and weather forecasting training
- rainfall run off details
- rainfall profiling and development toward a rainfall standard that is not overly conservative in conjunction with effective discharge control provision
- hydrology processes including calibration
- hydrology - difference between methods, which is appropriate and when.
- a uniform country-wide methodology to determine the peak flow that covers smaller catchments in the provinces

- how to consider snowfall, baseflows
- lack of training in NZ for estimating flood frequency
- review of current peak flow techniques
- calculation of quantity (e.g. detention volumes required)
- more and more need to design systems to achieve stormwater neutrality post development

Hydraulics

- hydraulics design: not a lot of designers are aware what a Hydraulic Grade Line is... i.e. water doesn't run uphill
- stormwater and hydraulics fundamentals
- sound understanding of the underlying principles of stormwater management, especially hydrology and hydraulics
- understanding carriageway surface water catchment and aquaplaning risk
- Water Sensitive Design is increasingly well understood by land development and urban design practitioners. Hydraulics, modelling, and policy interpretation is an ongoing need.
- hydraulics is part of basic training/education. Modelling is very specialised and only suitable for those in that mode; however appreciation of what models can achieve and the associated caveats would be worthwhile
- there is clearly a need for a greater output of modellers, WSD practitioners and integrated planning/risk specialists
- sizing infrastructure for flood events
- overland flow paths/secondary flow path modelling
- catchment modelling:
 - introductory e.g. good general horses for watercourses approach to ensure modelling is not misused
 - advanced
 - refreshers
- additional modelling training for all of those more widely used throughout the NZ industry (or deciding on an industry specific model)
- some software training
- modelling software/ methods
- other software design trainings such as TUFLOW, Mike Urban, Drains, Civil 3D training etc and some training in the use of other stormwater modelling applications
- 1D/2D stormwater modelling
- 2D modelling, bridge scour assessments, debris management and assessment, energy dissipation, culvert design
- linking 3D drafting and design software together
- better understand the future direction of 3D and design software outputs for construction
- detention modelling and not just using TP108!!!!
- stormwater & flood modelling e.g. flood risk assessment and analysis
- water quality modelling/calculation techniques
- detention/retention modelling
- pre and post development stormwater run-off modelling techniques
- probabilistic/deterioration based approaches
- up to date hydraulic modelling
- at least one form of modelling software for hydraulic catchment analysis
- up to date water quality assessment using modelling

GIS analysis, hydraulic modelling and software training

Suggestions were split up and included under hydrology and hydraulics as the fundamental areas. GIS, modelling and software are tools to achieve this and training in the software the mechanism.

Design

WSUD Part 3

- design for the 4 well-beings, social, cultural, economic and environment
- advanced stormwater design focusing on upgrading using limited budgets
- make sure designers especially new designers understand how their designs will be built and maintained. Designed that are good in theory as still useless if they are difficult/impossible to build or just block up
- translating design into construction
- sustainability and future-proofing
- environmental and sustainability in stormwater design
- make integrated design mainstream (i.e. stormwater forms part of the design along with other disciplines such as urban design, roading, planning etc from the outset of the project.

- still seeing lots of the "wrong device in the wrong place" at the design end, particularly with placing devices to get Council approval but not following through on how practical the devices are to maintain or operate - assets sign-off is missing
- understand that the stormwater is different to sewer so do not use the same material specifications
- design of stormwater as NZWETA or Opus course have done
- design of effluent irrigated land treatment systems
- safety in design
- subdivision design. There is a New Zealand Standard on sustainable subdivision design at <https://shop.standards.govt.nz/catalog/4404%3A2010%28NZS%29/view>
- renewals design
- mass load and flow based design
- soakage design is an issue and lots of systems are poorly designed and specified and hence will fail if truly tested
- design of raincells, swales, rain gardens, permeable paving, etc
- one big gap is the divide between draughting (traditionally done by draughties) and hydraulic design (increasingly done by engineers using smart software). We need to widen the skills of both groups so that the interface is more seamless and effective.
- interactions between stormwater design and other environmental aspects such as groundwater etc
- stormwater fundamentals (structures, operation)
- units that build toward a standard covering such things as hydraulics, hydrology, culvert design, open channel design, water sensitive design, river morphology and design, etc
- I would like to know if there are requirements for a stormwater specific strands/qualification for people who design, install or maintain stormwater systems
- correct stormwater treatment/design techniques/design pathways
- treatment device choice outside the recipe cookbook guidelines i.e. targeting plastic / litter / debris / gross pollutants as target contaminants of concern
- training relating to different requirements of design in other regions of NZ
- operation and maintenance training needs to be included in design training
- design training needs relate to integrated multidisciplinary design and devices
- lack of understanding of how the design will actually work in practice
- technical design of typical WSUD devices (design for maintenance, design for benefit maximisation)
- emerging/new local plan or guidance changes (e.g. planning provisions, GD01, GD05)

Ecological aspects: water quality, landscape architecture, stormwater treatment, habitat, amenity [*we need to link in with ecology and landscape architecture here somehow*]

- See new guideline at <https://www.rmla.org.nz/2018/10/11/biodiversity-offsetting-under-the-rma/>
- improving knowledge of integration of ecology and engineering in stormwater management
 - sound understanding of the underlying principles of stormwater treatment processes
 - need a values-based approach like Christchurch City Council's waterways and wetlands guideline
 - stream morphology/erosion
 - stream restoration techniques
 - riparian planting
 - plant palette selection training
 - impact assessment
 - ecological understanding and considerations
 - fish passage design
 - water quality contaminants and treatment
 - urban stream restoration
 - erosion protection techniques that integrate ecosystem services land scape amenity and flood protection
 - water quality, freshwater and marine ecology
 - landscape design
 - runoff treatment best practice
 - water quality assessment using modelling
 - quality & quantity monitoring in urban catchments: capturing data on flashy impervious type catchments
 - what are the contaminants of concern, their impacts and how do you monitor them
 - interested in management examples for how hydrological regime and contaminants are managed
 - water quality treatments (hard and soft)
 - stormwater treatment e.g. RG media hydraulic performance
 - river management
 - basic understanding of hydraulics round structures, scour protection design at inlets/outlets
 - macrophyte identification
 - water quality/treatment
 - cumulative effects

<ul style="list-style-type: none"> indirect stormwater contamination risks and treatment lack of knowledge by industrial sites regarding good/best management practices for stormwater protection. Educating developers and decision-makers (e.g. Councils) of the importance of getting the above right targeting plastic / litter / debris / gross pollutants as target contaminants of concern
BPO/multi-criteria analysis
<ul style="list-style-type: none"> explain here how it's different from costs and benefits
Construction
<ul style="list-style-type: none"> getting the basics right around design/construction interfaces design through to construction process, lack of continuum: there's a big gap where doesn't seem to be any training on translating design into construction some activity areas are reasonably well understood and consistently delivered (e.g. hydraulics and modelling), whilst for some activity areas (e.g. construction, handover and MO) are not particularly well understood and industry knowledge is too often lacking erosion and sediment control lack of understanding on how to actually build the designed systems better insight into construction sequencing and installation processes for stormwater infrastructure such as rain gardens, swales, wetlands, treatment devices treatment, attenuation and conveyance contractor and operator training installation fundamentals construction run-off trenchless technology installation fundamentals there's a big gap where doesn't seem to be any training on construction poor understanding of stormwater management by construction contractors. construction and sign off of typical WSUD devices
Flooding
<ul style="list-style-type: none"> Monte-Carlo analysis and long term simulations
Operation and maintenance
<ul style="list-style-type: none"> there is a gap between design and operation / maintenance / monitoring of WSUD. Councils are in danger of ending up with green infrastructure that does not actually work as intended, due to a lack of consultation with those on the ground how can we better balance the need to minimize maintenance while achieving exceptional water treatment need to better understand how their designs can be built and maintained and how they will perform in the real world - understanding O&M implications of design aware of new pipe inspection technology post flood cleanup network rehabilitation operations and maintenance training is critical for the designers (who often lack this), and those in consenting approver roles. It is critical that where the design is developed and approved that the O&M are considered critically as poorly designed and vested assets creates H&S risks (e.g. Treatment devices located in the middle to T Junctions (btw, that's not the worst case seen), high maintenance costs to ratepayers, poor performance and durability there's a big gap where doesn't seem to be any training on Operation and maintenance lack of understanding on the problems of maintenance of many of the designed systems debunking the myths about stormwater device operation and maintenance stormwater BMP asset management monitoring and maintenance of stormwater treatment units: practical maintenance and asset management planning for typical WSUD devices
Monitoring and evaluation
<ul style="list-style-type: none"> understanding the \$ ROI of training compliance monitoring outcome monitoring?
Non-training needs
<ul style="list-style-type: none"> We can't pick and choose. A thorough understanding of all of the above (and wider socio-economic/ political processes) is essential to ensuring the correct solutions are identified and

implemented in the right way, at the right time. In this sense, the most critical issue is the risk of industry professionals operating in silo's within the areas identified above, without appreciating the drivers/challenges associated with the rest.

- There is a serious lack of resourcing, and investment in the sector as a whole in terms of knowledge transfer/management. The driver is to build houses. The effects are managed via PR.
- Training programmes are not the solution. The industry we operate within needs to better transfer/accumulate/value knowledge. This can only be achieved through better accountability enforced through stronger compliance processes/systems.
- Start an evidence based conversation with the 'general public' on relevant matters - better educate the voters, so they will demand more of our decision makers, which is critical to ensuring the correct systems (and prioritisations) happen

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Toolkit 2 Summary and gap analysis of stormwater training needs and providers

The following tables detail the training needs listed in **PLAN Table 4.1**, Integral and specialist stormwater training needs across the development cycle:

- an assessment of the underlying causes of the training need, to help identify if training is the solution to the problem
- flow-on effects of the need, to help with prioritising training in order of delivery timing
- other non-training supports that need to be in place, whether or not training is a solution to the performance problem.

Training needs and providers are then listed below that assessment.

Topic numbers within each table refer to the headings in **PLAN Table 4.1** and follow the development cycle in **PLAN Figure 4.1**.

The numbering convention allows courses to be listed in a logical order at the beginning while enabling other courses to be added while maintaining the integrity of the development cycle approach. The use of icons and numbers also allows clear navigation of:

- any future website
- where a given workshop fits within the development cycle.

As indicated above, all training interventions need many other specific supports for trainees before and after formal training events.

Much stormwater-related technical training must be based on a guideline that codifies best practice. The best overview of the many guidelines in New Zealand is that of the Canterbury Regional Stormwater Forum Technical Design and Best Practice Working Group¹. This document must be a core reference for this work.

WaterNZ also has national [guidelines](#) in development, including the New Zealand Rainfall Runoff Guidelines and the New Zealand Pipe Inspection Manual.

The Education and Training Subgroup asks the industry to fill in any gaps in the following tables with respect to courses and trainers, in order to complete the gap analysis.

For any new training, we must identify what, who, how: some solutions will be simple; others will take longer².

This can be done at the same time as seeking feedback on priorities.

The table overleaf will help with navigating the subtopics under the main training topic headings.

Integral and specialist stormwater training needs across the water sensitive development cycle

1. Integral skills	
See Toolkit 2 Tables 1.1-1.7	
1.1	Te Ao Māori and iwi engagement
1.2	Principles of sustainability and water sensitive design across the four wellbeings
1.3	Wellbeings Part 1: Introduction to cost sensitivity/life cycle costings, cost & benefit analysis of sustainability/WSD across the four wellbeings, including multidisciplinary engagement
1.4	Community engagement methods including positive communication & conflict resolution
1.5	Creativity and innovation
1.6	Train the Trainer training for environmental experts delivering non-NGICP training
1.7	Responsible procurement: how to prepare, respond to and deliver on tenders requiring outcomes across the four wellbeings/six capitals
Specialist skills	
2. Research, planning and governance (Toolkit 2 Tables 2.1-2.5)	
2.1	Research, planning and governance: from research & policy to consenting & compliance; statutory & other methods, catchment governance – beyond the three waters
2.2	Monitoring and evaluation Part 1: how to define desired outcomes and indicators across the four wellbeings
2.3	WSD Part 1: Water sensitive/green/low impact design overview and principles
2.4	Risk and resilience, including climate change effects, mitigation and adaptation
2.5	Wellbeings Part 2: Costs and benefits of WSD and its alternatives
3. Catchment assessment and planning (Toolkit 2 Tables 3.1-3.5)	
3.1	Catchment management planning
3.2	Ecology Part 1: ecological, cultural, archaeological and social analyses
3.3	Asset planning and management, including mixed green and grey infrastructure
3.4	Hydrology including flooding, and hydrological modelling
3.5	Hydraulics and hydraulic modelling
4. Design (Toolkit 2 Tables 4.1-4.2)	
4.1	WSUD Part 2: detailed design, from site characterisation to device design and sizing
4.2	Wellbeings Part 3: BPO/MCA: best practicable option/multi-criteria analysis of all wellbeings
5. Construction (Toolkit 2 Tables 5.1-5.3)	
5.1	WSUD Part 3: How WSUD infrastructure and devices operate; fit-for-purpose construction; inspection (checklists, what to look for)
5.2	Ecology Part 2: Protection, capture and/or relocation of sensitive terrestrial and aquatic species
5.3	Sensitive construction methodologies including subdivision-scale erosion and sediment control and small site erosion and sediment control + pollution prevention
6. Establishment: ecological and amenity aspects (Toolkit 2 Tables 6.1-6.2)	
6.1	Establishment and care of stormwater and other plantings, including weeding and replacement
6.2	Ecological re-establishment, including introduction/reintroduction of terrestrial & aquatic fauna
7. Handover (Toolkit 2 Tables 7.1-7.3)	
7.1	Legal aspects Part 1: subdivision-scale decommissioning of temporary environmental controls
7.2	Legal aspects Part 2: handover hold points, verification and rectification of asset condition
7.3	Legal aspects Part 3: small site-scale – environmental controls
8. Green and grey asset operation (Toolkit 2 Tables 8.1-8.3)	
8.1	Green and grey asset operation with respect to desired levels of service
8.2	Ongoing point source contaminant control from industrial and other source premises
8.3	Ongoing diffuse source contaminant identification and control

9. Maintenance (Toolkit 2 Tables 9.1-9.3)	
9.1	Inspection: the art and science of inspecting green and grey assets on public and private land
9.2	Proactive maintenance: planning, budgeting, implementing, documenting, learning
9.3	Reactive maintenance: budgeting, implementing, documenting, learning
10. Monitoring and evaluation (Toolkit 2 Tables 10.10.5)	
10.1	How to measure and monetise the effectiveness of environmental training
10.2	The art and science of compliance monitoring
10.3	Wellbeings Part 4: How to measure the effectiveness of catchment and asset management plans across the four wellbeings as per the statutory analysis in 2.1 and 2.2
10.4	Wellbeings Part 5: how to capture costs and benefits at all stages of the development cycle to contribute to cost/benefit assessments & case studies
10.5	The learning organisation, evaluation and learning for adaptive and creative management
Strategic and leadership skills	
(To be added to the table in Toolkit 2 when fully assessed)	
11.1	Career pathing
11.2	Leadership training
11.3	Sustainability leadership training
11.4	MBAs (Masters of Business Administration)
11.5	Masters of Public Policy
11.6	Director training

Table 1 Needs assessment for integral skills that pervade the stormwater world

1.1 Te Ao Māori					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> • basic tikanga Māori • marae protocol • Te Ao Māori with respect to wai • New Zealand legislation that supports this e.g. 2014 Te Urewera Act and 2017 Whanganui River Act (recommended by Dan Hikuroa) • iwi engagement • basic reo to support the above 		<ul style="list-style-type: none"> • as engineers we tend put more emphasis on the economic wellbeing of a project, and less (or none at all) on environmental, social and cultural wellbeings • low confidence and lack of knowledge by stormwater practitioners • lack of access to existing training • lack of targeted training for stormwater audiences 	<ul style="list-style-type: none"> • less effective iwi engagement • stormwater information is less accessible to iwi and hapu • less public awareness of synergies 	<ul style="list-style-type: none"> • ideally all practitioners in stormwater and related trades and professions, so we all appreciate water as a treasured taonga (gift/resource) which we, as humans, are intrinsically linked to. If we preserve and protect our water, it in turn will look after us and the generations that follow 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> • general awareness in stormwater-related trades training 	Education: University <ul style="list-style-type: none"> • Te Ao Māori with respect to wai 	Professional training <ul style="list-style-type: none"> • Te Ao Māori with respect to wai • how to engage with iwi and hapu 	Other support <ul style="list-style-type: none"> • professional and iwi awareness of stormwater and related information • public awareness and education 	
Providers	<ul style="list-style-type: none"> • https://www.tewikiotereomaori.co.nz/ 	<ul style="list-style-type: none"> • engineering and Māori university courses across NZ 	<ul style="list-style-type: none"> • WSP Opus (Troy Brockbank) • Auckland University, Dr Dan Hikuroa • NZ Planning Institute prospectus 		

1.2 Principles of sustainability and water sensitive design across the four wellbeing					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> sustainability and WSD principles and outcomes across the four wellbeing policy context including the National Policy Statement on Urban Development Capacity (NPS-UDC) <p>Given the dynamic and occasionally subjective definition of sustainability do we need to be explicit about the four wellbeing or reference national guidance (e.g. Local Government (community wellbeing) Amendment Bill the Government's Wellbeing budget and Treasury's Wellbeing dashboard (ZEB))</p> <ul style="list-style-type: none"> selected case studies refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> as set out in Table 1.1, Key themes from Phase 1 WSUD Research, including lack of capacity, training and guidelines 	<ul style="list-style-type: none"> low uptake of more sustainable/water sensitive design lack of appreciation of how to design for and measure the co-benefits of WSD at little of no additional cost 	<ul style="list-style-type: none"> ideally all practitioners in stormwater and related trades and professions e.g. one survey respondent indicated they provide training for planners on stormwater-related issues 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> general awareness in stormwater-related trades training with particular reference to construction and decommissioning 	Education: University <ul style="list-style-type: none"> planning, architecture, biological sciences, civil engineering, geography, public policy, economics 	Professional training <ul style="list-style-type: none"> case studies toolbox talks 	Other support <ul style="list-style-type: none"> mentoring 	
Providers	<ul style="list-style-type: none"> see polytechnic courses available throughout New Zealand³ 	<ul style="list-style-type: none"> 8 universities across NZ: how to develop new specialist content 	<ul style="list-style-type: none"> Allan Leahy: two 1-day training workshops for Engineering NZ MfE: training in WSD principles Whangarei-based Continuing Professional Development runs two online courses on Stormwater and Groundwater – Development Effects, Part 1 and Part 2 		

1.3 Wellbeings Part 1: Introduction to cost sensitivity/life cycle cost & benefit analysis of sustainability/WSD across the four wellbeings, including multidisciplinary engagement					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> life cycle costs across the 4 wellbeings multi-criteria analysis across the 4 wellbeings analysing costs and benefits of WSD across the 4 wellbeings multidisciplinary engagement as part of project design, tendering & management selected case studies refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> as set out in Table 1.1, Key themes from Phase 1 WSUD Research, including lack of capacity, training and guidelines people don't capture and collate their cost/benefit information 	<ul style="list-style-type: none"> low uptake of more sustainable/water sensitive design costly mistakes that deter wider uptake 	<ul style="list-style-type: none"> ideally all practitioners in stormwater and related trades and professions 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> general awareness in stormwater-related trades training 	Education: University <ul style="list-style-type: none"> planning, civil engineering, geography, economics and ecological economics 	Professional training <ul style="list-style-type: none"> definition and application of the usual tools: BPO, BMP, MCA. Cost-benefit analysis 	Other support <ul style="list-style-type: none"> mentoring 	
Providers	<ul style="list-style-type: none"> see NZIHT and polytechnic courses available throughout New Zealand⁴ 	<ul style="list-style-type: none"> 8 universities across NZ: how to develop new specialist content 	<ul style="list-style-type: none"> NAMS NZ Planning Institute prospectus 		

1.4 Community engagement methods including positive communication and conflict resolution					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> stakeholder identification and analysis community engagement and communication being comfortable with conflict 		<ul style="list-style-type: none"> siloed approach to project management low confidence lack of shared processes and systems 	<ul style="list-style-type: none"> less cost-effective engagement less public awareness 	<ul style="list-style-type: none"> practitioners in stormwater and related trades and professions who interface with the community 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> Connexis <ul style="list-style-type: none"> NZ Certificate In Infrastructure Works - Level 2 (IW2) http://bit.ly/2CvVWDr and Level 3 http://bit.ly/2C2bLk2 Diploma in Engineering Practice Level 6: http://bit.ly/2Oafpif 	Education: University <ul style="list-style-type: none"> psychology, sociology, anthropology, geography 	Professional training <ul style="list-style-type: none"> community engagement being comfortable with conflict 	Other support <ul style="list-style-type: none"> mentoring fostering sustainable behaviour change through community-based social marketing Dr Doug McKenzie-Mohr CBSM online consensus-based decision-making software e.g. Loomio virtual/augmented reality tools 	
Providers	<ul style="list-style-type: none"> Connexis as part of the above courses NZIHT 	<ul style="list-style-type: none"> IAP2 Australasia training (includes certification) on community and stakeholder engagement training 	<ul style="list-style-type: none"> stakeholders: Dr Will Allen (live) and Continuing Professional Development (online) and here engagement: Koru Environmental and/or Annette Lees NZ Planning Institute prospectus Changeologist Les Robinson conflict: many locally available trainers such as Thriving Under Fire 		

1.5 Creativity and innovation					
Needs		Underlying causes of performance gap		Flow-on results of the performance gap	Target audiences
<ul style="list-style-type: none"> • how to foster creativity • the innovation process, from inspiration to implementation 		<ul style="list-style-type: none"> • institutional aversion to new methods (see Table 1.1) • lack of guidance e.g. incomplete GD03 Proprietary Device Evaluation Protocol 		<ul style="list-style-type: none"> • lack of receptivity in community/iwi engagement low/slow uptake of more sustainable / water sensitive design 	<ul style="list-style-type: none"> • stormwater practitioners with particular interest in these areas
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> • 	Education: University <ul style="list-style-type: none"> • 	Professional training <ul style="list-style-type: none"> • creativity • innovation • revisit GD03, Proprietary Device Evaluation Protocol? 	Other support <ul style="list-style-type: none"> • 	
Providers	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Auckland Council (GD03) • Liam Foster WSP • https://creativehq.co.nz/our-work/: startups, corporates, government • webinar series from Clare Feeney⁵ 		

1.6 Train the Trainer Training (TTT) for environmental experts delivering non-NGICP training					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> environmental experts (like experts in any other field) should undergo what's known as 'train the trainer' training (TTT) to acquire adult learning and vocational training skills that help them maximise trainees' uptake of the technical content help with preparing interactive training, rehearsing it in a supportive space and receiving feedback from a training expert 		<ul style="list-style-type: none"> many subject matter experts are not aware of the existence of the training profession and the depth of skills that can add value to how they deliver their technical training lack of cross-fertilisation between environmental and other professional trainers 	<ul style="list-style-type: none"> learning is more difficult for trainees so they retain less information training is less cost-effective than it could be 	<ul style="list-style-type: none"> subject matter experts delivering training across all phases of the water sensitive development cycle 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO/ITP <ul style="list-style-type: none"> how to develop and deliver training in workplaces, including literacy, online delivery and more 	Education: University <ul style="list-style-type: none"> N/A 	Professional training <ul style="list-style-type: none"> stormwater subject matter experts need to become good trainers if their training is to be enjoyable and effective 	Other support <ul style="list-style-type: none"> New Zealand Association of Training and Development (NZATD) – it is highly recommended that people undertaking TTT commit to their own ongoing professional development as trainers by becoming members. They can attend local branch events, be notified of upcoming workshops and receive copies of the monthly magazine for professional trainers in both New Zealand and Australia 	
Providers	<ul style="list-style-type: none"> Helen McPhun of LEARNPLUS offers Unit Standards qualifications in a wide ranges of topics around Adult Education and Training EMA Certificate in Adult Education & Training 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> Clare Feeney Beryl Oldham Dr Rich Allen TTT workshops run by professional trainers who are members of or otherwise affiliated to NZATD training through the EMA (Employers and Manufacturers Association), including Delivering Effective Training Programmes: Adult Education and Training; and Training Design and Training Needs Analysis There are many other respected workshops that run in centres all over New Zealand: search for "train the trainer course nz" 		

1.7 Responsible procurement: how to prepare, respond to and deliver on tenders requiring outcomes across the four wellbeings/six capitals					
Needs		Underlying causes of performance gap		Flow-on results of the performance gap	Target audiences
<ul style="list-style-type: none"> • 4 wellbeings/6 capitals • 		<ul style="list-style-type: none"> • 		<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> •
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> • 	Education: University <ul style="list-style-type: none"> • 	Professional training <ul style="list-style-type: none"> • 	Other support <ul style="list-style-type: none"> • NGICP • New Zealand Association of Training and Development (NZATD) 	
Providers	<ul style="list-style-type: none"> • as above 	<ul style="list-style-type: none"> • as above 	<ul style="list-style-type: none"> • Plan A • Height PM • Proxima Global 		

Source: Contractor magazine Kel McBeath and Rachel Devine (2018) Social Procurement – towards a healthier society. An article by [Height Project Management](#) in the December 2018-January 2019 issue of [Contractor](#), the official magazine of Civil Contractors New Zealand ([CCNZ](#)).

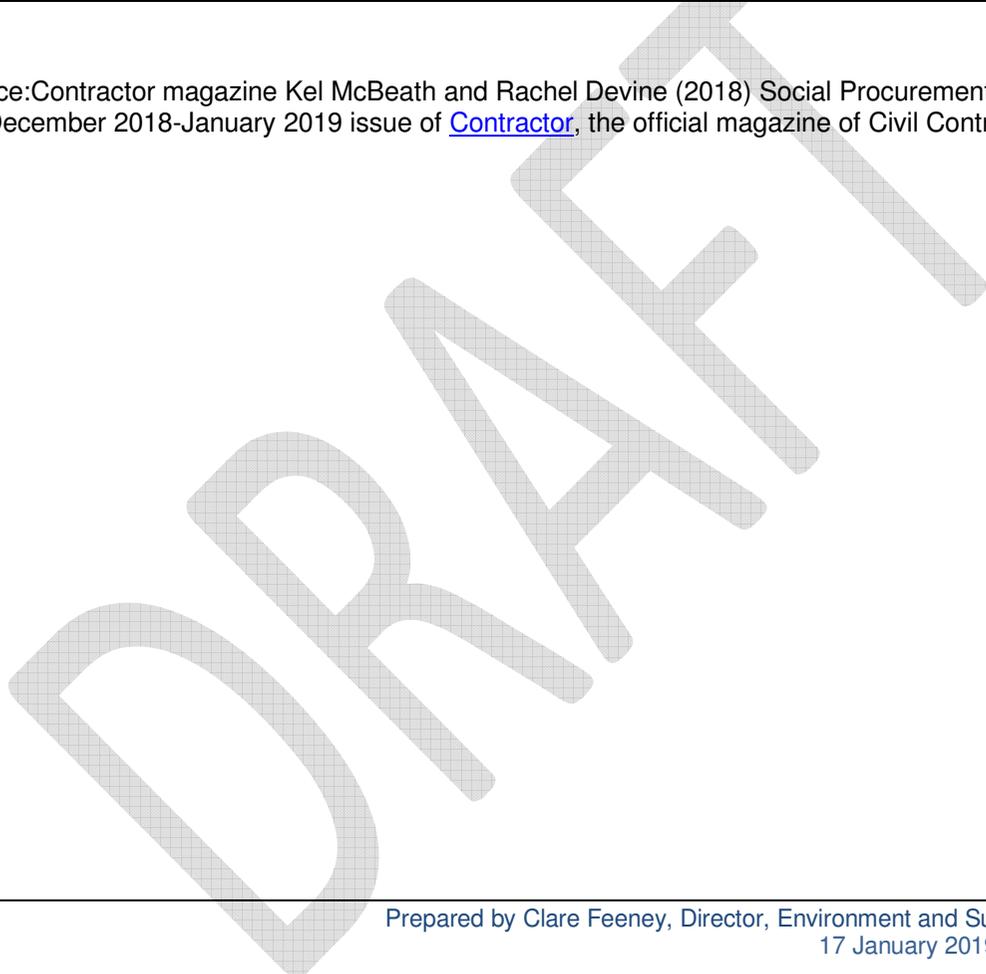


Table 2 Needs assessment for specialist planning skills

2.1 Research, planning and governance					
Needs		Underlying causes of performance gap		Flow-on results of the performance gap	Target audiences
<ul style="list-style-type: none"> policy, planning, standards, guidelines, consenting and compliance: the big picture and why it's important statutory and "other" methods how to prepare an AEE catchment governance how to plan in terms of the four wellbeings Auckland Unitary Plan Stormwater and related rules (same for other regions) refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> complexity and ongoing change of guiding and requiring documents siloed project management: planners don't have ongoing dialogue with other professions complex and siloed council processes 		<ul style="list-style-type: none"> full statutory analysis is seldom done; too complex to be cost-effective at project scale too hard to join the dots between high level requirements and on-the-ground actions and their outcomes 	<ul style="list-style-type: none"> ideally all practitioners in stormwater and related trades and professions in practical terms, tender and project management teams, consenting and compliance personnel
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> overview 	Education: University <ul style="list-style-type: none"> civil engineering, planning, law, public policy 		Professional training <ul style="list-style-type: none"> RMA and environmental training governance training council guidelines 	Other support <ul style="list-style-type: none"> Quality Planning website Ecosystem governance⁶ by Prof Stephen Olsen
Providers	<ul style="list-style-type: none"> NZIHT: http://bit.ly/2NwThKy Connexis: http://bit.ly/2Oafpif 	<ul style="list-style-type: none"> Auckland University, Masters of Urban Planning Auckland University, Masters of Urban Design 		<ul style="list-style-type: none"> WSP Opus RMA courses http://bit.ly/2E5aSKs (Appendix A) NZIHT: http://bit.ly/2NwThKy Engineering NZ RMA course http://bit.ly/2E5n7X6 NZ Planning Institute prospectus Auckland Council and other councils Dr Bruce P Hooper, International Water Policy Adviser and Author and governance adviser How to prepare an AEE (Clare Feeney can donate the materials for a 1-day workshop paid for by the legacy Auckland Regional Council) 	

2.2 Monitoring and evaluation Part 1: How to define desired outcomes and indicators across the four wellbeings					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> outcome monitoring frameworks that work for complex ecosystems capturing different data e.g. receiving environment objectives, amenity, walkability defining and measuring levels of service from green and grey infrastructure refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> it is difficult to address the problem of attribution and contribution of management interventions and monitored change in the ecosystems and communities of concern many other benefits are not captured 	<ul style="list-style-type: none"> it's seen as "just too hard", especially in cultures fearful of adaptive management monitoring and evaluation is traditionally very underfunded lack of data on cost-effectiveness of interventions 	<ul style="list-style-type: none"> agencies that require wellbeing outcomes of completed works and companies reporting on these councils, MfE and other environmental reporting agencies including policy planners and environmental managers 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> overview 	Education: University <ul style="list-style-type: none"> planning, biological sciences, civil engineering, geography, public policy 	Professional training <ul style="list-style-type: none"> how to write a good plan as per the PUCM research using the Orders of Outcomes Framework (see Toolkit 8) 	Other support <ul style="list-style-type: none"> Quality Planning website good statutory analyses as described in 2.1 above to enable cost-effective monitoring 	
Providers	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> 8 universities across NZ: how to develop new specialist content 	<ul style="list-style-type: none"> Beat Huser, Environment Waikato Annette Lees and Susie Wood Jan Crawford NZ Planning Institute prospectus 		

2.3 WSD Part 1: Water sensitive/green/low impact design overview and principles					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> overview principles the transition from the “drained” to the “regenerative” city (based on the CRC model and adding the Regenesis approach) introduction to “how to” design case studies that address the four wellbeings refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> WSD practitioners, stormwater engineers included, tend to pay more attention to devices rather than design that delivers on all four wellbeings lack of tracking of multiple wellbeing outcomes from WSD measures 	<ul style="list-style-type: none"> WSD still seen less than mainstream lack of political will / social licence, plus competing mandates (Table 1.1) there are many case studies but they do not appear to be persuasive: what's missing? 	<ul style="list-style-type: none"> multidisciplinary stormwater and related professionals construction and maintenance contractors 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> short course for construction and maintenance contractors and landscapers 	Education: University <ul style="list-style-type: none"> planning, architecture, biological sciences, civil engineering, geography 	Professional training <ul style="list-style-type: none"> principles case studies Auckland Council, based on GD04: Water Sensitive Design Guide and Christchurch City Council Waterways, Wetlands and Drainage Design Guide 	Other support <ul style="list-style-type: none"> more emphasis on multi-disciplinary design and construction teams New Zealand Fish Passage Guidelines 	
Providers	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Masters courses at Canterbury & Auckland Universities 	<ul style="list-style-type: none"> Allan Leahy ENZ courses MfE, based on new WSD principles Jamie Comley WSD course NZ Planning Institute prospectus specialists in other disciplines CRC trainers 		

2.4 Risk and resilience, including climate change effects, mitigation and adaptation					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> risk assessment, climate change modelling, influence on WSD best practice sustainability and resilience in stormwater design adaptive, systems approach: how and when to adapt existing (legacy) stormwater systems to a changing big picture and why it's important climate change and ongoing development pressures standardisation of practices refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> lack of credible and consistent / standardised guidance for councils lack of political will / social licence (Table 1.1) developer aversion ratepayer revolt 	<ul style="list-style-type: none"> increasing delays and costs of plan changes reduce ability to adapt in a timely way infrastructure is undersized and out of date the day its built ever-increasing insurance costs lead to insurers becoming de facto land use planners 	<ul style="list-style-type: none"> stormwater professionals land use planners insurance council LGNZ / SOLGM RMLA MfE Treasury 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> overview 	Education: University <ul style="list-style-type: none"> planning, civil engineering, geography, public policy 	Professional training <ul style="list-style-type: none"> full workshops and ongoing technical and legal updates 	Other support <ul style="list-style-type: none"> http://www.mfe.govt.nz/climate-change/what-government-doing/climate-change-programme http://www.mfe.govt.nz/climate-change/technical-guidance/guidance-local-government-preparing-climate-change http://www.lgnz.co.nz/our-work/our-policy-priorities/2-risk-and-resilience/ MBIE's Just Transition Hub 	
Providers	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Universities CRIs (Niwa) 	<ul style="list-style-type: none"> NZ Planning Institute prospectus Niwa 		

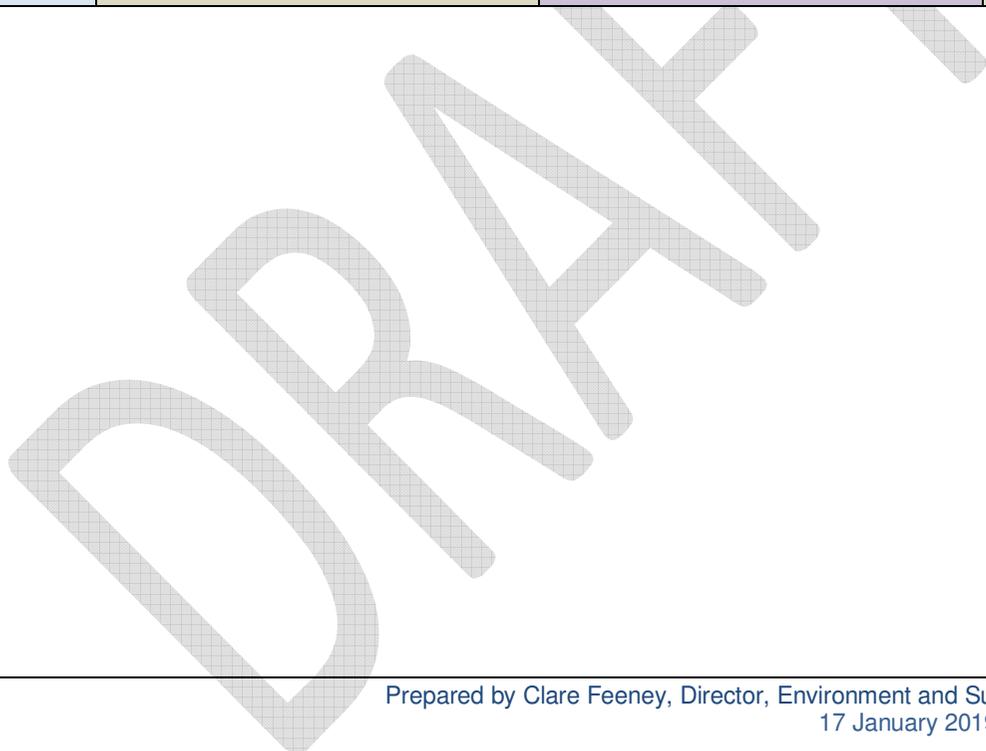
2.5 Wellbeings Part 2: costs and benefits of WSD and its alternatives					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> knowledge of WSD benefits across the four wellbeings (social, cultural, environmental, economic) cost/benefits for water sensitive design over conventional infrastructure cost of unintended consequences e.g. private assets vested in council life span/lifecycle costs/savings of assets (planning, design, construction, handover, operational delivery (monitoring, maintenance), disposal (cradle to cradle) understanding optimal whole of life asset solutions, options analysis and cost/benefit realisations how to track data to contribute to cost/benefit assessments & case studies refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> upfront costs are borne by the developer and the council but benefits are socialised across many other agencies over time (e.g. mental and physical health, carbon reduction etc)⁷ 	<ul style="list-style-type: none"> WSD stacks up as being “too expensive” because externalised costs of conventional design are not counted and neither are the externalised benefits of WSD 	<ul style="list-style-type: none"> stormwater professionals developers land use planners MfE 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> overview 	Education: University <ul style="list-style-type: none"> planning, civil engineering, geography, economics, ecological economics, public policy 	Professional training <ul style="list-style-type: none"> full workshops 	Other support <ul style="list-style-type: none"> NZTA Economic Evaluation Manual Statistics New Zealand and Treasury wellbeing indicators https://treasury.govt.nz/information-and-services/nz-economy/living-standards ongoing technical and legal updates 	
Providers	<ul style="list-style-type: none"> NZIHT 	<ul style="list-style-type: none"> Universities CRIs (Manaaki Whenua Landcare Research) 	<ul style="list-style-type: none"> Activating WSUD Aotearoa: Chris Batstone and Sue Ira NAMS 		

Table 3 Needs assessment for specialist catchment management skills

3.1 Catchment management planning					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> how to write an ICMP so its implementation & outcomes can be monitored how to measure 'state and trends' performance related to stormwater influenced catchments (hydrology and water quality, i.e. is your stormwater management getting better or worse?) how services fit into the overall networks and systems that make up a community refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> the level of skills for writing plans in New Zealand is low – see Auditor-General reports on local government and waste management plans + PUCM research (Clare has access to this) complexity of the policy framework – too many policies, plans, rules and strategies silos/lack of multi- and trans-disciplinary teams underfunding of development of ICMPs because their vital importance is under-rated 	<ul style="list-style-type: none"> implementation and outcomes of ICMPs are not tracked lack of data on cost-effectiveness of interventions ICMPs lose status as useful management tools 	<ul style="list-style-type: none"> stormwater professionals land use planners landscape architects other professionals MfE 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO	Education: University	Professional training	Other support	
	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> planning course in plan-making 	<ul style="list-style-type: none"> how to write a good ICMP as per the PUCM research 	<ul style="list-style-type: none"> PUCM research Quality Planning website Ecosystem-based management: markers for assessing progress⁸ and other reports by Prof Stephen Olsen Statistics New Zealand and Treasury wellbeing indicators https://treasury.govt.nz/information-and-services/nz-economy/living-standards 	
Providers		Universities of Canterbury and Auckland	<ul style="list-style-type: none"> Beat Huser, Environment Waikato Annette Lees and Susie Wood Jan Crawford Zeb Worth & Clare Feeney NZ Planning Institute prospectus 		

3.2 Ecology Part 1: Ecological, cultural, social analyses					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> ecological aspects, terrestrial and aquatic water quality and habitat assessment including SEV, MCI, shmak/iwi shmak, cultural health indices and riparian assessments landscape architecture, amenity archaeology community refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> lack of skills for understanding and engaging on iwi and community values 	<ul style="list-style-type: none"> lack of iwi and community “buy-in” with the catchment management process 	<ul style="list-style-type: none"> stormwater professionals utilities MfE 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO N/A	Education: University <ul style="list-style-type: none"> Biology, Māori studies, archaeology 	Professional training <ul style="list-style-type: none"> best practice asset management 	Other support <ul style="list-style-type: none"> 	
Providers	N/A	<ul style="list-style-type: none"> some universities? NIWA 	<ul style="list-style-type: none"> Gail Tipa, IWI Shmak Russell Foster, archaeologist 		

3.3 Asset planning and management					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> green and asset management planning, with old conventional + new WSUD/LID + hybrid stormwater infrastructure knowledge of extreme events, network response and how systems cope beyond the nominated LOS how services fit into the overall networks and systems that make up a community refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> silos/lack of multi- and trans-disciplinary teams underfunding of “green” asset management 	<ul style="list-style-type: none"> replacement of green infrastructure with grey due to larger capex than opex budgets 	<ul style="list-style-type: none"> stormwater professionals utilities MfE 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO	Education: University	Professional training	Other support	
	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> best practice asset management 	<ul style="list-style-type: none"> ISCA 	
Providers			<ul style="list-style-type: none"> NAMS Software providers? NZ Planning Institute prospectus 	<ul style="list-style-type: none"> Statistics New Zealand and Treasury wellbeing indicators http://www.lgnz.co.nz/our-work/our-policy-priorities/1-infrastructure/ 	



3.4 Hydrology, including flooding and hydrological modelling					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> knowledge of extreme events, network response and how systems cope beyond the nominated LOS hydrological modelling and analysis techniques, including flooding 		<ul style="list-style-type: none"> Lack of understanding of how to translate theoretical principles into practical application between tertiary and education and practitioner fast-changing, high training-need and comparatively expensive modelling systems re-inventing of the wheel around the country 	<ul style="list-style-type: none"> estimates not accurate/conservative enough green and grey infrastructure not properly sized (under- or over-sized) different performance standards around the country 	<ul style="list-style-type: none"> stormwater professionals modelers software suppliers 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO	Education: University	Professional training	Other support	
	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> masters courses in modeling 	<ul style="list-style-type: none"> workshops on NZ Rainfall Runoff Guidelines workshops on hydraulic modelling software (ICM, MIKE, Tuflow, HEC RAS, XP, SWMM etc) 		
Providers	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Universities of Canterbury and Auckland CRI's (NIWA) 	<ul style="list-style-type: none"> Engineering New Zealand software providers NAMS NZ Planning Institute prospectus Continuing Professional Development online courses 'Stormwater and Groundwater – Development Effects (Parts 1 and 2) 		

3.5 Hydraulics, including hydraulic modeling					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> hydraulic modelling and analysis techniques 		<ul style="list-style-type: none"> Lack of understanding of how to translate theoretical principles into practical application between tertiary and education and practitioner fast-changing, high training-need and comparatively expensive modelling systems re-inventing of the wheel around the country 	<ul style="list-style-type: none"> Poor understanding of performance of existing systems leading to over or under investment. Inappropriately sized infrastructure. 	<ul style="list-style-type: none"> stormwater professionals modelers software suppliers 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO N/A	Education: University <ul style="list-style-type: none"> masters course in modeling 	Professional training <ul style="list-style-type: none"> workshops on NZ Rainfall Runoff Guidelines workshops on hydraulic modelling software (MIKE Urban, Tuflow, HEC RAS, XP, SWMM, Civil 3D; 1D/2D modeling etc) 	Other support <ul style="list-style-type: none"> http://www.lgnz.co.nz/our-work/our-policy-priorities/1-infrastructure/ 	
Providers	N/A	<ul style="list-style-type: none"> Universities of Canterbury and Auckland CRIs (Niwa) 	<ul style="list-style-type: none"> Engineering New Zealand software providers NAMS 		

Table 4 Needs assessment for specialist design skills

4.1 WSUD Part 2: detailed design					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> site characterisation as per 3.2 above site design: how to design a WSD development/best practice in stormwater water quantity and quality devices: how to design WSD treatment trains and devices fish passage balancing multiple requirements e.g. emissions reduction with hydrological neutrality, walkability, amenity and more refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> lack of consistent guidance complexity of the policy framework – too many policies, plans, rules and strategies silos/lack of multi- and trans-disciplinary teams underfunding of development of ICMPs because their vital importance is under-rated 	<ul style="list-style-type: none"> implementation and outcomes of ICMPs are not tracked lack of data on cost-effectiveness of interventions ICMPs lose status as useful management tools 	<ul style="list-style-type: none"> stormwater professionals surveyors land use planners urban planners and designers landscape architects ecologists architects other professionals MfE 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> Overview 	Education: University <ul style="list-style-type: none"> Planning, engineering 	Professional training <ul style="list-style-type: none"> Possibly a series of detailed topic-specific workshops with some core content and local specificity 	Other support <ul style="list-style-type: none"> NZS 4404:2010 Land development and subdivision infrastructure, including design and LID New Zealand Fish Passage Guidelines MfE water sensitive design principles Activating WSUD research Statistics New Zealand and Treasury wellbeing indicators 	
Providers	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Schools of Engineering at Canterbury and Auckland Auckland University, Masters of Urban Planning Auckland University, Masters of Urban Design 	<ul style="list-style-type: none"> Jamie Comley, ClearWater Allan Leahy, Stantec Marjorie van Roon, Auckland University Activating WSUD research team Auckland Council, based on GD01: Stormwater Management Devices Guide Christchurch City Council Waterways, Wetlands and Drainage Design Guide NZ Planning Institute prospectus 		

4.2 Wellbeings Part 3: BPO/multi-criteria analysis					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> BPO/multi-criteria analysis across the four wellbeings 		<ul style="list-style-type: none"> lack of consistent use of MCA across the four wellbeings ratings skewed towards economic costs and savings 	<ul style="list-style-type: none"> failure to adequately value, protect and enhance social, cultural and environmental aspects of sites and their context 	<ul style="list-style-type: none"> stormwater professionals land use planners other professionals 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> 	Education: University <ul style="list-style-type: none"> 	Professional training <ul style="list-style-type: none"> 	Other support <ul style="list-style-type: none"> Statistics New Zealand and Treasury wellbeing indicators 	
Providers	<ul style="list-style-type: none"> NZIHT Economic Evaluations for Infrastructure Works 	<ul style="list-style-type: none"> Universities of Canterbury and Auckland 	<ul style="list-style-type: none"> NAMS Dr David Kettle 		

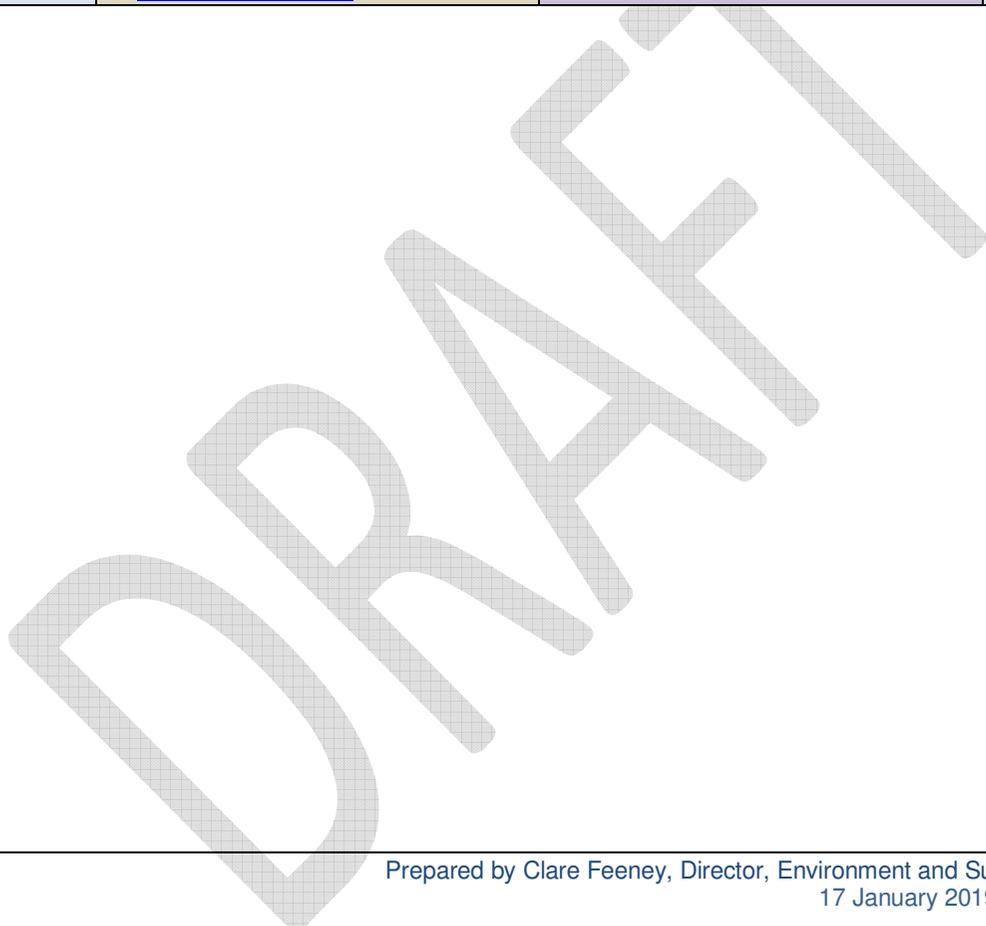
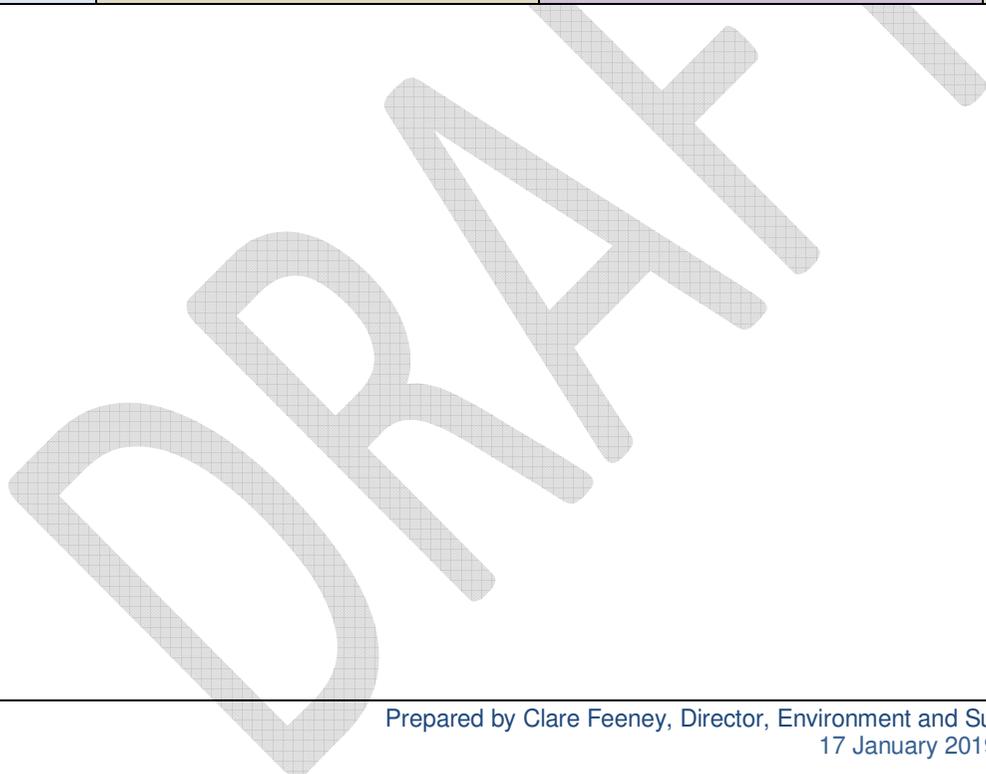


Table 5 Needs assessment for specialist construction skills

5.1 WSUD Part 3: Construction					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> • how WSUD infrastructure and devices operate • fit-for-purpose construction of structural WSUD controls • supervision/inspection and checklists – what “good” looks like, common errors to look for • refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> • lack of training and supervision of constructors • lack of timely audits by suitably qualified and experienced WSUD professionals • pressure on time and budgets 	<ul style="list-style-type: none"> • devices don't function as intended • WSUD seen as expensive and ineffective • risk aversion by developers, designers and councils • cynicism/disillusionment of constructors 	<ul style="list-style-type: none"> • stormwater professionals • contractors • developers • organisations calling for and responding to tenders (proper pricing of construction) • utilities 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> • Purpose and proper installation of devices 	Education: University <ul style="list-style-type: none"> • Schools of Engineering and Landscape Architecture 	Professional training <ul style="list-style-type: none"> • Possibly a series of detailed topic-specific workshops with some core content and local specificity 	Other support <ul style="list-style-type: none"> • Activating WSUD research • CRC • Melbourne Water, CRC for Water Sensitive Cities and Manningham Council (2018) ZAM-WSUD Handbook: Zero Additional Maintenance Water Sensitive Urban Design without ongoing maintenance requirements for asset owners. Updated versions of the handbook will be available online via the Clearwater website: www.clearwater.asn.au/resource-library/publications-and-reports/zero-additional-maintenance-water-sensitive-urban-design-zam-wsud-handbook.php • NGICP 	
Providers	<ul style="list-style-type: none"> • NZIHT New Zealand Certificate in Infrastructure Works (Level 2) • Connexis? • Unitec 	<ul style="list-style-type: none"> • Auckland and Canterbury Universities 	<ul style="list-style-type: none"> • International Green Infrastructure Certification Programme (IGICP), Auckland Council/WSP • Jamie Comley, ClearWater • Peter Mitchell AMA • Activating WSUD research team • Auckland Council, based on GD04: Water Sensitive Design Guide • Christchurch City Council Waterways, Wetlands and Drainage Design Guide • Peter Christensen and other councils • NAMS 		

5.2 Ecology Part 2: Protection, capture and/or relocation of sensitive terrestrial and aquatic species					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> • protection, capture and/or relocation of sensitive terrestrial and aquatic species • whitebait spawning platforms • refer to Table 1.4 for detailed needs 		<ul style="list-style-type: none"> • pressure on time and budgets 	<ul style="list-style-type: none"> • missed opportunities for more diverse or restorative/regenerative ecosystems 	<ul style="list-style-type: none"> • stormwater professionals • contractors • developers • organisations calling for and responding to tenders (proper pricing of construction) • utilities 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> • overview 	Education: University <ul style="list-style-type: none"> • Engineering, Biology 	Professional training <ul style="list-style-type: none"> • Possibly a series of detailed topic-specific workshops with some core content and local specificity 	Other support <ul style="list-style-type: none"> • Activating WSUD research 	
Providers	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Auckland and Canterbury Universities • Niwa 	<ul style="list-style-type: none"> • Activating WSUD research team • Christchurch City Council Waterways, Wetlands and Drainage Design Guide 		



5.3 Sensitive methodologies: erosion and sediment control					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> erosion and sediment control on large (horizontal construction) sites erosion and sediment control plus control of other pollutants (e.g. concrete, paint, solid waste) on small (vertical construction) sites 		<ul style="list-style-type: none"> large sites more or less consistently managed across New Zealand small sites an issue largely due to huge numbers and language issues service provision and auditing model for erosion and sediment control on large sites not paralleled by that for small sites gap between issuing building consents & requiring erosion & sediment control 	<ul style="list-style-type: none"> contractors required to stabilise sites before s224 handover information and regulation not fully in place for builders enforcement used as a first resort on small sites (not fair) volumes of uncontrolled sediment runoff from multiple small sites adds up to about the same as is controlled from large sites⁹ WSUD devices damaged by sediment at the very start of their working life 	<ul style="list-style-type: none"> stormwater professionals contractors utilities/built asset managers organisations calling for and responding to tenders (proper pricing of construction) 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO	Education: University	Professional training	Other support	
	<ul style="list-style-type: none"> erosion and sediment control on small sites 	<ul style="list-style-type: none"> Schools of Engineering 	<ul style="list-style-type: none"> Large sites: 1-day workshops for contractors and council staff 2-day workshops for consultants, planners and council staff 		
Providers	<ul style="list-style-type: none"> BCITO, Connexis and related organisations such as Master Builders, Construction Industry Council and more 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> small sites: Graham Jones, Auckland Council; Nathan Dougherty at Ecan; Radleigh Cairns at Tauranga City Council and others large sites: Auckland Council, based on GD05: Earthwork erosion and sediment control plus regional erosion and sediment control guidelines and national NZTA guideline Peter Christensen and other councils 	<ul style="list-style-type: none"> Compliance officers conference Beca report for Auckland Council¹⁰ Digger Dunlop model for small site service providers regionally-specific large and small site erosion and sediment control guidelines across New Zealand 	

Table 6 Needs assessment for specialist establishment skills

6.1 Establishment: ecological and amenity aspects					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> establishment and care of plantings, weeding, replacement control of sediment and other pollutants 		<ul style="list-style-type: none"> lack of training and supervision of landscape designer, gardeners and plant maintenance crews lack of timely audits by suitably qualified and experienced professionals pressure on time and budgets 	<ul style="list-style-type: none"> plantings fail and devices don't function as intended WSUD seen as expensive and ineffective risk aversion by developers, designers and councils cynicism/disillusionment of communities 	<ul style="list-style-type: none"> stormwater professionals contractors developers organisations calling for and responding to tenders (proper pricing of construction) utilities 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> Purpose and proper installation of devices 	Education: University <ul style="list-style-type: none"> Unitec 	Professional training <ul style="list-style-type: none"> Possibly a series of detailed topic-specific workshops with some core content and local specificity 	Other support <ul style="list-style-type: none"> Activating WSUD research NGICP 	
Providers			<ul style="list-style-type: none"> Christchurch City Council Waterways, Wetlands and Drainage Design Guide Peter Christensen and other councils Boffa Miskell Wildlands 		

6.2 Ecological re-establishment					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> • introduction/reintroduction of terrestrial and aquatic fauna • interpretation of ecological, amenity and other human health benefits 		<ul style="list-style-type: none"> • pressure on time and budgets 	<ul style="list-style-type: none"> • missed opportunities for biodiversity • cynicism/disillusionment of communities 	<ul style="list-style-type: none"> • stormwater professionals • contractors • developers • organisations calling for and responding to tenders (proper pricing of construction) • utilities 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO	Education: University	Professional training	Other support	
	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • capture and release • fish passage • stream daylighting 	<ul style="list-style-type: none"> • Activating WSUD research • MfE riparian guidelines 	
Providers	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Robyn Simcock, Manaaki Whenua • Tim Lovegrove, Auckland Council • Kaipatiki Project 8-week course on Hands-on Ecology 		

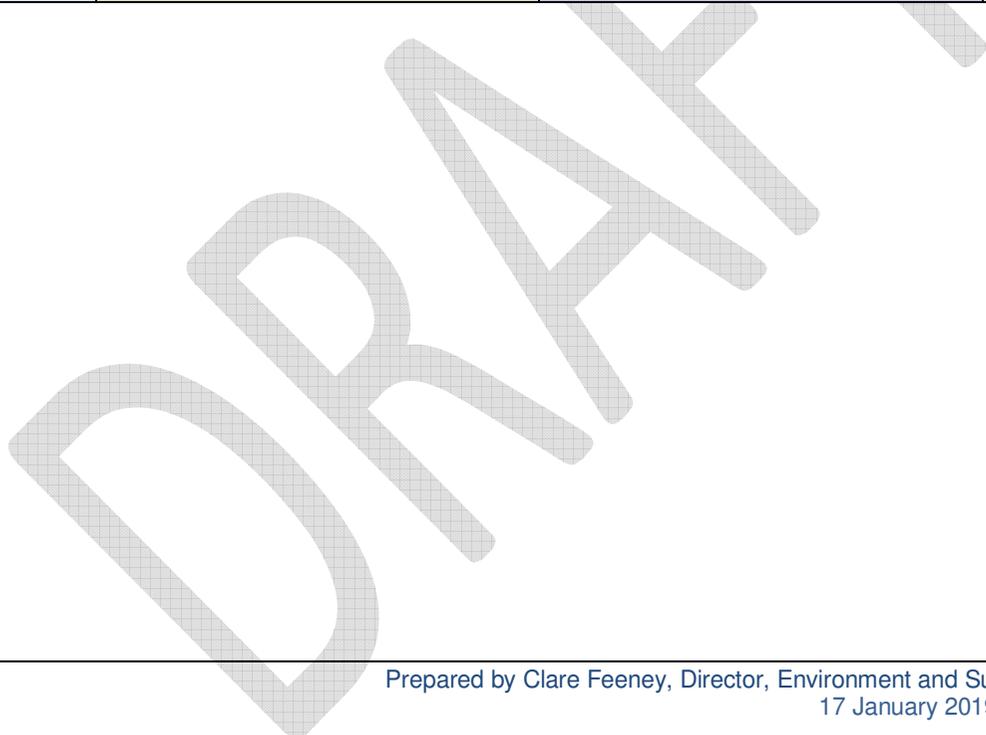


Table 7 Needs assessment for specialist handover skills

7.1 Legal aspects Part 1: decommissioning of subdivision-scale temporary environmental controls					
Needs		Underlying causes of performance gap		Flow-on results of the performance gap	Target audiences
<ul style="list-style-type: none"> decommissioning of subdivision-scale erosion and sediment controls and final stabilisation before/during s224 signoff is a vulnerable point where adverse environmental effects can occur, especially from sediment arrangements and communication between the client, consultant, contractor and council cost recovery e.g. bonds and more inspection, repairs and cost recovery Practical Completion and Defects Liability period prior to official asset handover Checklists, expanding on Appendix B in GD01, would be useful. Perhaps based on the content of the Activating WSUD programme 		<ul style="list-style-type: none"> technical difficulties with the last set of erosion and sediment controls e.g. catchpit protection, grassing etc lack of timely audits by suitably qualified and experienced WSUD professionals pressure on time and budgets 		<ul style="list-style-type: none"> large site erosion and sediment controls may be decommissioned too early or left in place for too long assets handed over to councils or developers may be impaired by sediment 	<ul style="list-style-type: none"> stormwater professionals contractors developers organisations calling for and responding to tenders (proper pricing of construction) utilities council consenting and inspection staff
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> erosion and sediment control training 	Education: University <ul style="list-style-type: none"> Schools of Engineering and Planning 	Professional training <ul style="list-style-type: none"> detailed topic-specific workshop with some core content and some local specificity 	Other support <ul style="list-style-type: none"> Activating WSUD research CRC Portland and others 	
Providers		<ul style="list-style-type: none"> Schools of landscape design e.g. Unitec 	<ul style="list-style-type: none"> IECA Jamie Conley at Clearwater in Melbourne Activating WSUD research team Trainers on council erosion and sediment control guidelines 		

Notes:

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7.2 Legal aspects Part 2: handover hold points					
Needs		Underlying causes of performance gap		Flow-on results of the performance gap	Target audiences
<ul style="list-style-type: none"> • construction hold points help to ensure WSUD assets are constructed as designed and fully-functional to accept at handover. Hold points are defined as the key points in time where work must cease until all tasks have been checked, completed, approved and signed off by all parties, e.g. the handover point at s224 • verification of asset condition • making good if needed • cost-recovery • updating asset registers 		<ul style="list-style-type: none"> • lack of timely audits by suitably qualified and experienced WSUD professionals and development engineers • pressure on time and budgets 		<ul style="list-style-type: none"> • assets handed over to councils or developers may be impaired by defective design or construction that are expensive to remedy 	<ul style="list-style-type: none"> • council staff especially development engineers • stormwater professionals • contractors • developers • organisations calling for and responding to tenders (proper pricing of construction) • utilities • council consenting staff
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> • costs of faulty infrastructure • avoiding, detecting and remedying defects 	Education: University <ul style="list-style-type: none"> • Schools of Engineering, Planning and economics 	Professional training <ul style="list-style-type: none"> • detailed topic-specific workshop with some core content and some local specificity 	Other support <ul style="list-style-type: none"> • Activating WSUD research • NGICP • Portland and others 	
Providers	<ul style="list-style-type: none"> • Connexis 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Scott Speed/Peter Brooks and Development Engineers, Auckland Council • Clearwater in Melbourne • Activating WSUD research team • Council codes of practice • NZIHT 	<ul style="list-style-type: none"> • Infrastructure New Zealand https://infrastructure.org.nz/ • NGICP 	

7.3 Legal aspects Part 3: small site-scale environmental controls					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> environmental controls on small site development: an integrated approach to erosion & sediment control, prevention of concrete/paint and other water/soil pollution, solid waste minimisation etc titles, sales, green infrastructure covenants/LIMs building consents with environmental conditions e.g. WSUD designs and devices on private sites 		<ul style="list-style-type: none"> lack of coordination between environmental and building consents and other gaps and barriers identified in the 2016 Beca report¹¹ lack of service providers to ease the burden on builders lack of timely audits by suitably qualified and experienced professionals pressure on time and budgets and the pace of build at a time of housing deficit 	<ul style="list-style-type: none"> costs of damage to green and grey infrastructure water and soil pollution high carbon costs and demand on landfill/cleanfill space by lack of waste minimisation-focused procurement, reuse and recycling of building materials 	<ul style="list-style-type: none"> developers builders council consenting and compliance staff other actors identified in the Beca report 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> environmental controls on building sites 	Education: University <ul style="list-style-type: none"> Schools of Geography and Resource Management 	Professional training <ul style="list-style-type: none"> detailed topic-specific workshop with some core content and some local specificity 	Other support <ul style="list-style-type: none"> KiwiBuild, HLC and other housing providers and industry suppliers actors identified in the Beca report 	
Providers	<ul style="list-style-type: none"> BCITO 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> IECA Urban pollution control specialists BRANZ resource efficiency in the building and related industries (REBRI) programme NZIHT pollution control course Waste Management Institute of New Zealand (wasteMINZ) 		

Table 8 Needs assessment for specialist green and grey asset operation skills

8.1 Green and grey asset operation with respect to desired levels of service					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> operational requirements for green and grey infrastructure on public and private land to meet desired levels of service across the four wellbeings inspection of green infrastructure on public and private land: what to look for and what to do about it keeping records review for learnings/continual improvement/adaptive management 		<ul style="list-style-type: none"> more difficult to get good opex budgets compared with capex funding difficult to estimate and maintain levels of service provided by green assets lack of WSUD design for ease of operating the system lack of consistent approach and training for green asset inspectors lack of training in WSUD asset management generally general lack of a culture of learning and adaptive management 	<ul style="list-style-type: none"> operating costs hard to separate from maintenance costs unknown sensitivity of overall infrastructure performance to the proportion of WSUD vs conventional stormwater infrastructure green infrastructure on private land allowed to decay or be removed, reinforcing the view that it's an "expensive optional extra" 	<ul style="list-style-type: none"> stormwater professionals developers contractors utilities/built asset managers council consenting and compliance staff 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> operation, inspection and maintenance of WSUD and conventional stormwater infrastructure 	Education: University <ul style="list-style-type: none"> 	Professional training <ul style="list-style-type: none"> defining LoS across the 4 wellbeings interactive GIS-based asset management 	Other support <ul style="list-style-type: none"> Infrastructure New Zealand https://infrastructure.org.nz/ <u>ZAM-WSUD Handbook: Zero Additional Maintenance Water Sensitive Urban Design without ongoing maintenance requirements for asset owners</u> www.clearwater.asn.au/resource-library/publications-and-reports/zero-additional-maintenance-water-sensitive-urban-design-zam-wsud-handbook.php ISCA NGICP 	
Providers	<ul style="list-style-type: none"> BCITO, Connexis and NZIHT Unitec school of landscape architecture 	<ul style="list-style-type: none"> schools of engineering, biological sciences 	<ul style="list-style-type: none"> NGICP Peter Mitchell, Stormwater Asset Manager, Auckland Motorways Alliance Kieran Daji, Auckland Council NAMS Infrastructure Management Manual and others here Clearwater asset management training WSP Opus 		

Note to Tables 8: Guidelines of interest (see also the 2016 Canterbury Regional Stormwater Forum Technical Design and Best Practice Working Group, [Canterbury Stormwater Best Practice Gap Analysis^{12\)}](#))

Source: Email of Monday 17 September 2018 from Troy Brockbank to Andy Ericksen

New Zealand does not have an overarching operations and maintenance guideline for stormwater management devices in NZ, but there are a few (design) guideline documents that individual regulatory authorities have produced, some with more information about operations and maintenance:

1. Waikato Regional Council TR2018/01: Waikato Stormwater Guideline (2018) <https://www.waikatoregion.govt.nz/services/publications/technical-reports/2018-technical-reports/tr201801/>
2. Auckland Council GD01: Stormwater Management Device Guide (2017) http://content.aucklanddesignmanual.co.nz/project-type/infrastructure/technical-guidance/stormwatermanagement/Documents/GD01_SWMD.pdf
3. Auckland Council Operation and maintenance guides (circa 2015) Attached for Wetlands, Ponds, Swales, Raingardens, Permeable Pavers, Treepits etc
4. New Zealand Transport Agency (NZTA) Stormwater Treatment Standard for State Highway Infrastructure (May 2010) <https://www.nzta.govt.nz/assets/resources/stormwater-management/docs/201005-nzta-stormwater-standard.pdf>
5. New Zealand Transport Agency (NZTA) Sediment Accumulation Monitoring Techniques (Nov 2010) <https://www.nzta.govt.nz/assets/resources/stormwater-management/docs/ama-sediment-measurement-final-report-2010.pdf>
6. OPUS Barrys Point Stormwater Pond Operation and Maintenance Manual (2007) <https://1drv.ms/b/s!Ao1e2XXolt6YmmSQcNhxHpMPReeZ>
7. OPUS Esmonde Rd Interchange SW Ponds O&M Manual (2007) <https://1drv.ms/b/s!Ao1e2XXolt6YmmX7YQopDlcPHoyq>

The last two are operation and maintenance guidelines for some stormwater ponds constructed in 2007.

See also the NSW Guidelines For Maintenance Of Stormwater Treatment Measures (DRAFT) <http://stormwater.nsw.asn.au/nsw-guidelines-maintenance-stormwater-treatment-measures-draft-launched-industry-feedback-welcomed/>.

8.2 Ongoing point source contaminant control					
Needs		Underlying causes of performance gap		Flow-on results of the performance gap	Target audiences
<ul style="list-style-type: none"> • pollution prevention for industrial premises • controlling road runoff • controlling point source zinc sources e.g. industrial/commercial zinc roofs • management of wet and dry-weather wastewater overflows 		<ul style="list-style-type: none"> • harder to get good opex budgets • lack of design for ease of maintenance • lack of consistent approach and training for asset inspectors • lack of training in stormwater BMP asset management generally • general lack of a culture of learning and adaptive management 		<ul style="list-style-type: none"> • high maintenance costs to ratepayers • poor infrastructure performance • poor infrastructure durability • poorly designed and vested assets create H&S risks (e.g. treatment devices located in the middle of T Junctions (not the worst case seen) • loss of trust in WSUD as an affordable and effective infrastructure solution 	<ul style="list-style-type: none"> • stormwater professionals • contractors • utilities/built asset managers • council consenting and compliance staff
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> • basic pollution prevention for industrial premises • dealing with wastewater overflows 	Education: University <ul style="list-style-type: none"> • geography 	Professional training <ul style="list-style-type: none"> • high risk industrial premises • road runoff • point source zinc control • device providers at conferences and roadshows 	Other support <ul style="list-style-type: none"> • Oregon industrial stormwater program and training • Washington Stormwater Center • legacy Auckland Regional Council EOP (Environmental Operating Plan) – Clare has a copy • URBAN POLLUTION CONTROL: - a proposal to develop a post-graduate qualification. FIRST DRAFT March 2000, Environment and Business Group Ltd (Clare has a copy) • wastewater overflows – unit standards and guidelines 	
Providers	<ul style="list-style-type: none"> • Connexis 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Campbell Sturrock's training program at ARC • NZIHT pollution control course • Nigel Mark-Brown has worked on minimising zinc in runoff from industrial areas • Peter Mitchell, Stormwater Asset Manager, Auckland Motorways Alliance for road runoff devices • WSUD research team 		

8.3 Ongoing diffuse source contaminant control					
Needs		Underlying causes of performance gap		Flow-on results of the performance gap	Target audiences
•		•		•	•
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	•	•	•	•	
Providers	•	•	•	•	

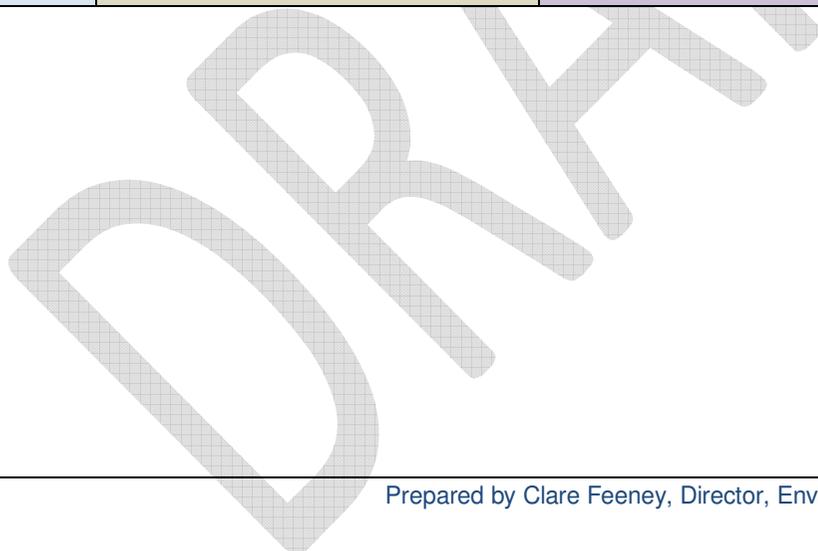
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Table 9 Needs assessment for specialist maintenance skills

NB Table C.9.1 is the only table where I feel I properly filled out the Solutions rows, so the other tables will need to be checked

9.1 Inspection: The art and science of inspecting green and grey assets on public and private land					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> inspection: what to look for and what to do about it for green infrastructure (including natural water bodies) and the interfaces between green and grey infrastructure the importance of keeping good records building an interactive GIS-based asset register review for learnings/continual improvement/adaptive management 		<ul style="list-style-type: none"> lack of consistent approach and training for asset inspectors lack of understanding of the synergies and gaps between green and grey infrastructure lack of training in stormwater BMP asset management generally communities don't understand green and grey asset life cycles 	<ul style="list-style-type: none"> inspectors don't know what to look for under-performance of the green assets investment in assets doesn't deliver the anticipated ROI across the four wellbeings communities are less likely to find what they misunderstand 	<ul style="list-style-type: none"> stormwater professionals developers consultants contractors utilities/built asset managers council consenting and compliance staff 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> inspection of WSUD and green/grey stormwater infrastructure 	Education: University <ul style="list-style-type: none"> lecture topic 	Professional training <ul style="list-style-type: none"> inspection of WSUD and mixed green/grey stormwater infrastructure 	Other support <ul style="list-style-type: none"> Infrastructure New Zealand https://infrastructure.org.nz/ ZAM WSUD Handbook: Zero Additional Maintenance Water Sensitive Urban Design without ongoing maintenance requirements for asset owners, CRC et al, 2018 ISCA NGICP 	
Providers	<ul style="list-style-type: none"> BCITO Connexis NZIHT Unitec (landscape architecture) 	<ul style="list-style-type: none"> schools of engineering, biological sciences at Auckland and Canterbury 	<ul style="list-style-type: none"> Peter Mitchell, Stormwater Asset Manager, Auckland Motorways Alliance NAMS Infrastructure Management Manual and others here NGICP Clearwater asset management training WSUD research team Peter Christensen and other councils 		

9.2 Proactive maintenance: planning, budgeting, implementing, documenting, learning					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> ecological vs financial vs built asset depreciation cycles practical tips for funding, delivering and documenting programmed maintenance of WSUD infrastructure the importance of keeping good records review for learnings/continual improvement/adaptive management 		<ul style="list-style-type: none"> harder to get good opex budgets lack of design for ease of maintenance lack of consistent approach and training for asset inspectors lack of training in stormwater BMP asset management generally general lack of a culture of learning and adaptive management 	<ul style="list-style-type: none"> high maintenance costs to ratepayers poor infrastructure performance poor infrastructure durability loss of trust in WSUD as an affordable and effective infrastructure solution 	<ul style="list-style-type: none"> stormwater professionals contractors utilities/built asset managers council consenting and compliance staff 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> maintenance of WSUD and mixed green/grey stormwater infrastructure 	Education: University <ul style="list-style-type: none"> lecture topic 	Professional training <ul style="list-style-type: none"> maintenance of WSUD and mixed green/grey stormwater infrastructure 	Other support <ul style="list-style-type: none"> Infrastructure New Zealand https://infrastructure.org.nz/ ISCA NGICP 	
Providers	<ul style="list-style-type: none"> BCITO Connexis NZIHT Unitec (landscape architecture) 	<ul style="list-style-type: none"> schools of engineering, biological sciences at Auckland and Canterbury 	<ul style="list-style-type: none"> Peter Mitchell, Stormwater Asset Manager, Auckland Motorways Alliance NAMS Infrastructure Management Manual and others here Clearwater asset management training WSUD research team 		



9.3 Reactive maintenance: budgeting, implementing, documenting, learning					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> practical tips for funding, delivering and documenting reactive / unprogrammed / emergency maintenance of WSUD infrastructure network rehabilitation/conversion to WSUD post flood cleanup the importance of keeping good records review for learnings/continual improvement/adaptive management 		<ul style="list-style-type: none"> harder to get good opex budgets lack of design for ease of maintenance lack of consistent approach and training for asset inspectors lack of training in stormwater BMP asset management generally general lack of a culture of learning and adaptive management 	<ul style="list-style-type: none"> underfunding leads to deferred but more expensive maintenance costs to ratepayers poor infrastructure performance poor infrastructure durability poorly designed and vested assets create H&S risks (e.g. treatment devices located in the middle of T Junctions (not the worst case seen) loss of trust in WSUD as an affordable and effective infrastructure solution 	<ul style="list-style-type: none"> stormwater professionals contractors utilities/built asset managers council consenting and compliance staff 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> unit on maintenance of WSUD and mixed green/grey stormwater infrastructure 	Education: University <ul style="list-style-type: none"> lecture topic on maintenance of WSUD and mixed green/grey stormwater infrastructure 	Professional training <ul style="list-style-type: none"> maintenance of WSUD and mixed green/grey stormwater infrastructure 	Other support <ul style="list-style-type: none"> Infrastructure New Zealand https://infrastructure.org.nz/ ISCA NGICP 	
Providers	<ul style="list-style-type: none"> BCITO Connexis NZIHT Unitec (landscape architecture) 	<ul style="list-style-type: none"> schools of engineering, biological sciences at Auckland and Canterbury 	<ul style="list-style-type: none"> Peter Mitchell, Stormwater Asset Manager, Auckland Motorways Alliance NAMS Infrastructure Management Manual and others here Clearwater asset management training WSUD research team Peter Christensen and other councils 		

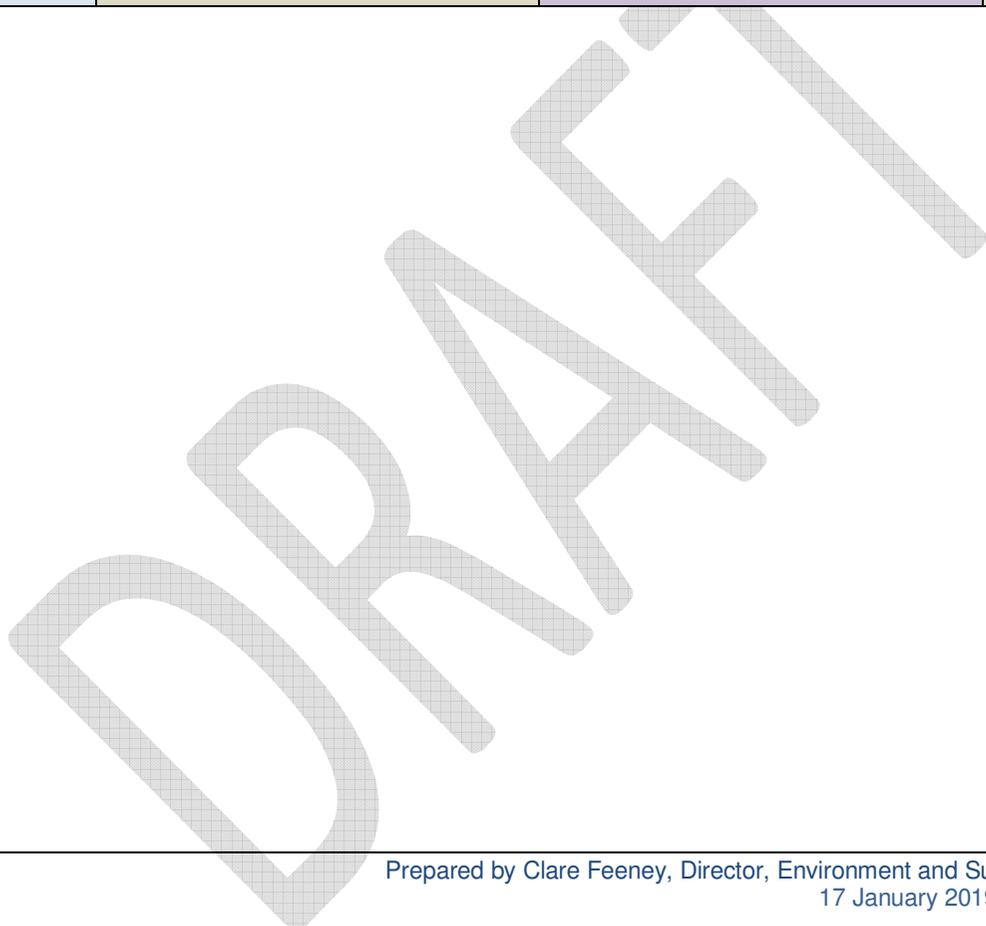
Table 10 Needs assessment for specialist monitoring and evaluation skills

10.1 How to measure the effectiveness of environmental training					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> understanding the importance of clear training needs assessment knowing how to frame learning outcomes with respect to desired changes in practice knowing how and when to work with the five globally accepted levels of evaluating the effectiveness of training as set out in Appendix C 		<ul style="list-style-type: none"> subject matter experts are not aware of the disciplines mastered by professional trainers, including evaluation lack of cross-fertilisation between environmental and other professional trainers 	<ul style="list-style-type: none"> the effectiveness of training is not fully assessed so depends on anecdotal evidence reluctance to fund training where the business case is not rigorously proven training sometimes not used as a solution when it could be very cost-effective 	<ul style="list-style-type: none"> agencies requiring training to be delivered, in-house or externally trainers delivering training 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> N/A due to unit standard and other assessments e.g. Civil Trades, micro-credentials 	Education: University <ul style="list-style-type: none"> N/A due to exam and other assessments 	Professional training <ul style="list-style-type: none"> agencies requiring and delivering training need to understand the importance of this knowledge 	Other support <ul style="list-style-type: none"> NGICP New Zealand Association of Training and Development (NZATD) 	
Providers	<ul style="list-style-type: none"> as above 	<ul style="list-style-type: none"> as above 	<ul style="list-style-type: none"> NGICP Clare Feeney and Beryl Oldham 		

10.2 The art and science of compliance inspection and monitoring					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> companies need to understand the technicalities and legalities of compliance monitoring with respect to your consents how to use compliance monitoring as a tool for organisational learning and development moderation of auditors how to lift productivity by going beyond compliance 		<ul style="list-style-type: none"> people see compliance monitoring and audits as a bureaucratic and punitive waste of time rather than an opportunity for learning and great business efficiency there is a reactive rather than proactive view and focus on lagging rather than leading indicators 	<ul style="list-style-type: none"> projects are slower and less productive as they react to compliance issues rather than picking them up through audits before they arise or get worse can lead on to polarised and unhelpful communication with clients, consultants, contractors and councils infrastructure and ecosystem integrity can suffer 	<ul style="list-style-type: none"> constructors in-house company auditors council compliance inspectors 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO Technical, communication and interpersonal skills on: <ul style="list-style-type: none"> how to be audited for environmental compliance how to carry out an environmental compliance inspection 	Education: University <ul style="list-style-type: none"> lecture 	Professional training <ul style="list-style-type: none"> workshops 	Other support <ul style="list-style-type: none"> NGICP MfE – also see new compliance, monitoring and enforcement guidelines Quality Planning website Auckland Council Internship Programme - Compliance Monitoring Compliance officers annual conference 	
Providers	<ul style="list-style-type: none"> as above 	<ul style="list-style-type: none"> planning and environmental management courses 	<ul style="list-style-type: none"> NGICP WSP Opus Karenza de Silva enviroKNOWLEGE Dunedin NZ Planning Institute prospectus 		

10.3 Wellbeings Part 4: How to measure the effectiveness of catchment and asset management plans across the four wellbeings					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> how to align the evaluation of water-sensitive training, planning, design, construction, operation and maintenance with each other and with the existing state and desired outcomes for aquatic receiving environments 		<ul style="list-style-type: none"> it is predominantly engineers who develop catchment and asset plans and they need training to do this catchment management plans are so large and multi-faceted and are so often overtaken by events that their implementation and outcomes are seldom documented it is hard to establish causation rather than correlation (the attribution / contribution problem) between actions on the ground and the expression of results in the complex aquatic ecosystems we are trying to manage 	<ul style="list-style-type: none"> we don't have robust evidence about what worked and what didn't, so the attribution and contribution of our effort towards identified outcomes can not be estimated with confidence we can't justify the investment we ask for (business case) and may not be learning about more cost-effective interventions 	<ul style="list-style-type: none"> all professionals around the development cycle, but especially those making plans and measuring indicators across the four wellbeings 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO	Education: University	Professional training	Other support	
	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> Short course 	<ul style="list-style-type: none"> how to monitor and evaluate plan outcomes as per the PUCM research 	<ul style="list-style-type: none"> good statutory analyses and plan making as described in 2.1, 2.2 and 3.1 above to enable cost-effective monitoring 	
Providers	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> planning and environmental management courses 	<ul style="list-style-type: none"> Beat Huser, Environment Waikato Annette Lees and Susie Wood Jan Crawford NZ Planning Institute prospectus 	<ul style="list-style-type: none"> Quality Planning website Ecosystem governance¹³ by Prof Stephen Olsen 	

10.4 Wellbeings Part 5: how to capture costs and benefits at all stages of the development cycle to contribute to cost/benefit assessments & case studies					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
<ul style="list-style-type: none"> how to gather enough data on the direct and indirect costs and benefits of WSUS compared with conventional stormwater management 		<ul style="list-style-type: none"> financial data isn't collected if it is collected, it is not collated at some central point 	<ul style="list-style-type: none"> we don't have robust evidence about to make the business case for WSUD compared with the BAU model 	<ul style="list-style-type: none"> all professionals around the development cycle, but especially those working with cost estimates and budgets in companies and councils 	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO <ul style="list-style-type: none"> N/A 	Education: University <ul style="list-style-type: none"> short course 	Professional training <ul style="list-style-type: none"> how to collect and interpret cost / benefit data 	Other support <ul style="list-style-type: none"> WSUD and LIUDD research findings central repository of data and active and interactive knowledge management 	
Providers	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> economics, engineering, geography 	<ul style="list-style-type: none"> Sue Ira Chris Batstone 		



10.5 The learning organisation: data-rich review, evaluation and learning for adaptive and creative management					
Needs		Underlying causes of performance gap	Flow-on results of the performance gap	Target audiences	
•		•	•	•	
Solutions (please also refer to the list of providers in Toolkits 13 and 14)					
Needs	Education: Polytech/ITO •	Education: University •	Professional training •	Other support Key references: • Peter Senge • Michael Porter	
Providers	•	•	•		

To be completed

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Toolkit 3 The ADDIE and SAM models for developing training

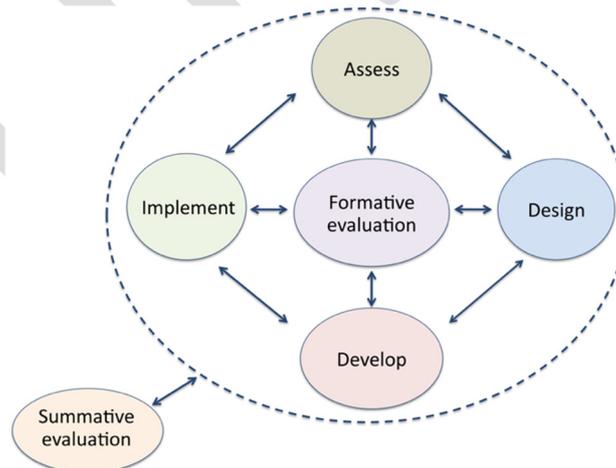
Working Groups can use this information to help them develop their training, using the model that best suits their needs and preferences.

ADDIE

This section overviews the most common instructional design model that is used all around the world: the ADDIE model. The ADDIE model is shown in **Figure 3.1**. Each phase generates an outcome that feeds into the next step in the sequence, as follows¹⁴:

- **assessment:** here the designer analyses the learning problem, the goals and objectives, the audience's needs, existing knowledge and other relevant characteristics, including the learning environment, any constraints, delivery options, and timeline for the project
- **design:** the design phase is a systematic process of specifying learning objectives and the look and feel, graphic design, user-interface and content
- **development:** this phase involves the actual creation (production) of the content and learning materials based on the design phase
- **implementation:** the plan is put into action and a procedure for training the trainer and trainees and supporting the trainees' managers is developed and the training is delivered
- **evaluation:** formative evaluation happens at all stages of the ADDIE process and should be carried out by stormwater subject matter experts working closely with a professional trainer with recognised credentials (more how to evaluate the effectiveness of training in **Section 8**). This stormwater education and training plan is a three-year plan, and the same people should conduct a summative evaluation at the end of that time.

Figure 3.1 The ADDIE model for instructional design



SAM: the successive approximation model

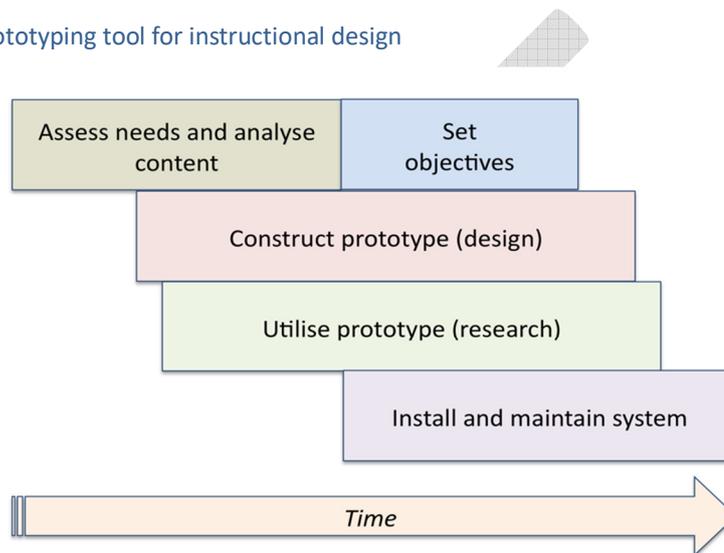
Rapid prototyping with continual feedback has emerged in response to e-learning needs as an adaptation of the generic ADDIE model.

Shown in **Figure 3.2**, SAM¹⁵, or the successive approximation model, is a development methodology that can also be applied to conventional training delivery methods.

It models the design, implementation and evaluation such that after a succinct statement of needs and objectives, research and development are conducted as parallel processes to create prototypes which are then tested and which may or may not evolve into a final product¹⁶.

One of its advantages is saving time.

Figure 3.2 The rapid prototyping tool for instructional design



Toolkit 4 Types of training needs assessment

From its 2016 and 2018 surveys, the Stormwater Education and Training Subgroup has obtained detailed training needs information from experienced practitioners, giving the Subgroup a good overview of the topics on which they consider training is needed and the numbers of people interested in each topic.

However for a good needs assessment, other filters are also required, and these are set out overleaf in **Table 4**.

The value of these layers of assessment is that they help distinguish between performance gaps that can be met by training and those that can not.

Working Groups developing the training can refer to the checklist overleaf to ensure an appropriate level of rigour in the training they produce.

Table 4 Types of needs assessment

Source Adapted from Barbazette, 2006¹⁷, Allan, 2009¹⁸ and World Bank¹⁹

Type of needs assessment	Questions the assessment answers
Performance analysis or gap analysis	<ul style="list-style-type: none"> <input type="checkbox"/> Can we define the performance gap in terms of “what is” vs “what should be”; that is, measurable current vs desired practice and the difference between them? <input type="checkbox"/> How can the performance gap be addressed? <input type="checkbox"/> Is training the most appropriate way to fix this gap?
Feasibility analysis	<ul style="list-style-type: none"> <input type="checkbox"/> How do the costs and benefits of this training stack up, in its own right, and compared with other training needs? <input type="checkbox"/> Is the benefit of the training greater than the cost of the current performance gap?
Needs vs Wants analysis	<ul style="list-style-type: none"> <input type="checkbox"/> Why should the training be done? <input type="checkbox"/> Is the training a need or a want? <input type="checkbox"/> Are we investing our scarce training dollars in high relevance, high impact programs?
Competency / objectives analysis	<ul style="list-style-type: none"> <input type="checkbox"/> What is the specific change in practice that is needed? <input type="checkbox"/> Can it be objectively described for the benefit of the trainer and trainee? <input type="checkbox"/> Can the desired practice and its outcomes be observed by an independent third party?
Job/task analysis	<ul style="list-style-type: none"> <input type="checkbox"/> What is the best way to carry out this practice or process? <input type="checkbox"/> How can the desired practice or process be broken down into trainable parts?
Target group analysis	<ul style="list-style-type: none"> <input type="checkbox"/> Who is the trainee for this training? <input type="checkbox"/> What do we know about them so we can train them how they learn best? <input type="checkbox"/> What other groups may benefit from this training?
Training context analysis	<ul style="list-style-type: none"> <input type="checkbox"/> How and when will the training be delivered? <input type="checkbox"/> What are the other requirements for successful delivery of the training? <input type="checkbox"/> What things are needed to support uptake of the training and sustain the desired changes in practice?
Training outcomes analysis	<ul style="list-style-type: none"> <input type="checkbox"/> What will we measure to tell us how effective our training is? <input type="checkbox"/> Who needs to help us carry out that evaluation? <input type="checkbox"/> Where/how will we store that information so that we can update it and use it for continual improvement?
Wider outcomes analysis / business impact	<ul style="list-style-type: none"> <input type="checkbox"/> How does the training contribute to <u>strategic outcomes</u> for WaterNZ, the world of stormwater and the wider wellbeing of the communities we serve? <input type="checkbox"/> How does the training contribute to the <u>tactical outcomes</u> that WaterNZ members’ clients want, with respect to their policies, procedures and organisational goals? <input type="checkbox"/> How does the training contribute to the <u>operational outcomes</u> of WaterNZ and our members’ clients with respect to our projects?

Toolkit 5 Capturing both formal and informal levels of stormwater education and training

“ Your present situation is not your final destination.
The best is yet to come. Zig Ziglar

Purpose of this Toolkit:

To present a clear summary of the complex world of stormwater-related education and training so that education and training can be delivered at the right level and in the right way for the right audiences.

There are many different agencies involved in environment, sustainability and specifically stormwater-related education and training for people in tertiary education and in the workforce.

The summary below lists the many different agencies delivering different levels of stormwater-related training in New Zealand.

Working Groups can use this list to help them design training to meet the various needs of stormwater practitioners needing different types and levels of expertise within each topic.

Below are listed broad grouping of agencies and what they deliver:

- **recognised qualifications** under the New Zealand Qualification Framework (NZQF), which is quality assured and covers secondary and tertiary education through schools, institutes of technology & polytechnics (ITPs), wānanga, universities, industry training organisations (ITOs) and the other bodies listed in **Appendix A**
- **recognised skills and experience:** on stormwater-related topics, this is available through:
 - Connexis, the Infrastructure ITO, in the form of Recognition of Current Competence (RCC) and Civil Trades Certification (see **Appendix B**)
 - Otago Polytechnic, through two programmes²⁰:
 - EduBits, also known as digital micro-credentials, which allow working people to submit examples of their skills for assessment and NZQA-recognition
 - Capable NZ, a free programme that measures people’s existing capability from their years of work and life experience against an actual NZQA-accredited qualification and confers academic credit towards it, based on what they already know and skills they already have
- **formal recognition of levels of training** that are formally recognised by:
 - professional bodies such as Water New Zealand, Engineering NZ, NZPI etc through systems such as professional registration processes and continuing professional development (CPD) points
 - the New Zealand Association of Training and Development and its sister organisations all around the world (Levels 1-5 of the Kirkpatrick and Phillips training evaluation frameworks, listed in **Appendix C**)
- **informal recognition of levels of training** that are not formally recognised but may be tracked by in-house learning management systems (LMS), or by attendance certificates issued by the person or body delivering the training, in the form of hard copy or electronic certificates or cloud-based portable systems of electronic badging.

However there is much other training that is seldom captured in any of the above, for example:

- **informal learning** from leaders and peers in the workplace, which is a significant component of workplace learning that is strongly influenced by explicit and tacit expressions of organisational culture. The Subgroup's approach to stormwater education and training should include explicit support for constructive informal learning
- **other in-house learning**: much training is also delivered in-house by subject matter experts on the staff of councils and the larger consulting and contracting companies, and hence flies well under the radar in terms of assessing overall workforce capability. Mentoring and other forms of learning and professional development may not all be documented. Moreover, at least one civil construction company has become an accredited training provider, able to issue appropriate recognition of training to its own employees [CF to locate reference]. This project has an opportunity to identify these in-house experts so that where possible, their skills can be made available to others.

It is unrealistic to expect all this information to be captured as part of implementing the Stormwater Education and Training Plan.

What we can realistically aim for is to define good practice monitoring, documentation and evaluation of training and workplace learning and encourage its uptake as part of a strategic development plan for the stormwater sector.

Toolkit 6 A matrix to help build a gap analysis of stormwater courses from professional bodies

[To be populated by Working groups if they feel this is useful]

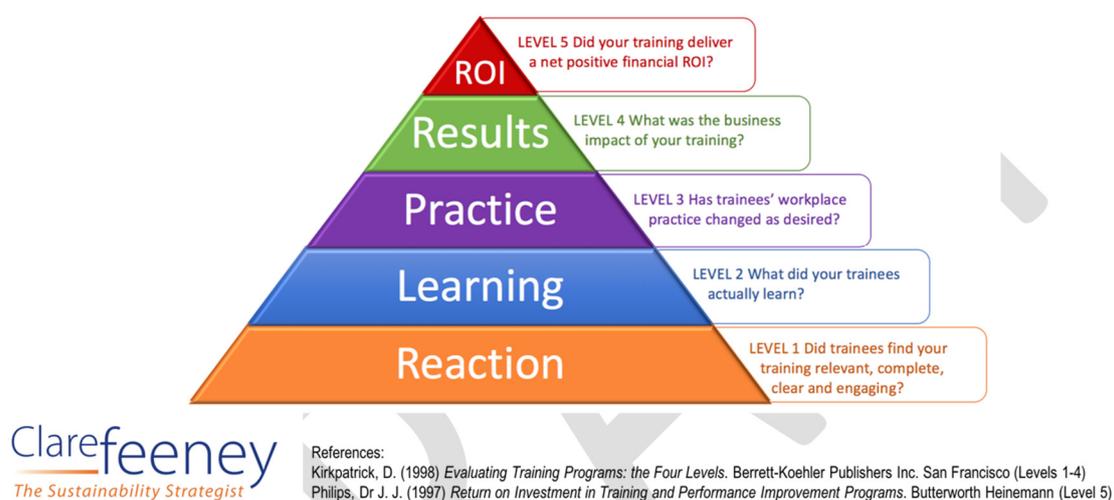
Integral skills	Opus	Engineering NZ	NZPI	NAMS
1.1				
1.2				
1.3				
1.4				
Specialist skills				
Planning				
2.1				
2.2				
2.3				
2.4				
Assessment				
3.1				
3.2				
3.3				
3.4				
Design				
4.1				
4.2				
4.3				
4.4				
Construction				

5.1				
5.2				
5.3				
5.4				
Operation/maintenance				
6.1				
6.2				
6.3				
6.4				
Monitoring/evaluation				
7.1				
7.2				
7.3				
Other skills				
7.1				
7.2				
7.3				
Leadership skills				
7.1				
7.2				
7.3				

Toolkit 7 How professional trainers evaluate the effectiveness of their training

Learning and development professionals all around the world recognise five levels of evaluation of the effectiveness of training. Levels 1-4 were developed by Donald Kirkpatrick and Level 4 by Drs Jack and Patti Phillips of the ROI Institute²¹. These five levels are summarised in Figure 9.1 and below²².

Figure 7 How professional trainers evaluate the effectiveness of their training



Level 1 – Reaction: What did the trainees think of the training?

Reaction identifies the extent to which your trainees found the training relevant, clear, complete and engaging. Usually collected via the “smile sheet” filled out at the end of a workshop, this level of evaluation seeks feedback on workshop delivery, content, relevance, location, interaction, enjoyment and the like.

Level 2 – Learning: What did they learn from it?

Asking trainees questions such as “What did you learn?” will tell you how much they think they’ve learned. You can also test their new knowledge; for example, by a short end-of-workshop or online test, or a group feedback session for people with weak language and literacy skills. You can also ask the trainees and their supervisors to fill out an online survey three months or so after the workshop – and they need support themselves as part of the training to do this well.

Level 3 – Performance: What can they do as a result of it?

Performance evaluation means that supervisors, managers and human resources personnel assess “What observable changes are there in trainees’ performance (as defined in the training needs assessment) as a result of the training?” Supervisors and managers need to deliver support and conduct weekly reviews with trainees within one month after the workshop.

Level 4 – Results: what was the business impact of the training?

Evaluation of results means asking “How much of a change did the training produce for the business? What measurable results have been observed?” This means measuring and comparing results such as compliance with environmental approvals and performance standards before and after the training. This could involve seeking feedback from company staff as well as, for example, people carrying out site inspections and audits for the regulatory agency.

Level 5 – ROI: did the training produce a financial return on investment?

Return on investment analyses in dollar terms the ROI in training and performance improvement programs. It asks “Was there a financially measurable improvement in performance as a result of the training, and was this less than, the same as, or more than the cost of the entire training package?”

According to Dr Jack Phillips, the steps involved are:

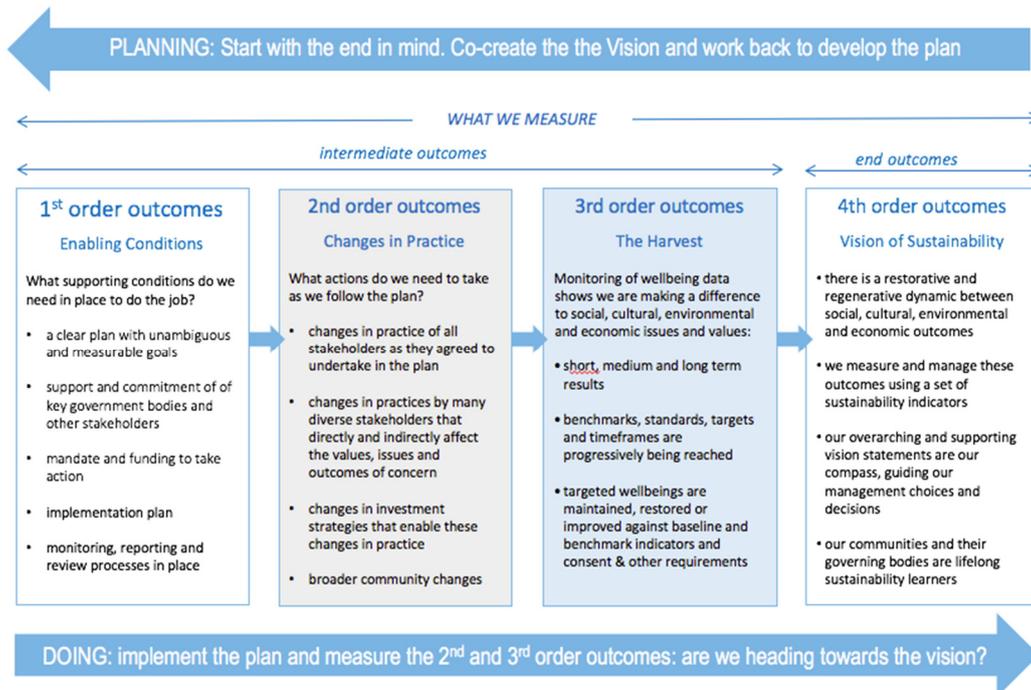
1. identify program benefits (level 4 business impact)
2. convert benefits to monetary value
3. identify intangible benefits
4. tabulate all costs (needs assessment, design/development, delivery/implementation, evaluation and overhead/administrative costs)
5. calculate the ROI.

Level 5 can include all four wellbeings as they become increasingly monetised.

Understanding the value that training delivers is part of preparing the **business case** for funding its delivery. Given the size of the investments at stake, the stormwater sector needs to take a much more systematic and rigorous approach to measuring the effectiveness of industry training.

Toolkit 8 How catchment managers can evaluate the effectiveness of their plans: more about the orders of outcomes framework

Figure 8.1 The orders of outcomes framework
 Source: Adapted from UNEP/GPA, 2006¹⁸



The four orders of outcomes are:

- 1st order outcomes: the things that need to be in place at the outset (enabling conditions).
- 2nd order outcomes: evidence of changes in practice through compliance with regulatory requirements and uptake of new practices.
- 3rd order outcomes: changes in the indicators that measure environment, social, cultural and economic wellbeing.
- 4th order outcomes: progress towards achieving the long-term vision of sustainable development as expressed in our vision.

Planning starts with a high level objective or vision – the 4th order outcome. Progress towards the vision is made by creating the enabling conditions needed to start work – the 1st order outcomes, including the plan itself and its associated methods and resources. Managers implement the plan by carrying out the methods that aim to lead to observable changes in practice by themselves and by third parties – the 2nd order outcomes. According to the plan logic, these will then result in the desired measurable 3rd order outcomes over the short, medium and long term with regard to the values and issues of concern. This then gets us closer to understanding and achieving the 4th order outcomes – the vision and attainment of sustainable development.

The framework also makes us think about monitoring in the earliest stages of planning, thereby providing a stronger basis on which to monitor and evaluate a plan's effectiveness and efficiency. The same applies to training: the more rigorous the needs assessment, the more measurable the effectiveness of the training will be.

Figure 8.1 indicates that we will become less confident over time about attributing outcomes directly to our plan, because external factors come into play; some may be synergising (contributing to the outcomes we want) and others confounding (preventing or reducing the effectiveness of our actions). These factors are often beyond the control of stormwater managers, but documenting them helps identify what influenced a given outcome. The orders of outcomes framework thus provides a conceptual framework that helps us to tease out the many webs of causality at work in the complex social and environmental systems we work in.

The benefit of monitoring the 1st, 2nd and 3rd order outcomes is that it gives catchment managers and plan evaluators the information they need to assess how well the plan is achieving or has achieved the various 3rd order outcomes in the short, medium and long term. If the plan is not achieving the desired outcomes, the information helps managers and evaluators to differentiate between²³:

- implementation failure, where expected outcomes are not achieved due to poor plan implementation, and
- plan failure, where the plan's internal logic is flawed and the chosen methods are unable to achieve the expected outcomes and/or the indicators selected are not the right ones to demonstrate actual outcomes.

Table 8 Summary of the four orders of outcomes
 Source: Adapted from UNEP/GPA, 2006²

1st order outcomes: the enabling conditions	First order outcomes are the organisational conditions that must be present at the start of any program aiming to bring about change. They involve building constituencies and capacity such as commitment, cooperation, resources, documentation, processes and guidance. Examples include securing mandate and commitment, designing intervention theories, revealing and testing assumptions about causality (e.g. "If we do 'x', they will do 'y' and then 'z' will happen"), developing and signing off relevant documentation, building institutional capacity, forming partnerships with key stakeholders, securing funding and other resources and planning for monitoring, evaluation and reporting. The setting of clear and measurable outcomes is a key element at this stage.
2nd order outcomes: observable changes in practice	Second order outcomes are evidence of successful plan implementation. They mark changes in the practices of individuals and individual organisational groups, such as evidence of new forms of collaborative action among stakeholder groups, investments in infrastructure, the voluntary responses of actors and their actions in response to policy and regulations, and also non-regulatory methods such as guidance, training and education, community development and so on. Examples include the application of new skills and behaviours such as collaborative actions, installation of environmental controls, and compliance with policies, rules and environmental authorizations.
3rd order outcomes: 'the harvest'	Third order outcomes are the changes in the indicators of environmental, social, cultural or economic wellbeing that the program was set up to achieve, and which define its effectiveness.
4th order outcomes: sustainable development	Together, the 1 st , 2 nd and 3 rd order outcomes collectively contribute towards our vision of an enhanced future in which we achieve a long-term desirable balance between the four wellbeings. They may not yet be measurable, but over successive

	policy cycles, we should learn more and more about what sustainability looks like and how we can measure it. In this sense, fourth order outcomes act as a compass to help us make sure we are heading in the right direction when setting out first, second and third order outcomes. The New Zealand government's commitment to the four wellbeing indicator framework gives a strong direction on this ²⁴ .
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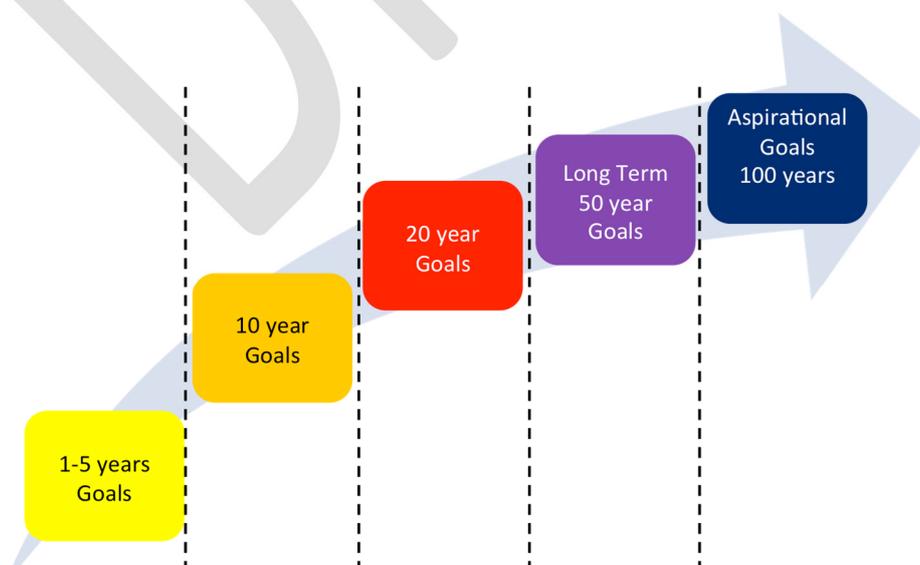
A key benefit of the orders of outcomes framework is that it's essentially a logic model: it allows us to test our assumptions about how things work; some of our assumptions about causality may be inaccurate, and this will emerge as we monitor the plans' implementation and outcomes. This is shown in **Figure 8.2**.

One of the difficulties of monitoring environmental plans is that outcomes may not eventuate for some years – although some can manifest very quickly, as experience with [Raglan Harbour](#) and the [Rotorua Lakes](#) demonstrate. **Figure 8.3** shows how 3rd order outcomes can be split into varying timeframes as needed.

In order to evaluate the effectiveness of a plan, it is important to measure and document outcomes across all the orders, so that the underpinning (usually unconscious) assumptions about cause-effect relationships associated with interventions can be highlighted and tested.

The successive outcomes defined by the framework reflect the underlying (and usually unstated) assumptions about causality that underpin a plan's internal logic. Defining the plan's vision and setting its measurable objectives are informed by the plan's external synergy with other guiding and requiring documents. These documents set the high level objectives that catchment initiatives can help achieve, and were illustrated in **Figure 2.3**, Overview of stormwater-related guiding and requiring documents.

Figure 8.4 Using different timeframes for third order outcomes



Toolkit 9 How to develop good training that can be evaluated

In this Toolkit:

1. Steps to developing training whose effectiveness can be evaluated
2. A team effort by the industry
3. Developing “good” training
4. Coping with multiple guidelines
5. Building in certification to a comprehensive training framework

9.1 Steps to developing training whose effectiveness can be evaluated

How will evaluation actually be set up and undertaken in practice? What does this mean for developing and delivering our training?

Evaluation of effectiveness starts with robust assessment of the training need, or performance gap. This means that it’s built into the training from the start, for every single training topic listed in **Table 3.2**.

The value of this process cannot be overstated: starting with this level of rigour at the design and development phase will enhance the effectiveness of all our stormwater training.

Practical steps to achieve this are listed below as an example of how this could be done.

Step 1 develop a sampling plan for evaluating all the training delivered in each calendar year whereby the risk, harm and/or costs associated with poor workplace performance are assessed for each training topic in order to group them into High, Medium or Low risk categories

Step 2: subject matter experts supported by a professional trainer define the evaluation criteria of the training on each topic in **Table 3.2** during and at the end of its development

Step 3 100% of training experiences (some like micro-learning may be aggregated) are evaluated to Levels 1 and 2 (Reaction and Learning), as shown in **Figure 5.1**

Step 4 100% of trainees in employment take a Supervisor Support Package back to work, including a questionnaire to help their manager evaluate Level 3 outcomes (Practice) with the aim of getting at least a 10% return rate for Low risk, 30% for Medium Risk and 80% for High risk topics

Step 5 Trainees’ employers are invited to take part in a Level 4 assessment of business Results, on a sampled basis across the high, medium and low risk training topics (this could be via an online questionnaire supported by a webinar)

Step 6 Trainees’ employers are invited to take part in a Level 5 assessment of full financial ROI of the training, again on a sampled basis across the high, medium and low risk training topics, by questionnaire, webinar or 1-day workshop

Step 7 Water New Zealand analyses and reports on the results to its Board and the sector, and supports the trainers to apply the feedback back into their training.

Who will do this? Ensuring that this happens is one of the key responsibilities of the people managing the implementation of this Stormwater Education, Training and Development Plan.

9.2 Developing “good” training

The ever-widening choice of electronic training delivery methods can dazzle us with technical possibilities, so we have to go back to the basics and revisit what makes for good training for adult learners.

Mark Nichols²⁵ cites the educational principles listed below that constitute good practice.

Devised for schools, these are equally relevant to adult vocational training:

- encourage student–faculty (or in our case, trainee-trainer) engagement
- encourage cooperation between students (trainees)
- encourage active learning
- give prompt and informative feedback
- emphasise time on task
- communicate high expectations
- respect diverse talents and ways of learning
- make clear the learning goals and one or more paths towards them
- use extensive deliberative practice
- provide an optimal balance of challenge and support that is tailored to the individual trainee’s readiness and potential
- elicit active and critical reflection by trainees on their growing experience base
- link inquiries to genuine problems or issues of high interest to the trainees (thus enhancing motivation and accelerating their learning)
- develop learners’ effectiveness as learners
- create an institutional environment that supports and encourages inquiry – and this is important not only in the learning environment but also back in the trainees’ workplaces.

Essentially, our training must be relevant to the issues, drivers and learning outcomes identified by the industry and to the workplace needs of the trainees – that is, authentic. Dr Jan Herrington has identified²⁶ nine key design elements of authentic blended learning environments:

1. authentic contexts that reflect the way the knowledge will be used in real life
2. authentic tasks and activities
3. access to expert performances and the modelling of processes
4. multiple roles and perspectives
5. collaborative construction of knowledge
6. reflection to enable abstractions to be formed
7. articulation to enable tacit knowledge to be made explicit
8. coaching and scaffolding by the teacher at critical times
9. authentic assessment of learning within the tasks.

Essentially this allows the training to appeal to trainees’ innate sense that as dedicated professionals, they also have something to offer in attending the training.

This will further develop the stormwater sector’s positive attributes, such as:

- collaborative learning
- the “critical community of inquiry” espoused by Mark Nichols²⁴
- the already strong sense of stormwater sector collegiality.

9.3 A team effort by the industry

The stormwater sector has or has access to all the experts it needs. We can take the Baron von Münchhausen approach and lift ourselves up by our bootstraps.

An example approach is:

- **working teams:** convening specialist teams of technical experts on prioritised training topics to work to a brief report back on their recommendations, for example, what tiers of training should there be (see **Table 3.2**) and who is best placed to provide each of these
- **technical support:** peer reviewers and target audiences reviewing the technical content of the training
- **professional training support:** a professional trainer and target audiences reviewing the detailed training needs assessments, design, delivery and criteria for evaluating the effectiveness of the training.

Where other bootstraps like funding are needed, this plan aims to provide the necessary lift.

9.4 Coping with multiple guidelines

Where there are multiple guidelines across New Zealand on different aspects of stormwater management, as identified by Peter Christensen et al²⁷, New Zealand could adopt WEF's approach with the NGICP.

Some first steps could be to:

- convene a working group of people implementing local, regional and national guidelines
- run a half- or 1-day workshop based on the Canterbury report in order to:
 - share knowledge
 - avoid reinventing the wheel
 - identify technical gaps where no guidelines are available
 - work out what it would take to plug these gaps
 - identify a training model based on the approach taken by NGICP, where core generic training is developed on each of the key topics and then additional locally-specific training is delivered in regions that have their own guideline or use a national guideline or that of an adjacent council
- report their findings and recommendations at the Stormwater Conference in May 2019.

9.5 Building in certification to a comprehensive training framework

Some straightforward steps towards a comprehensive training framework could look like this:

1. develop a simple but robust syllabus and clearly defined learning outcomes up to at least Level 4 (**Toolkit 7**) from traini2n delivery for each training topic
2. work with the relevant professional associations to deliver workshops that enable their members to gain CPD points
3. work with the relevant vocational and adult training institutions and industry representatives to develop workplace competency-based qualifications and deliver the training to professional trades people and the regulatory staff who inspect and enforce them
4. consider the need for the various forms of certification outlined in **Toolkit 21**.

That said, below are some of the cautionary comments from the 2018 industry survey about specifying the requirements for certified stormwater professionals:

“All the above are not solutions per se for what is broken or how we move forward. There will always be people with different knowledge, as stormwater is multi-disciplinary these days. It is the court and individual business that decide who is suitably qualified or experienced; however, having a certification system helps to clarify these levels of expectation and provides client assurance. Yet, making this mandatory will only make getting into the industry harder in a multi-disciplinary environment.”

“Provide onsite demonstrations to businesses to create awareness then regulate or incentivise through certification.”

“I do not think certification is required – simply attending suitable courses will suffice.”

DRAFT

Toolkit 10 Trial run of a priority-setting assessment

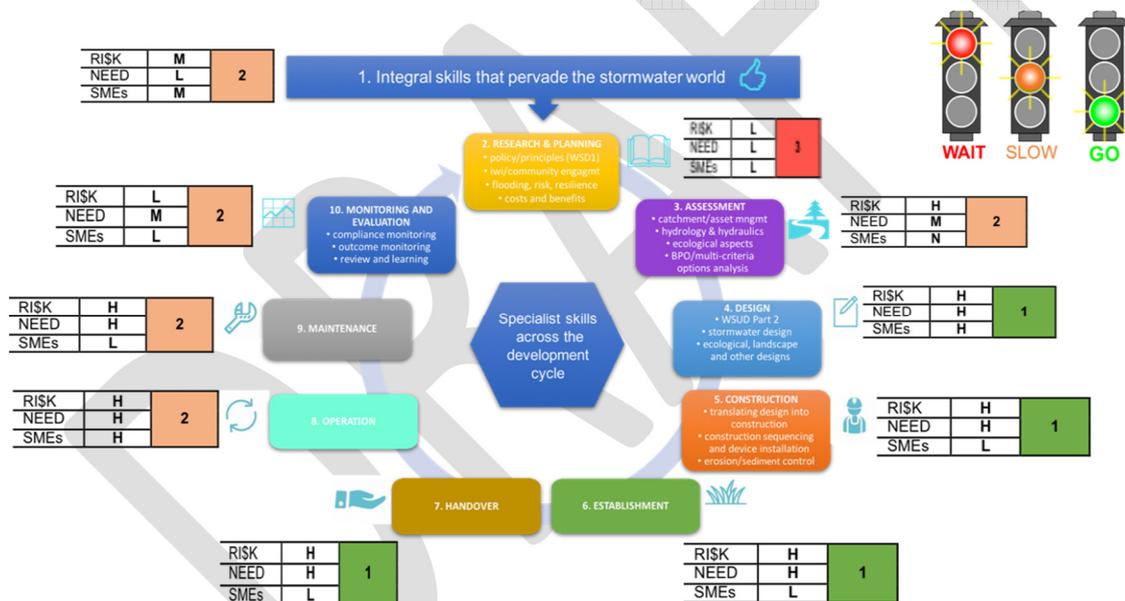
Training priorities could be tentatively identified using a traffic light system based on:

Factors determining if training is red, amber or green light are ranked low, medium or high for:

- the risk of not doing the training
- the need for doing it
- the availability of stormwater subject matter experts or other providers (e.g. universities, polytechs) delivering or able to develop training.

We have ranked these as:

1. how do we **empower** our SMEs to step up to preparing and/or delivering training?
2. how do we **fill the gaps** were there are not enough SMEs who can become trainers?
3. **low priority**/too hard basket for now



Priorities

The high priorities for training from this rapid “proof of concept” assessment are:

- construction
- establishment
- operation
- maintenance.

Based on other needs, high and medium priorities are:

- design
- monitoring and evaluation of training and environmental outcomes.

Others phases of the development cycle can wait.

Toolkit 11 Detailed industry and other suggestions for training delivery

This Toolkit lists training delivery methods culled from all surveys and many referenced reports. Throughout the course of the project these will be expanded and sorted to align with the key groups of training needs.

Table 9.1 overviews 2018 training delivery preferences. The categories are not mutually exclusive.

Table 9.1 Summary of suggested training delivery methods

Source: 77 respondents to the 2018 survey

In person
1. Interaction with experienced practitioners to collaborate and share knowledge and expertise
2. More peer review
3. Individual training (one-on-one) on a specific project
4. More training with mentor support
5. Work experience: Working as a civil contractor, or plumber or drainlayer for say 18 months in a supervisory role
6. Conferences: once the basics are mastered, conferences would be a better source of continuing education than specific courses
7. Stormwater conference: Is there any benefit in having an education and training stand in the exhibition hall? Not sure if providers would be willing to fund this, but struggling to think how to disseminate what information we have on existing or future opportunities
8. Technical papers at conferences on broad topics could lead into webinars and specialised training
9. Local technical, practical short courses/workshops e.g. WSD, culverts, etc. More nitty gritty technical stuff on specific issues. All the generic stuff is pretty well covered
10. Regional stormwater groups, including Monthly Water New Zealand evening-based CPD/networking sessions, with presentations shared/recorded as webinars for professionals based in the regions
11. Field days
12. After-work sessions, discussing real projects - successes/failures, case studies/specific examples to know what works and what doesn't work in real life applications etc
13. Toolbox talks
Online
1. Videos: small videos for quick and easy reference and guidance. Series of training videos open source on Youtube. Most impact and spread with lowest cost to trainees
2. Webinars: synchronous and asynchronous, one-off or series on a topic
3. Online courses: easier to access training (at your own pace)
4. Online presentations recorded from live events
In training or education
1. Case studies to know what works and what does not work in real life application
2. Paper or national certificate/diploma course
3. More teaching at tertiary institutions to bring 1) more people and 2) more skilled people into the field. Contaminated land and other environmental sector fields suffer from this as well

Other suggestions included:

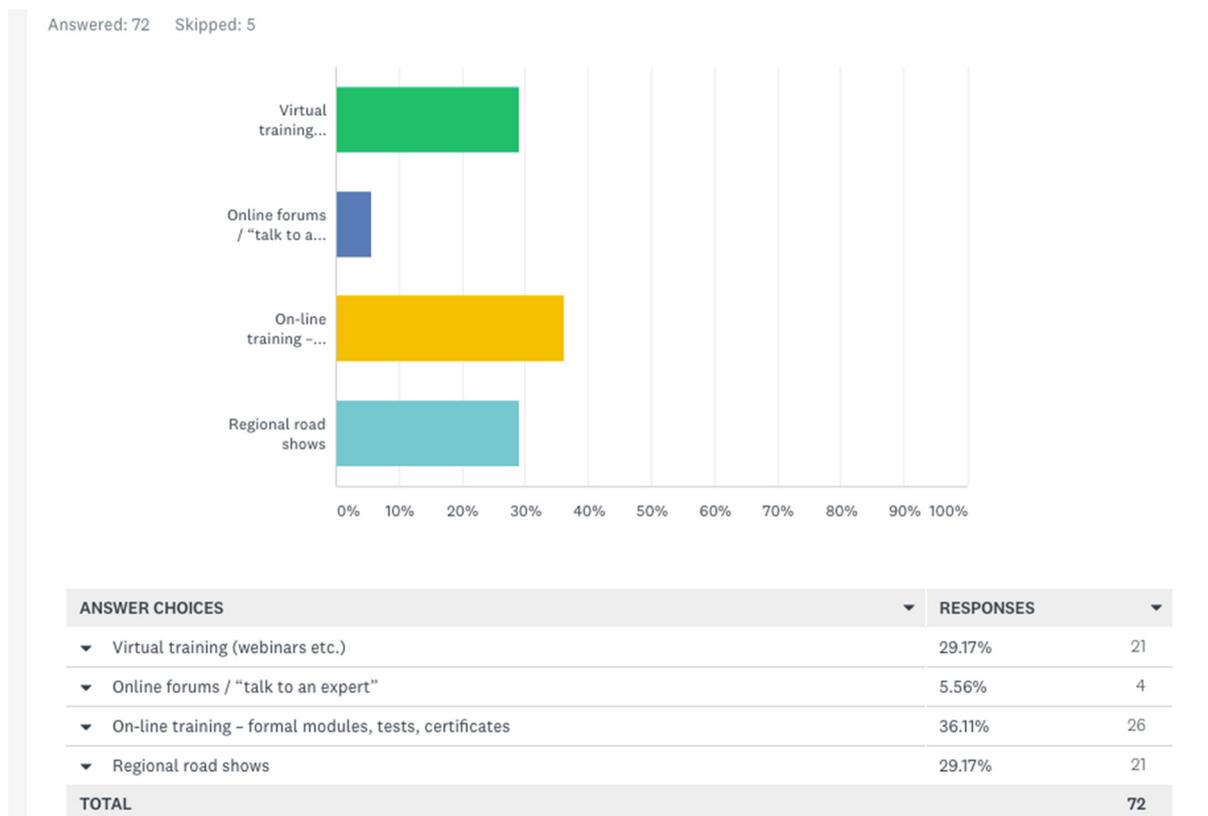
- graduate programmes: for the next stage, do we also need to think bigger and contact the bigger consulting and contracting companies in our organisation to explore stormwater-focused graduate programmes?
- small firms: what about the little guys, with only a handful of employees?
- outreach: expand to other industries and professions?

Question 7 of the 2018 stormwater industry survey asked respondents:

How can we deliver training so that regions, as well as main centres, benefit?

Respondents were given several prompts and the opportunity to make further comments, and the results are in Figure 3.2 and the dot-point list below.

Figure 9 Delivering training to the regions



Other comments:

- All the above bullets are relevant
- I think it's probably a combination
- Best to mix all of the above for best outcomes
- Partner with IPENZ
- Personally, I believe that a combination of face-2-face and online training could be beneficial from a learner's point of view.
- Develop peer support networks such as those that collaborate together for IPENZ registration
- Central training centre need to be together.
- Webinars are great for us in the main centres as well
- Bring together people out of their work environments and big corporate silos to develop real multidisciplinary skills
- setting up sessions where people can log in from the regions would work and level the playing field. on-line training needs a lot of management and curating information and can become outdated very quickly.
- Followed by regional roadshows targeted audience training, across multidisciplinary professions
- Best to be 'in a place' and 'go into the field' to ensure place-based emphasis
- Most will come from the regions if they know others who think the course is good.
- Supplemented with short courses in strategic centres. Site visits are also very instructive.
- Regional courses. If it's a good course and not too drawn out people will travel.

- Guidance Documents
- Something similar to Lynda.com where they have online videos, transcript, and exercise files, but also in addition to this need some interactive discussion with experts either in person or Skype
- I think people absorb information better and are more likely to ask relevant questions when there is an actual person.
- Ultimately face to face training is best and that means regional hubs/centres are used.

The comments below best summarise and overview these responses.

Firstly, a key low hanging fruit is setting up regional meetings monthly or bimonthly to share recent local information. Over the past few years Peter Christensen has organised 3-4 regional stormwater meetings a year in Christchurch with an attendance of 50-70 people. This is a great model that costs nothing (different consultants host each time and there is an element of competitiveness to provide decent drinks and food) and is both upskilling people and building the stormwater profession. This could readily be rolled out in other areas. *I would be happy to put pen to paper to outline the model. [who said this? Survey responses were anonymous].*

Secondly, Allan Leahy outlined the integrated delivery system in **Table 3.2**.

Table 9.2 An integrated training delivery system

- Allan Leahy from Stantec also set out a tiered training delivery system as follows:
 1. Conference and associated workshops.
 - i. Format exists for this, keep it going
 - ii. 1-day, half-day
 2. Industry information events: short sessions on local/national topics of interest delivered at local venues.
 - i. Free or sponsored events
 - ii. Can tie in with electronic media as well as Journal publications, some of this happening now
 - iii. Probably a good one for the Stormwater Education and Training Subgroup to lead
 3. Short courses: Half, full day or webinar sessions, covering more detailed information on given topics of interest
 - i. Probably need to be paid for
 - ii. Cost/benefit needs to be considered, probably start by targeting known hot button areas
 - iii. Probably need to be run by an technical or professional organisation
 - iv. Needs good presenters
 - v. Can repeat courses in multiple locations or times
 4. International Training programmes
 - i. There are a range of programs and certifications available: Aussie, UK, US. How can we leverage off these?
 5. Full Blown NZ based Stormwater training course and certification.
 - i. Some of this has been/is offered in undergraduate courses by the universities
 - ii. I note Frances Chalmers was looking at developing a post graduate (Masters level) course.
 - iii. Will likely need a range of presenters from various topic areas
 - iv. Will need to work through certification requirements. NZQA?
 - v. Need to be run by a professional or educational authority
 - vi. Think this is a great medium term goal, but will take (lots of) time, business cases and funding to realise.

Delivery methods can be combined on other ways, for example where there is a locally-specific technical guideline, it would form the basis of local training. However, all such training has a strong generic component across the country. In such cases generic content could be delivered as live or online prerequisite training, with locally-specific training being delivered in a locally suitable format including site visits. Trainees can then join local and online peer-mentoring and

networking groups to take advantage of further formal and informal training opportunities both in person and online.

Table 9.3 A sample of electronic media that can support training

<ul style="list-style-type: none"> • dedicated websites • e-newsletters • webinar tools like Zoom • podcasts • online forums, bulletin or discussion boards • wikis/online glossaries • FAQs • blogs (including audio and video blogs) • discussion forums • intranets • text messaging groups such as WhatsApp • interactive elearning modules • pre-and post-training session surveys 	<ul style="list-style-type: none"> • m-learning and e-portfolios • file-sharing e.g. YouTube, slideshare, instagram • social media e.g. twitter, facebook, linked in groups and so on, that enable people to form online learning communities • online quizzes and surveys • mashups²⁸ • document sharing in the cloud • real-time polling • social bookmarking e.g. Del.ici.us or Digg • Sim-City/Second Life • prosocial MMOPoRGs (massively multi-player online role-playing games)
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Workforces and workplaces are changing, with multi-generational teams working in different sites (not all of them offices) and in different countries²⁹. Generation X (born between 1964 and 1980) and Gen Y, or the Millennials (born between 1980 and 2000), are particularly tech-savvy, independent and wanting meaningful work. These people make up a large and growing proportion of the workforce. Raised with electronic devices, they expect and demand their use as part of their vocational training.

Learning is becoming more social and more virtual as technologies enable this. It is also becoming much more collaborative – not only amongst learners, but between learners and trainers, as trainees take responsibility for their own learning and ask correspondingly more of their trainers.

Collaborative learning is now the order of the day: learning is essentially a social activity and the ‘lone learner’ of early e-training days is now a social learner, even when part of a geographically dispersed learning community.

Nationally consistent and effective stormwater training delivery must meet this need.

The choice of delivery modes or the right mix of blended delivery – a mix of in-person, onsite, online and augmented reality interactions – will only be able to provide the most cost-effective mix of training delivery methods when appropriate and tailored to every training need and audience.

The two key contributions of e-learning, Mark Nichols⁵ notes, are that it provides a wider choice of ways to deliver good education and fosters the development of a ‘critical community of inquiry’, thereby extending existing educational frameworks rather than replacing them.

Nichols emphasises that ‘the core tenets of education do not change when e-learning is applied, and that e-learning practitioners must be careful to base their practice on identifiable learning theories’ – that is, on good pedagogy. He says that rather than ‘trying to replace theories of education, e-learning creates new possibilities for applying established educational and

interpersonal theories'. He cites the following educational principles that constitute good practice. Devised for schools, these are equally relevant to adult vocational training:

That is, good teaching practice is good teaching practice, regardless of the delivery medium.

Other interesting models that could be applied to training delivery methods include [MOOCs](#), Massive Open Online Courses that are free online available for anyone to enroll. They provide an affordable and flexible way deliver quality educational experiences at scale. Some are available from leading US universities for free and below is a sample of providers:

- [Coursera](#), which partners with top universities and organizations to offer courses online. It runs some environmental training but not on stormwater
- [lynda.com](#), which has some [stormwater-related](#) content
- the [Khan Academy](#), a non-profit educational organization created in 2005 by Salman Khan with the goal of creating a set of online tools that help educate students. The organization produces short lessons in the form of YouTube videos. Its website also includes supplementary practice exercises and materials for educators. It has no stormwater-related content but is a very successful and effective delivery model.

Gaming and virtual and augmented reality are also effective learning tools, such as [SimCity](#).

E-training and blended delivery

Source: This Appendix is an excerpt from:

[Clare Feeny, Teresa O'Regan-Byrnes and Graeme Ridley \(2012\). How blended delivery can enhance the outcomes of the Stormwater Unit's industry training courses. \(2012\) A report prepared by Environment and Business Group, Innovaid Ltd and RidleyDunphy Environmental for the Auckland Council, June 2012](#)

What is e-training?

For many decades, correspondence schools have seen millions of children in remote parts of the world gain an excellent education via the post. Electronic tools also reach beyond the classic 'classroom' – and have moved on a great deal since the early 'computer-based training', which was essentially just electronic text books on static web pages or CD-Roms.

This more dynamic 'pedagogy empowered by technology', as Mark Nichols³⁰ calls it, is technology-supported education or training where the medium of instruction is computer technology, particularly digital technologies. Naturally suited to distance and flexible learning, e-learning can also be used together with face-to-face teaching – a 'blended learning' solution.

E-learning pioneer Bernard Luskin³¹ argues that for e-learning to be effective, the 'E' must be understood differently, to mean exciting, energetic, enthusiastic, emotional, extended, excellent and educational in addition to merely 'electronic'. Elliot Masie⁸ adds that it is also for everyone, everywhere at any time.

For the purposes of this report we use the term e-training to include e-learning as the electronic component of blended delivery.

E-training can be text-light, image heavy and interactive, so it works well when trainees are:

- poor readers
- bad with numbers
- learning in a new language
- learning very practical applications where images are better than text.

E-training is also excellent when:

- large numbers of people are involved
- working people need to study in their own time
- a system is needed for giving trainees regular positive feedback
- large distances and dispersed workplaces make it hard for trainees to get together
- an electronic learning management system (LMS) is used to manage students and their learning.

Developers of e-training distinguish three aspects:

- the electronic delivery platform, electronic presentation of training material and the associated interactivity for the trainees; and the ability for the trainers to monitor their work: this is the province of the specialist information technology service providers – the developers
- the subject matter itself: this is the province of the subject matter expert (SME), who understands the topic of the training very deeply but may not be an experienced trainer or familiar with e-training
- the pedagogy, or applied understanding by a training expert of how people learn and what constitutes best practice training, which informs the development of the platform and the content.

The key point is that the quality of the training reflects the quality of the pedagogy, regardless of the platform. Bad training will still be bad training regardless of how many bells and whistles are plugged in to the electronic media. It is also very important to appreciate from the outset that blended delivery is not a quick fix: it is based on deep communication between the SME and the e-training experts.

Recent developments include m-learning, or learning that is enabled by mobile technology.

Most training continues to use a mix of methods and this is described by the term 'blended learning'. The mix of delivery methods can include electronic, 'conventional classroom' and on-site training.

However, new delivery methods are emerging all the time and at an increasing rate. Next, we overview some of the more commonly used tools.

What is blended delivery?

A classical definition of blended learning is learning systems that 'combine face-to-face instruction with computer-mediated instruction'³². Blended training is thus delivered by a mix of methods including face to face training, onsite or workplace training, computer-based training or m-learning, using mobile devices. However it has moved far beyond mere instruction to more creative and collaborative tools.

E-training has traditionally been described in terms of a number of criteria, including:

- synchronous and asynchronous:
 - asynchronous means³³ ‘communication that doesn’t require same-time interaction. For example, email is asynchronous, in that email correspondence does not require the recipient of the message to be involved with the message as it is being prepared (unlike synchronous telephone conversations, for example, where the generator and recipient of the message are both involved at the same time). By using asynchronous techniques such as letters, email, and discussion or bulletin boards, you can communicate across time’
 - synchronous means (ibid) communication that ‘requires same-time interaction. A face-to-face conversation is synchronous because both people must be involved with the conversation at the same time for it to take place.’ A traditional ‘classroom’-based workshop is also synchronous
 - note that these terms are not mutually exclusive: for example, a webinar (seminar delivered over the web) can be delivered live and interactively (synchronously) and recorded for later use as an asynchronous resource
- CD or web-based: a CD can contain a great deal of information and interactivity, but is essentially like a book: it has a production date and can become out of date. Web-based material, however, can be updated and trainees routinely notified of changes and additions
- computer-based or mobile: e-training began and was initially known as ‘computer-based’ training, but for many years a wide variety of mobile devices have been playing a growing role. Smart phones in particular but also PDAs and tablet computers are increasingly used for both mobile learning (m-learning) and workplace performance support³⁴
- passive, active, interactive, creative and collaborative: early e-training efforts were essentially html or pdfs on websites; that is, Web 0.0 was as static as a book. Web 1.0 allowed a bit more interaction, e.g. through discussion boards or chat rooms and some use of audio, while Web 2.0 (the read-write or social web, or the user-generated web) is³⁵ ‘characterised by creativity, collaboration, communication, openness, microcontent, sharing, and user-centredness’. Web 3, or as Tim Berners-Lee (founder of the Internet) calls it, the ‘semantic web’, provides³⁶ ‘a common framework that allows data to be shared and reused across application, enterprise, and community boundaries.’ ... ‘While its critics have questioned whether or not it is truly feasible, its proponents argue that applications in industry, biology and human sciences research have already proven the validity of the original concept.’

NB: The report also highlights also the need for blended delivery for the Council’s courses, because enabling trainees to be on site and actually build a control or sample a stream is also vital for effective learning of the skills the industry needs.

Toolkit 12 Criteria to assess and compare cost-effective methods of delivering training

When assessing the time and money to develop a given piece of training, the erstwhile CRC Coastal's Citizen Science Toolbox³⁷ may also be useful. It assesses the outcomes, costs, benefits and logistics needs of 63 methods of public engagement on waterways science under the following headings (some of its headings below have been adapted to suit this project):

- description of method
- objectives
- outcomes
- uses/strengths
- special considerations/weaknesses
- results of past experiences such as identified in past stormwater industry surveys
- resources required (e.g. venue and equipment hire, catering, field trip costs)
- suitable for use by (e.g. government, industry, community)
- can be used for (type of plan, process or project)
- number of people required to help organise
- audience size (small, medium large)
- time required to prepare and deliver, as well as delivery time (e.g. 1-hour webinar, half-day workshop, series of workshops, online course etc)
- trainer skill level/support required
- cost (high, medium, low), including upfront and ongoing costs, as well as delivery in multiple locations
- participation/decision-making level, based on the IAP2³⁸ spectrum of public engagement
- innovation level (high, medium, low)
- method
- references
- case studies.

Toolkit 13 New Zealand providers of stormwater education and training

One survey respondent pointed out a need to align University education with industry needs.

In this Toolkit are stormwater-related education and training opportunities from:

- survey suggestions of training providers
- other training providers
- detailed lists of training courses.

Working Groups: In the next stage of the project the education and training providers listed below will need to be expanded and sorted to align with the key groups of training needs.

13.1 Survey suggestions of training providers

Table 13.1 New Zealand providers of stormwater education and training

Source: 2016 and 2018 survey results

Training providers

- I am providing training for planners on stormwater-related issues (*who was this?*)
- Auckland Council is looking at training – 1-day workshops at Botanic Gardens
- Activating WSUD Aotearoa research project is looking at a central collection of resources for trainers
- Ministry for the Environment is engaging on WSUD principles/guideline
- every region has its own guidelines
- Ecan website has a 1-stop shop for related guidelines
- Hamilton City Council is looking at (1) skilled green infrastructure practitioners who are skilled enough to maintain green infrastructure in parks as well as WSUD and know the difference (2) WSUD training for Building Inspectors
- MfE is investigating training for its Urban Water Principles Project through its “Outreach and capability building sub-group”
- Coursera
- Engineering New Zealand
- work with providers in identifying presenters for tier 3 short courses
- bring in international experts from places like Canada where water sensitive design is taken more seriously
- identify and profile international courses for WaterNZ. Perhaps provide sponsorship to help towards this training
- identify and work with providers to develop recognised qualifications

New Zealand bodies that deliver training (*preliminary list only*)

- Engineering New Zealand’s Sustainability Society
- Vivian Kloosterman, a chartered engineer based in Whangarei, runs a number of online courses including on stormwater through her company at <http://continuingprofessionaldevelopment.org/>
- ACENZ (Association for Consulting and Engineering Professionals of NZ)
- IPWEA (Institution of Public Works Engineering Australasia)
- IECA (International Erosion and Sediment Control Association, Australasian chapter)
- NZIHT (NZ Institute of Highway Technology)
- Connexis, an ITO (industry training organisation)
- Infrastructure Sustainability Council of Australia
- Civil Contractors New Zealand
- The Environmental Institute of Australia and New Zealand
- LGNZ (Local Government New Zealand)
- SOLGM (Society of Local Government managers)
- Quality Planning/NZ Planning Institute
- Institute of surveyors through its Otago University degree course.

It is clear from this list that practitioners have a very good understanding of a range of training delivery methods that will make it easier for them to access their key training needs.

The list also reveals a selection of the large and diverse group of training providers associated with a trans-disciplinary sector like stormwater, while additional training providers will emerge from prior work and the next tasks. In the future, the National Urban Development Authority (UDA) and any new water authority may also be involved with training.

13.2 Other training providers

Below are listed:

- universities
- ITPs (institutes of technology and polytechnics)
- councils
- Crown Research Institutes (CRIs)
- professional associations
- companies
- NAMS (New Zealand Asset Management Support).

Universities

Universities play a leading educational role in many of the key stormwater-related disciplines, with Canterbury and Auckland being cited several times. Many survey respondents identified a need to better align University education with industry needs.

Opportunities for this may exist in the following courses:

- Frances Charters is looking at developing a post graduate (Masters level) course at Canterbury School of Engineering in water sensitive urban design
- stormwater-related courses could be included in the Canterbury and Auckland engineering departments as well as in the:
 - New Zealand Diploma in Engineering (NZDE), a post graduate diploma paper in Drainage Design and the BEngTech (CIVIL) offered by ITPs (institutes of technology & polytechnics)
 - BE (Civil/Natural Resources, Environmental Engineering) degree: these courses would have to be amended, but the University of Auckland is currently engaged in its 10-yearly review of the engineering degree, which is being led by Naresh Singhal³⁹
- environmental Science courses at the University of Auckland such as the ENVSCI 714 (Water Quality Science) which covers a range of topics not covered in Environmental Engineering or Civil Engineering courses^{ibid}
- Susan Krumdieck at the University of Canterbury⁴⁰ is the Co-Leader of GATE, the Global Association for Transition Engineering. Part of her work involves Energy Transition in Buildings and Urban Form, and this could link to water- as well as energy-sensitive urban design⁴¹
- planning, surveying, architecture, landscape architecture and the biological sciences could also play an important role, along with psychology, sociology and anthropology, for the so-called “soft skills” without which nothing much changes.

ITPs (institutes of technology & polytechnics)

Unitec in Auckland offers some WSUD-related training⁴²:

- [Landscape Architecture](#)
 - [Bachelor of Landscape Architecture](#)
 - [Master of Landscape Architecture](#)
- [Landscape and Garden Design](#)
 - [New Zealand Certificate in Horticulture Services \(Landscape Design\)](#)
 - [New Zealand Diploma in Landscape \(Design\)](#)

Other Unitec programmes can be seen [here](#).

Industry Training Organisations that confer formal recognition of stormwater-related learning and competence

Industry Training Organisations (ITOs) are recognised by the Associate Minister of Education (Tertiary Education) under the Industry Training Act 1992. They are established by [particular industries](#) and are responsible for:

- setting national skill standards for their industry
- providing information and advice to trainees and their employers
- arranging for the delivery of on and off-job training (including developing training packages for employers)
- arranging for the assessment of trainees and
- arranging the monitoring of quality training.

ITOs can assist in gaining qualifications listed on the New Zealand Qualifications Framework.

Here are the Zealand registered industry training organisations (ITOs) that most directly affect stormwater – some of the other also affect stormwater but for the purposes of this project, they are lower priority for now.

<https://www.tec.govt.nz/teo/working-with-teos/itos/directory/>

Name	Gazette recognition
BCITO , the Building and Construction Industry Training Organisation	Building, construction, flooring, masonry, glass and glazing, joinery, interior systems, and painting and decorating.
Competenz , the Competenz Trust	Engineering, manufacturing, forestry, communications and media, maritime and rail transport, and other trades (locksmithing, fire protection, refrigeration, heating and air conditioning).
Connexis , the Infrastructure Industry Training Organisation	Civil construction, electricity supply and transmission, water, and telecommunications.
The Skills Organisation	Plumbing, gasfitting, drainlaying, roofing, electrotechnology, real estate, financial services, local government, public sector (with some exclusions), security, contact centre, offender management, cranes and scaffolding, ambulance, emergency management, and fire services.

Recognition of training and competence: available pathways through Connexis

Connexis is the Infrastructure ITO. It offers two [pathways](#) towards qualifications under the NZQF:

- Civil Trades Certification
- Recognition of Current Competence (RCC)

Apprenticeships (see further below) are for people of all ages who are new to a given industry. By enrolling in a New Zealand Apprenticeship, you can work towards your specialist trade qualification at level 4. On completion of these 2-3 year programmes, you will be eligible to apply for Civil Trades Certification (CTC).

Civil Trades Certification

To apply for Civil Trades Certification you need to hold a Level 4 Qualification in either:

- Civil Works
- Utilities Maintenance
- Pipe Installation
- Bitumen Surfacing Construction
- Bituminous Product Manufacturing
- Forestry Earthworks

There is more information on the [Civil Trades](#) page at <http://www.connexis.org.nz/civil/civil-trades/>.

Recognition of current competence (RCC)

If you have been working in the industry and at a Level 4 for some years, you may be able to undertake this qualification through recognition of current competence (RCC). RCC allows you to gain a New Zealand qualification by recognising the skills and knowledge you have already gained through your previous work/study.

For this you will need:

- 8000 hours of practical experience
- Two letters of recommendation
- Five years experience working within your industry
- Currently employed within industry at the level of the qualification you are seeking, and have been so for the past two years
- Be able to provide evidence of your previous work experience

The process takes around 9-12 months to complete. There is more information in the brochure at <http://www.connexis.org.nz/wp-content/uploads/2017/06/NZ-Apprenticeships.pdf>.

Connexis apprenticeships in civil infrastructure trades

- Civil works
- Pipe installations
- Utilities maintenance

CIVIL WORKS

NZC IN INFRASTRUCTURE TRADES CIVIL WORKS (L4) WITH STRANDS IN EARTHWORKS, ROAD CONSTRUCTION, CONCRETE WORKS (NON STRUCTURAL), AND ROAD MAINTENANCE

EARTHWORKS

- Quick Facts:
- Level 4
- 152-167 Credits
- 30 Months
- NZQA Ref: 2725

Strands: Earthworks, Road Construction, Concrete Works (non-structural), and Road Maintenance

This qualification will take approximately 30 months to complete, depending on the strands selected.

CORE SKILLS COVERED:

- Ensure onsite health, safety, environment, and quality assurance requirements are met as required for the range of work undertaken by a civil works tradesperson
- Interpret infrastructure plans and apply methodology to civil works operations
- Undertake civil works operations using small and large plant and equipment
- Apply communication skills relevant to the role of a civil works tradesperson

Plus the skills in one of the following strands:

Earthworks: Applying industry standards and following procedures when performing duties as a civil works tradesperson undertaking earthworks operations

Road Construction: Applying industry standards and following procedures when performing duties as a civil works tradesperson undertaking work for road construction

Concrete Works (non-structural): Applying industry standards and following procedures when performing duties as a civil works tradesperson undertaking non-structural concrete work

Road Maintenance: Applying industry standards and following procedures when performing duties as a civil works tradesperson undertaking work for road maintenance

PIPE INSTALLATIONS

NZC IN PIPE INSTALLATIONS WITH STRANDS IN FOR THE TRENCHED, AND FOR THE TRENCHLESS (L4)

- Quick Facts:
- Level 4
- 108-121 Credits
- 18-24 Months
- NZQA Ref: 2694

Strands: Trenched and Trenchless

This qualification will take approximately 18 to 24 months to complete.

CORE SKILLS COVERED:

- Communicating and maintaining safety both onsite and for the community
- Applying knowledge of pipes, fittings and structures installation processes

Plus the skills in one of the following strands:

Trenched: Installing underground utilities using appropriate trenched installations methodology and technology

Trenchless: Installing underground utilities using appropriate trenchless installations methodology and technology

UTILITIES MAINTENANCE

NZC IN CIVIL INFRASTRUCTURE TRADES (UTILITIES MAINTENANCE) WITH STRANDS IN WATER, AND STORMWATER, AND WASTEWATER (L4)

- Quick Facts:
- Level 4
- 200 Credits
- 36 Months
- NZQA Ref: 2967

Strands: Water, and Stormwater and Wastewater

This qualification will take approximately 36 months to complete, depending on the strands selected.

CORE SKILLS COVERED:

- Ensure onsite health, safety, environment, and quality assurance requirements are met as required for the range of work undertaken by a pipe installations tradesperson
- Interpret infrastructure plans and apply appropriate pipe installation methodology when installing pipes
- Undertake pipe installations operations using small and large plant and equipment
- Practice effective communication when operating as a tradesperson within a pipe installation team

Plus the skills in one of the following strands:

Water: Identifying and repairing water reticulation faults within the ground utility network, including scheduled and reactive works

Stormwater and Wastewater: Identifying and repairing stormwater and wastewater reticulation faults within the underground utility network including scheduled and reactive works

Councils

Councils have traditionally been strong providers of industry training, especially for erosion and sediment control, with some councils also starting to deliver training on other topics. This looks set to grow, for example:

- Auckland Council is looking at 1-day environmental workshops at the Botanic Gardens
- Environment Waikato and other councils deliver erosion and sediment control training
- Hamilton City Council is looking at training, led by Andrea Phillips, with the training delivered by Stu Farrant of Morphem Environmental, for:
 - skilled green infrastructure practitioners who have to capacity to deliver WSUD and maintain green infrastructure in parks (and know the difference)
 - WSUD training for Building Inspectors
- Tauranga City Council has some environmental information for urban development, including:
 - its [Infrastructure Development Code](#):
 - a Stormwater Management Guideline ([SMG](#)) that is similar to the legacy Auckland TP10 and TP125 documents

- the SMG's Operation & Maintenance section, including inspection forms, were written by the same author as for the New Zealand Transport Agency (NZTA) [Stormwater Treatment Standard for State Highway Infrastructure](#) (May 2010)
- Ecan delivers erosion and sediment control training. Of particular interest as a mode of delivery is its erosion and sediment control [online toolbox](#).

Crown Research Institutes (CRIs)

CRIs have delivered environmental training in the past, including for Auckland's stream ecological training (NIWA) and the Ministry for the Environment's riparian training (John Quinn, NIWA). They may be well-placed to deliver stormwater/WSUD-related training in future as an outcome of current research projects, and it would be good to identify how they can maximise their effectiveness in line with their mandate, including by focusing on enhancing the capability of industry training providers to deliver such training in the future.

Professional associations

As well as the bodies listed above, many professional associations deliver CPD-eligible training to members meet their specific professional needs, including:

- Engineering New Zealand, [ENZ](#)
- Engineering New Zealand's [Sustainability Society](#)
- New Zealand Planning Institute, [NZPI](#)
- Local Government New Zealand, [LGNZ](#)
- Society of Local Government Managers, [SOLGM](#)
- Association for Consulting and Engineering Professionals of NZ, [ACENZ](#)
- Institute of Public Engineering Works Australasia, [IPWEA](#)
- Environmental Institute of Australia and New Zealand, [EIANZ](#).

Other organisations do not deliver training per se but run a lot of update events. Stormwater survey respondents also identified a strong need for these, and they will become more important as the local, national and international pressure picks up for systemic environmental change. There is potential to seek sister organisation status with organisations such as the following, allowing WaterNZ members to attend update functions hosted by, for example:

- Infrastructure New Zealand, [INZ](#)
- Civil Contractors New Zealand, [CCNZ](#)
- Resource Management Law Association, [RMLA](#)
- [National Association of Women in Construction, NAWIC](#)
- NZ Institute of Landscape Architects, [NZILA](#)
- NZ Institute of Surveyors, [NZIS](#)
- International Erosion and Sediment Control Association (Australasian chapter), [IECA](#).

Companies

Some environmental companies and CRIs deliver environmental training e.g.

- [ETC](#), the WSP Opus Environmental Training Centre¹¹: discussed in s2.3.2, the ETC remains committed to training and the focus now is to respond to market demand for

training, where existing skills require extension, and also where there is a need and an established demand for developing training and related services to meet that demand.

The ETC delivers a comprehensive suite of training under the following topics:

- water & wastewater
- aquatics
- health & safety
- making good decisions
- Resource Management Act and environmental training
- [Southern Skies](#) Environmental Ltd, [RidleyDunphy](#) Environmental and [Mountfort Consulting](#) provide consulting and training on erosion and sediment control
- Chartered Professional Engineer Vivian Kloosterman through her Whangarei-based firm [Continuing Professional Development](#) runs online environmental training [courses](#)
- the Environment and Sustainability Strategy and Training Institute ([ESSTI](#)) does not deliver environmental subject matter training but runs six workshops to enhance the effectiveness of training delivered by subject matter experts for government, business and non-profit bodies.

[NAMS \(New Zealand Asset Management Support\)](#)

New Zealand Asset Management Support ([NAMS](#)) is a non-profit industry organisation established in 2008 as a charitable entity under the 2005 Charities Act, to promote asset management through the development of best practice guidelines and training. It delivers training in the topics of its six guidelines:

- [International Infrastructure Management Manual 2015 Edition](#)
- [Optimised Decision Making Guidelines](#)
- [Infrastructure Asset Valuation & Depreciation Guidelines](#)
- [Developing Levels of Service and Performance Management Guidelines](#)
- [Property Asset Management Guide](#)
- [Insuring Public Infrastructure Assets Against Damage Caused by Natural Disaster Events.](#)

Selected courses run by some of these organisations are below.

[WSP Opus](#)

RMA and environmental courses

<https://opusetc.co.nz/resource-management-act>

Classroom Based Courses

- Introduction to Maturanga Maori
- Waahi Tapu Best Practice Identification, Protection and Management
- Tools, Tips and Techniques for Best Practice Iwi Consultation and Collaboration
- Project Management for Iwi
- An Introduction to Resource Management
- Tips and Hints for managing and negotiating within the Resource Management and Local Government Act environments
- Sampling Techniques and RMA Consent Monitoring and Compliance

- Tools for the Efficient Management and Running of Hearings
- Best Practice RMA Decision Writing

Seminar and Interactive E-Learning Courses

- RMA Caselaw Update - What you need to know (2 hour interactive e-learning session)
- Understanding s32 RMA Changes and Guidance for Preparing s32 Assessments (4 hour interactive e-learning session or can be broadened to a 1 day classroom course)
- Tips and Hints for Managing and Mediating Pre-hearing Meetings (4 hour interactive e-learning session).

Making Good Decisions Courses

- Foundation – this course is intended for Councillors, Council officials, industry professionals and iwi groups to obtain certification to sit as an accredited member of a Hearings Panel.
- Recertification for Panel members – this course is intended for existing certified panel members who wish to recertify before the expiration of their certificate.
- Recertification for Panel Chairs – this course is intended for commissioners who are already experienced Chairs or who would like to develop skills as Chairs.

Engineering New Zealand

Business Skills for Engineers: selected courses

- [Global Trends in Business and the Environment](#) 1 hour
- [Influencing with impact](#) 1 hour
- [A Practical Guide to Cross-Cultural Communication](#) 1 day
- [Improving Cultural Intelligence](#) 1 hour
- [Assertiveness Skills – communicating with respect](#) 1 day
- [Communication: Stakeholder Relationship Management](#) 1 hour
- [Conflict Resolution: Dealing with Difficult People](#) 1 hour
- [Innovation without buzzwords](#) 1 hour
- [Mind to market](#) 1 hour
- [Crossing the chasm - marketing innovation](#) 1 hour
- [Risk Management - The healthy side of paranoia](#)
- [Tendering 101](#) 1 day
- [Liability to Viability](#) 1 day

Civil / Structural: selected courses

- [Stormwater Management and Design - An Introduction](#) 1 day
- [The Principles of Stormwater Treatment](#) 1 day
- [NZS 3916 – Design & Construct](#) 1 day
- [Temporary Works: Risk and Awareness](#) 1 day
- [Maximising Quality through Design](#) 7.5 hours
- [Geotechnical education](#) Complete at your own pace
- [Rain water technologies](#) 1 Hour
- [Understanding and applying QA frameworks](#) 1 Hour

- [Our impact on our environment - Earth](#) 1 hour
- [Our impact on our environment - Fresh water](#) 1 hour
- [Our impact on our environment - Marine](#) 1 hour
- [Our impact on our environment - Air](#) 1 hour

Legal Skills for Engineers: selected courses

- [RMA - The Engineer's Needs and Experiences](#) 1 day
- [What's new in construction law](#) 1 day
- [Contract law for non lawyers](#) 1 Hour
- [Contracts: The engineer's role](#) 1 hour
- [Expert Witness: Evidence Presentation](#)

NZ Planning Institute

https://www.planning.org.nz/Category?Action=View&Category_id=866

CPD courses

Advanced Policy Writing

Basic Negotiation Skills

Case Law Update

Coastal Inundation Planning

Economics of Urban Development

Effective Stakeholder Engagement

Emerging Leaders in Planning Ethics for Planners

Expert Witness/Presenting Planning Evidence

Managing the Surface and Groundwater Effects of Development and Infrastructure

Planning for Maori Values: An Update

PM1: Plan Making – An Update

PM2: Effective Plan Making

PM3: Running a Good Process

Principles & Practice of Designations under the RMA

RC1: Resource Consents – An Update

RC2: Assessing Environmental Effects and Notification Issues

RC3: Conditions, Decisions, Reports and Hearings

RC4: Effective Engagement in Environment Court & Board of Inquiry Processes

Soft Skills for Planners

Understanding Noise & Effects

Urban Design and Planning

Water Quantity & Quality

Planning under the RMA

Online education resources

Videos on Planning

- [Resilience Planning - UN World Conference](#)
- [Urban Design for Successful Cities: Alexandros Washburn](#)
- [Bicycle Culture by Design: Mikael Colville-Andersen](#)
- [Jason Roberts - How To Build a Better Block](#)
- [Making urban planning urban: Gregor Wiltschko](#)
- [Plenty of space - urban planning in Norway: Johanne Borthne](#)
- [Melbourne City Planner Reckons that Bigger Cities are Better Cities - Rob Adams](#)
- [Auckland Conversations](#)
- [Post Disaster Planning Program](#)
- [How a Brazilian City Has Revolutionized Urban Planning](#)
- [New Urbanism](#)
- [How to keep people living in small towns: Noah Fleming](#)

General Videos of Interest to Planners

Massive Open Online Courses (MOOCS)

Planning Reading Resources

Podcasts

NZIS

https://www.surveyspatialnz.org/news_and_events/training_on_demand

[Emotional Intelligence - Webinar](#)

[Business Mentors - Webinar](#)

[Good Project Management Tips and Tricks - Webinar](#)

[Women in Industry Workshop - Webinar](#)

[Innovative Urban Design - Webinar](#)

[Natural Hazards and Climate Change - Webinar](#)

[Science of Subdivision - Webinar](#)

[How to Attract and Retain the Best Talent - Presented by Mark Fisher of 84 Recruitment](#)

[NZIS 2017 Conference - Amy Fletcher The ethics and politics of big data](#)

New Zealand Asset Management Support (NAMS)

<http://www.nams.org.nz/>

Training and education

<http://www.nams.org.nz/pages/7/training---education.htm>

Manuals & Guidelines

<http://www.nams.org.nz/pages/6/manuals---guidelines.htm>

The NAMS Groups manuals and guidelines are distributed worldwide, except for the new IIMM Manual.

[International Infrastructure Management Manual ebook](#)

[International Infrastructure Management Manual 2015 Edition](#)

The 5th Edition of the globally acclaimed, International Infrastructure Management Manual (IIMM) has been driven largely by the introduction of the new ISO 55000 Asset Management Standards.

[Optimised Decision Making Guidelines](#)

This covers decision making and economic analysis of the maintenance, renewal and replacement of infrastructure assets, and includes over 30 actual case studies.

[Infrastructure Asset Valuation & Depreciation Guidelines](#)

A practical guide into the assessment of value, economic life and depreciation methods for infrastructure assets.

[Developing Levels of Service and Performance Management Guidelines](#)

Practical guidance on how to develop service levels that best reflect customer needs/values.

[Property Asset Management Guide](#)

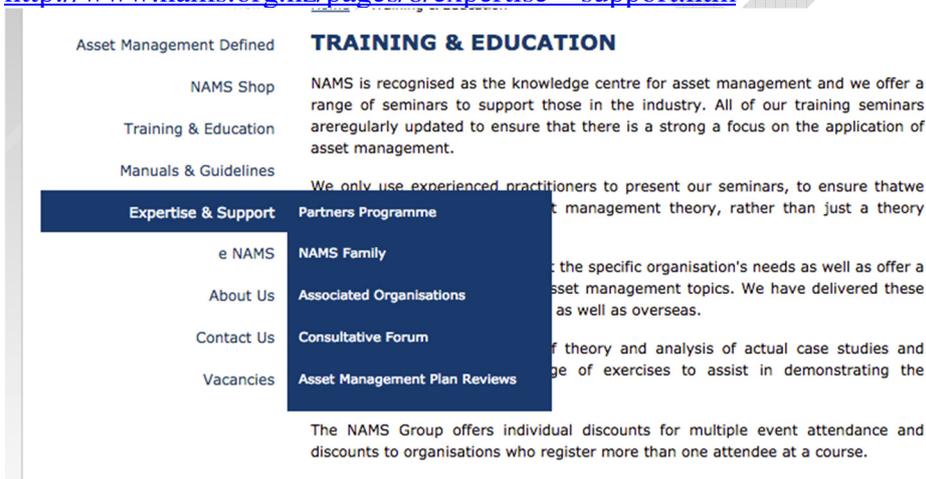
The newly developed e-manual now available. Described as a definitive guide to capital asset management, The NAMS Property manual is now available as a subscription based e-guide that will be dynamically updated as new regulations, tools and best-practice processes come to light. That means every subscriber will have the latest version, the latest information and latest tools available to them at all times, all in an easy-to-access online format. This completely replaces the print version of the manual.

[Insuring Public Infrastructure Assets Against Damage Caused by Natural Disaster Events.](#)

A natural disaster will typically be storm, tornado or cyclone, flood; earthquake, landslide, volcanic eruption or geothermal activity or tsunami. The guide does not include fire insurance other than fire occurring as a result of the listed perils. Fire insurance is a separate issue.



<http://www.nams.org.nz/pages/8/expertise---support.htm>



New Zealand Institute of Highway Technology (NZIHT)

The New Zealand Institute of Highway Technology (NZIHT) established in 1992 is a training organisation that delivers across New Zealand and off shore, offering formal block course qualifications from certificate to post graduate level and a diverse tailored range of short courses for the engineering, roading, construction and civil industries.

NZIHT is 100% owned by the Western Institute of Technology at Taranaki (WITT), but operates independently with its own offices, administration and Director. All programmes and courses offered by NZIHT are delivered under the Western Institute of Technology at Taranaki's accreditation. All academic processes associated with programme and course delivery are carried out in accordance with WITT's Quality Management System.

Currently the NZ Institute of Highway Technology is the largest provider of civil engineering, technical and skills training in New Zealand.

<https://www.nziht.co.nz/Short-Courses/>

- [Agile Management](#)
- [An Introduction to Quality Management](#)
- [Bitumen - Managing the Risks](#)
- [Communications Planning \(ON LINE course\)](#)
- [Competent Pipeline Rehabilitation](#)
- [Conflict Management Skills](#)
- [Construction and Maintenance of Road Drainage Systems](#)
- [Defining Project Goals and Objectives \(ON LINE course\)](#)
- [Economic Evaluations for Infrastructure Works](#)
- [Environmental Risks of Construction](#)
- [Productive Conflict](#)
- [Risk Management \(ON LINE course\)](#)
- [Stakeholder Identification and Analysis \(ON LINE course\)](#)
- [Stormwater and Groundwater - Development Effects - Part 1 \(ON-LINE COURSE\)](#)
- [Stormwater and Groundwater - Development Effects - Part 2 \(ON-LINE COURSE\)](#)
- [The Project Charter \(ON LINE course\)](#)
- [The Project Life Cycle and Organisational Styles \(ON LINE course\)](#)
- [The Project Work Schedule \(ON LINE course\)](#)
- [The Work Breakdown Structure \(ON LINE course\)](#)
- [Time Management](#)
- [Understanding the National Utilities Code](#)
- [Understanding the Tender Process](#)

Personal and professional development opportunities for stormwater professionals

Note that these organisations provide the technical training listed in **Task 2** and reproduced above, but only professional development course are listed here, and the list is not comprehensive.

The following organisations list particularly good options for career development as well as technical training:

- Society of Local Government Managers ([SOLGM](#))
- Environmental Institute of Australia and New Zealand([EIANZ](#)).

SOLGM professional development opportunities:

- [LGLeadershipPathways Initiative](#)
- [LG Accelerated Leadership Programme](#)
- [LG Executive Leaders Programme](#)
- [Management Challenge](#)
- [SOLGM Local Government Excellence Awards@](#)
- [Emerging Leader Award](#)
- [Leadership Scholarships](#)

- [Overseas Manager Exchanges](#)
- [LG How Local Government Works® Programme](#)
- [Webinar Recordings](#)

Engineering New Zealand offers the following selected Professional / leadership development courses:

- [Developing Leadership Potential](#) 1 hour
- [Professional Acumen - Networking](#) 1 hour
- [Career Bootcamp – your career, your responsibility](#) 1 hour (4 webinars)
- [Essential Skills of the Mentee](#) 1 hour
- [Essential Skills of the Mentor](#) 1 hour
- [Essential Skills of an Effective Mentor](#) half-day
- [Leading High Performance Teams](#) 1 day

The New Zealand Institute of Highway Technology (NZIHT) offers courses on:

- [Effective Leadership](#)
- [Transforming your Leadership](#)

Who could use this information? Some clues lie in the 2016 survey responses in **Table E** below. The results of the 2016 and 2018 surveys yield some interesting results as shown in **Tables 4.4 and 4.5**. Table 4.4 shows that the responding professionals are clumped into what may be called middle management, with a small number of graduates and a small number of directors.

Table E What best describes your current profession?

Source: 130 respondents to the 2016 stormwater industry survey

Role (selected from list)	Percentage of Respondents (rounded)	Number of Respondents
Senior	24	31
Team leader / manager	20	26
Intermediate	20	26
Principal	12	16
Director	11	14
Graduate	8	11
Other (self-stated)	Number of Respondents (totalling 5%)	
Director/Owner	3	
Intern	1	
Impartial Investigations Engineer	1	
General Manager	1	

Toolkit 14 Overseas examples of stormwater education and training

There are many well-established stormwater and WSUD research, training and outreach programs around the world. Most are from jurisdictions much larger than Auckland and indeed New Zealand. That said, we can learn much and perhaps benefit from partnerships and knowledge exchange as we put in place a more formal programme than has hitherto been available here.

Other overseas providers providing training are listed on the Water New Zealand [website](#).

Melbourne

The WSUD Aotearoa research program has partnered with the Melbourne-based Cooperative Research Centre for Water Sensitive Cities (CRCWSC, or CRC) which was established in July 2012. Its purpose is to help change the way we design, build and manage our cities and towns by valuing the contribution water makes to economic development and growth, our quality of life, and the ecosystems of which cities are a part. The CRC brings together many disciplines, world-renowned subject matter experts, and industry thought leaders who want to revolutionise urban water management in Australia and overseas. It has just released its [ZAM WSUD Handbook](#): Zero Additional Maintenance Water Sensitive Urban Design without ongoing maintenance requirements for asset owners.

Training topics offered by the CRC include:

- Benefit Cost Analysis and the Non Market Value Tools
- WSUD Maintenance
- Retrofitting for WSUD
- Biofilters, rain gardens, bioretention areas – what are they?
- Foundations of Water Stewardship Online Training
- Waterwise Council Program
- Governance and policy
- Comprehensive Economic Evaluation Framework project (IRP2)
- Catalysing WSCs through professional learning: design and delivery recommendations
- Non-market valuation of water sensitive systems and practices
- Urban Futures: see it for yourself
- Water Utilities of the Future: Australia's experience in starting the transition
- Water Sensitive Outcomes for infill developments (IRP4).

Other Australian programs

Some of the CRC's training is offered through partners, including via [New WATERways](#). New WATERways was formed as an incorporated association in Western Australia in 2006 to enable excellence in integrated water cycle management and WSUD and to build the capacity of government and industry practitioners. Its governing members are:

- Department of Planning, Lands and Heritage
- Department of Water and Environmental Regulation
- Department of Biodiversity, Conservation and Attractions
- Western Australian Local Government Association
- Urban Development Institute of Australia (WA)

- Water Corporation.

Other WSUD-related training in Australia is available through [Healthy Land and Water](#), an independent organisation working to improve the sustainable use of land and waterways in South-East Queensland. Its [Water by Design Program](#) provides training courses to support industry and government to implement best practice stormwater management and [Water Sensitive Urban Design](#), including:

- [bioretention design](#)
- [construction and establishment of vegetated stormwater systems](#)
- [managing and maintaining vegetated stormwater assets](#)
- introduction to water sensitive urban design
- concept design of water sensitive urban developments
- fundamentals of stormwater wetland design
- advanced stormwater wetland design
- fundamentals of swale and sediment basin design
- stormwater harvesting
- managing and maintaining vegetated stormwater assets
- MUSIC assessors training.

[Clearwater](#) in Melbourne focuses on building integrated water management capability, and works with local government and contractors in the Melbourne Water area to co-develop and deliver in-house training for them. Of particular interest is what it calls “[construction hold points](#)” training, to improve theoretical and practical understanding that ensures WSUD assets are constructed as designed and fully-functional to accept at handover. Hold points are defined as the key points in time where work must cease until all tasks have been checked, completed, approved and signed off by all parties.

The Infrastructure Sustainability Council of Australia, [ISCA](#), offers several training courses on sustainable infrastructure for people new to the profession as well as very experienced practitioners. It has an extensive set of infrastructure sustainability tools and offers an accreditation system. This programme is attracting a lot of interest from New Zealand and appears to be well-regarded.

Workshops on relevant topics are also run by the Institute of Public Engineering Works Australasia, [IPWEA](#) and the Environmental Institute of Australia and New Zealand, [EIANZ](#), as mentioned above.

The Australian Water Association is using [webinars](#) to break down the restrictions of interstate travel and to connect Australians nationally and internationally. A sister organisation approach could also be used to gain access relevant material.

Through the New Zealand Planning Institute, planners in New Zealand can access [podcasts](#) produced by the PlanningXchange in Melbourne. The series is supported by the Planning Institute of Australia. The programs involve an interview subject and cover a wide range of city, planning and design issues and are released on a monthly basis. The series seeks to be relevant to an international audience.

The Engineering Training Institute Australia ([ETIA](#)) is a training organisation that was established in 1998 under the banner of “Cement and Concrete Services”. It specialises in technical engineering workshops and training courses for professional people in the industry. Attendees to these courses include civil and structural engineers, environmental engineers, Council and Local Government technical staff, professionals in the armed forces, concrete suppliers as well as semi-professionals who wish to improve their skills in particular areas of expertise e.g. concrete repair and protection. Among its courses is a 1-day course covering the design and construction of concrete pipes and pipelines to AS/NZS 3725 and AS/NZS 4058.

[Ian Morgans](#) at Port Phillip & Westernport Catchment Authority <https://www.ppwcm.vic.gov.au/>
<https://www.ppwcm.vic.gov.au/regional-catchment-strategy/> [Clare to finish]

UK programs

Brunel

This is UK focused, but most of it is applicable to NZ. Appears to be entry level focused.
<https://www.brunel.ac.uk/business/Centre-for-Flood-Risk-and-Resilience/e-learning-courses>

CIRIA publish the SUDS manual

[CEEQUAL](#) in [CEEQUAL](#) - the evidence-based sustainability assessment, rating and awards scheme for civil engineering, infrastructure, landscaping and public realm projects.

[ICE](#), The UK-based Institute of Civil Engineers. See also [Thomas Telford Training](#)

The Chartered Institution of Water and Environmental Management ([CIWEM](#)) runs online and classroom-based courses and also accredits universities all around the world to deliver [bachelors and masters courses](#) on specialised water-related topics. It also offers [mentor training](#) and a number of online courses, including one on [constructed wetlands](#).

Institute of Environmental Management & Assessment, a network of more than 14,000 environment and sustainability professionals people in over 100 countries, [IEMA](#)

North American programmes

Overview

The [City of Portland](#) Oregon’s Environmental Services Unit manages the city’s stormwater system and works with citizens, businesses and property owners to reduce stormwater pollution, promote private stormwater management and protect our rivers, streams and groundwater. Portland manages stormwater as a valuable resource through green infrastructure, along with pipes, sumps and the [wastewater treatment plant](#), to improve [watershed health](#) in order to protect public health, water quality and the environment. Portland finances stormwater management services by collecting public utility fees on developed property, and system development charges (SDCs) on new development.

The City doesn’t appear to run training programmes itself, though there are trainers accredited to deliver stormwater training in various parts of the country, such as [Stormwater One](#). However the policy and community approach is robust and could usefully inform New Zealand stormwater management and training programmes.

[Forester University](#) runs an extensive webinar programme on a range of projects including erosion and sediment control and stormwater.

The US-based but now global International Erosion Control Association ([IECA](#)) offers online learning, regional & international events and onsite training on four educational tracks:

- erosion and sediment control
- stormwater management, including LID
- wetland, stream bank and shoreline restoration
- municipal separate storm sewer system (MS4) management.

The IECA offers two forms of certification:

- CPESC[®]: Certified Professional in Erosion & Sediment Control. CPESC training is delivered through [Envirocert](#) in the USA and in Australasia through the [Australasian](#) Chapter of the IECA
- RCEP: the Registered Continuing Education Providers ([RCEP](#)) Program is a nationwide registry of continuing education providers that have demonstrated adherence to high-quality, effective practices in the development and delivery of professional education activities for engineers, surveyors, and related industry professionals.

Examples of other stormwater-related training programs include⁴³:

- Minnesota [programs and training](#) related to:
 - stormwater design (most of the design criteria are set at the state level)
 - asset inspection, assessment & maintenance
 - erosion & sediment control
 - how to develop "Stormwater Pollution Prevention Plans" or sometimes Programs ([SWPPP](#)) at the state/municipal level
- North Carolina, which also provides a major [stormwater training program](#)
- two free LID e-learning [courses](#) from [Sustainable Technologies Evaluation Program \(STEP\)](#) and Natural Resources Canada, on quantifying design infiltration rates and LID construction preparation⁴⁴.

There is a huge amount of stormwater-related training and other information on the internet, and more targeted research would be needed to scan what's available and narrow down the best examples for New Zealand to follow on particular topics.

A leading US model currently being actively explored for use in New Zealand is outlined below.

WEF National Green Infrastructure Certification Program (NGICP)

Like WaterNZ, WEF is a membership organisation: it is a not-for-profit technical and educational organisation of more than 34,000 individual members and 75 Member Associations representing water quality professionals around the world. It thus enjoys considerable economies of scale.

The Water Environment Federation ([WEF](#)) is a center for excellence and innovation focused on developing best-in-class solutions to stormwater runoff and wet weather issues. It offers a large number of very specialised training [courses](#).

The Auckland Council's Healthy Waters team, with the support of the WaterNZ Stormwater

Education and Training Subgroup, is actively exploring the application in Auckland of the WEF's National Green Infrastructure Certification Program ([NGCIP](#)).

The NGCIP originated as a Washington D.C. water partnership program in which only trained and certified people were allowed to work on green infrastructure assets. This initiative grew to become a national program with WEF as the certifier. It was designed to meet international best practice standards and intended to establish a properly-trained workforce. The NGCIP certification applies to [individuals](#) who must pass a test after being trained and to [training providers](#).

The certification program provides the base-level skill set needed for entry-level workers to properly construct, inspect and maintain green infrastructure (GI).

In a skype meeting with the NGCIP Program Director, Adriana Caldarelli and Auckland Council Healthy Waters on 31 October 2018, the answers to some searching questions demonstrated that Washington D.C and WEF had followed a robust and collaborative development process for NGCIP. WEF was very open to exploring how it could be applied to New Zealand.

Among much other helpful detail, the following points emerged:

- to accommodate the diverse environments across the USA, the training and exam focus on core concepts, principles of constructing, inspecting and maintaining green infrastructure
- locally appropriate content can be added but none of the core material can be removed
- subject matter experts delivering the training must undergo a 5-day workshop and undertake ongoing professional development with respect to their training
- the certification does not apply to design of green infrastructure, but it has become evident that better industry understanding and practice of GI construction, inspection and maintenance was feeding back into improved design in these respects

An attendee at the 29 Sept-3 Oct 2018 WefTec conference in New Orleans also noted WEF's observation that setting the NGCIP was a heavier work burden than they had initially thought⁴⁵. This highlights the benefits of a very small country like New Zealand partnering with a larger one like the US.

Toolkit 15 Growing a pool of stormwater SMEs who can train

Method:

Work together with our stormwater SMEs to grow a pool of good trainers before and after the training: TTT and debrief continual improvement CPD.

Criteria for selecting stormwater SMEs to become trainers

We want people who:

- are interested in training
- have an aptitude for training
- have the tie to invest in the training
- willing to commit to his or her ongoing professional development both as a trainer and as a subject matter expert
- other – see Jonathans Mackey’s NGICP assessment sheet

For the stormwater sector, these people will have:

- passion
- vision
- competence

For developing/delivering training, these people will have:

- openness to learning
- interest in people
- time ...

Recruitment

How do we **empower** stormwater subject matter experts (SMEs) and their employers to give up their time to develop training? – e.g.:

- **inspire** individuals to take part: presentations and panel discussions at conference (like the Innovation one) to inspire members to support the training plan. Other communications that frame the opportunities and present the business case
- win the **commitment** of organisations
- **leverage** the talent (see # below)
- **incentivisation**: free 1-2 year membership of Water NZ + free conference registration
- **reputation**: recognising the firms who support their experts to develop and deliver training, peer review it and more.

What will it take to make this happen?

- key words/banners for the work:
 - placemaking in the stormwater sector by and for the people we serve
 - leverage off the stormwater sector’s strong sense of community, collegiality, connectivity
- making it safe to fail – we learn from our mistakes
- mentoring and support
- review panels for new ideas

- basic goal to speed up the water sensitive development process: review ⇒ stamp of approval, like the proprietary devices protocol idea

What's the stormwater sector's secret superpower? We like each other and we love stormwater!

Layers of expertise and empowerment:

Growing our own capability



Toolkit 16 Train the Trainer Training for stormwater subject matter experts

There is no requirement in New Zealand similar to the NGICP's for environmental subject matter experts to undergo Train the Trainer Training (TTT). However, to ensure credibility with target audiences and funders, stormwater trainers really must get up to speed with the principles and practices of adult vocational training.

The only evidence of interest in the TTT concept in the stormwater and related sectors in New Zealand is two short downloadable leaflets on Tips for Presenters (basic and advanced) on the NZ Planning Institute's [website](#).

For environmental experts delivering training on other stormwater-related topics, options include:

- a [Learning to Train](#) workshop especially for environmental experts that allows time for trainees to prepare and deliver a module of training and receive feedback on this, with the trainer also attending the subsequent live workshops and giving further feedback. This approach worked very well for the legacy ARC's staff delivering riparian training
- TTT workshops run by professional trainers who are members of or otherwise affiliated to the New Zealand Association of Training and Development ([NZATD](#)), and ongoing professional development as trainers through membership of the Association
- training through the EMA (Employers and Manufacturers Association), including:
 - Delivering Effective Training [Programmes](#)
 - [Adult](#) Education and Training
 - Training Design and Training [Needs Analysis](#)
 - EMA [Certificate](#) in Adult Education & Training
- extending current discussions with NGICP about the number of New Zealand trainers it can train in the near term in green infrastructure maintenance, to include an assessment of New Zealand-based TTT training content and delivery on offer, so as to ensure a similar standard of excellence is achieved.

This demonstrates the need for each trainer to commit to his or her ongoing professional development both as a trainer and as a subject matter expert.

Toolkit 17 The flipped classroom model

The flipped classroom model⁴⁶ reverses traditional learning delivery by delivering instructional content, often online, outside of the classroom and moving activities that may have traditionally been considered homework into the classroom.

New Zealand science teacher Chris Clay won a global award for his innovative teaching when he put podcasts of some of his Level 3 NCEA Biology lessons on YouTube⁴⁷.

He also created a wiki 'so his students could collaborate with one another about what they got - and didn't get - about the podcast. Often students would answer questions for each other'.

What this meant was that the role of lessons and homework were reversed: homework 'was to watch a podcast and post to the wiki. Class time was to "contextualise" the learning.'

As well as making the best possible use of the face-to-face time in the classroom, other benefits of this blended delivery model included:

- engaging students in their familiar online world
- providing personalised learning whereby students watch the podcasts at their own pace
- offering a collaborative environment – the wiki – for students and teachers to clarify understanding
- building relationships
- improved student achievement in NCEA
- benefits to Clay's own teaching practice from feedback given on his online resources.

Other supportive methods will be largely generic across all the training, though some will need special support, including, for example:

- study aids for people doing online training, such as those provided by:
 - WEF in the form of [quizzes](#), detailed technical [glossaries](#) and topic-specific [study guides](#)
 - [Spectrum Education](#), helping students learn how to learn (this approach could readily be tailored for adult learners)
- methods of training delivery and assessment for people with language and literacy challenges.

Toolkit 18 Other things that support effective training programs

One respondent to the 2018 survey said:

‘Many respondents want to know what is going on elsewhere, including industry developments. Water NZ is already playing a lead role in facilitating sharing knowledge through Magazine, LinkedIn and the website. Regular promotion of these platforms to the wider industry is needed.’

These and other follow-up activities are summarised in this Toolkit and can be expanded into different wrap-around supporting activities tailored to the audience and each training delivery audience, topic and method.

Table 18.1 Other activities that support uptake of stormwater-related training in New Zealand

Source: Water New Zealand Stormwater Education and Training Water New Zealand (2017)⁴⁸

Activity	Content	Frequency and location	Constraints and limitations	Actions
Regional Meetings	Technical Presentations by Guest Speakers Networking	Refer Stormwater Group Work Plan	Travel for attendees Undertaken in ‘free time’ Awareness of events Limited number of attendees	Ongoing, regular promotion of events.
WATER Magazine	Industry-wide	5 Magazines per year	Reach is limited to subscribers	Promote training opportunities in the magazine
LinkedIn	Ad hoc, generally relevant to stormwater	Ad hoc	Reach is limited to subscribers/users Reliant on volunteers to post Limited number of people viewing	Ongoing, regular promotion of platform by Water New Zealand Communications Water New Zealand

A network dedicated to sending regular updates is [The Water Network](#) hosted by Zurich-based AquaSPE, is the largest online knowledge portal and business ecosystem for water professionals.

Table 18.2 Action list arising from the 2016 stormwater industry survey

Who	What
Stormwater Committee	Identify/advise stormwater Education and Training Water New Zealand on existing courses/trainers (if any) in Water Sensitive Design.
Conference Committee Education & Training Water New Zealand	If there are existing courses/trainers available, identify a Water Sensitive Design training option for the Stormwater Conference, review, and incorporate into Conference Programme as appropriate.
Education & Training Water New Zealand	<p>If there isn't an existing course/trainer, prepare a plan for arranging a future training course.</p> <p>Feedback to Universities on industry needs.</p> <p>Review Stormwater Group webpage and prepare a plan for how it can be used as a knowledge library or reference point. Requires webpage update, scoping and initial data gathering.</p> <p>Review Jamie Comley WSD Course pre-conference content compared to IPENZ Stormwater Management course. Consider overlap, content, whether two courses or one longer course is appropriate.</p> <p>Review the scope of the UoC Masters course compared to identified skills gaps.</p> <p>Education and Training Sub Group working with Communications Sub Group.</p> <p>Ongoing identification of existing training opportunities/needs and ensure they are promoted via existing communications modes.</p>
Policy Sub Group Education & Training Water New Zealand	Approach Auckland Council to provide training on Stormwater Rules in the Unitary Plan
Communications Water New Zealand	<p>Identify measures to further promote/facilitate stormwater communication in the industry.</p> <p>Identify methods for engaging/sharing with organisations linked to stormwater (e.g. with cross over of Water Sensitive Design), such as Landscape Architects, Architects, Sustainability Society.</p> <p>Promote/communicate the website as a source for references.</p>
Technical Sub Group	support for NZ Rainfall Runoff Guidelines.
Water New Zealand	Liaise with IPENZ regarding CPD credits for future training courses.
Water New Zealand Stormwater Education and Training Water New Zealand	Financial review of WSD and AUP courses to identify how/whether the course could be run again.

It is a tribute to the collegiality and commitment of Water New Zealand members that these actions have been achieved, given that this work is done by volunteers supported by an active but small body of Water New Zealand staff.

Toolkit 19 Detailed industry suggestions for funding our training

Source: 2018 Water New Zealand Stormwater Education and Training Water New Zealand survey

First Priority (60 responses)
<p>1. Industry sponsors (10 responses)</p> <ul style="list-style-type: none"> • Industry could fund an introductory course on stormwater management • Plus in-kind support e.g. presenters <p>2. Certification through established professional bodies (9)</p> <ul style="list-style-type: none"> • Requirement for certified designers/installers through codes and plans would promote training • Make it compulsory for qualified people to design, construction and operate • [requirement for] experienced professionals <p>3. User pays (6)</p> <ul style="list-style-type: none"> • Paid course • self training to lower costs <p>4. Support through national professional bodies (5)</p> <ul style="list-style-type: none"> • Engineering NZ • Professional bodies – needs to be independent • Professional bodies working with industry • use professional bodies <p>5. Industry employers pay (3)</p> <ul style="list-style-type: none"> • must pay • Fund the training on the job ('team work') • Cadets programme for recently graduated with placements of fixed timeframes in design role, construction, regulatory and asset management. <p>6. Council sponsorship and other approaches (2)</p> <ul style="list-style-type: none"> • Local and regional authorities to drive training • Territorial authority rules requiring plans to be prepared or certified by a registered professional. [Registration] Fees pay for the training. <p>7. Support through educational institutes (2)</p> <ul style="list-style-type: none"> • designed and delivered by industry and educational institutes such as Unitec • As part of tertiary training (BE, Post Grad Diploma etc.) <p>Other comments:</p> <ul style="list-style-type: none"> • If general acceptance that the training adds value: then <ul style="list-style-type: none"> ○ incentives for industry and government to sign up for continuing education programs ○ include in professional development requirement of large public orgs (counted in 4 above) ○ keep each module to a day • fund their development and then make available online • How to ensure they are relevant to accreditation bodies. • Monthly professional events supported by industry sponsors held in Auckland/Wellington/etc, with presentations made available as fee-paying webinars to those in regions/elsewhere. • Prove the benefits of the training through application and success • Provide targeted efficient courses in a range of centres that are good value • Shorter and more targeted (block type courses) • specify whether its development of training resources
Second Priority (37 responses)
<p>1. Industry/other (unspecified) sponsors (8 responses)</p> <ul style="list-style-type: none"> • Industry Leadership <p>2. Certification through established professional bodies (5)</p> <ul style="list-style-type: none"> • Certification • Professional body CPD accreditation • Chartership <p>3. User pays (4)</p> <ul style="list-style-type: none"> • Self-funded training <p>4. Support through national professional bodies (6)</p> <ul style="list-style-type: none"> • Course development supported by professional bodies • attach to other industry training qualifications • Integrate into institutional learning i.e IPENZ, Worksafe etc • through Engineering NZ?? • IPENZ Stormwater membership fees

- manage through professional bodies - but be aware not all of us in stormwater are engineers so we don't neatly fit into existing professional bodies!
5. Industry employers pay (1)
 - Employer subsidy
 6. Council sponsorship and other approaches (0)
 7. Support through educational institutes (2)
 - Academic scholarships
 - educational grants
 8. Collaborative approaches
 - Private/Public sponsorship
 - Collaboration design, operation, etc. of stormwater devices with suppliers/manufacturers
 - Experts work together to donate time where they can
 - More partnership-working on chartership/certification schemes to avoid double-ups (e.g. partnerships between Water New Zealand /Engineering NZ / etc and overseas bodies such as CIWEM, AWA and Engineers Australia)
 - pipe suppliers will help sponsor some elements as long as we accept a bit of a sales pitch as well
- Other comments:
- Benefits of the outcome need to be fed back into the projects
 - [Development] versus actually delivering the courses
 - Make them available for companies/agencies to book for group trainings
 - Market through appropriate channels e.g. SOLGM
 - Webinar / videos available online
 - Webinars

Third Priority (16 responses)

1. Sponsors – unspecified and related ideas (4 responses)
 - Use donated spaces e.g.. industry premises
 2. Certification through established professional bodies (2)
 - tie to registration/chartership
 3. User pays (1)
 4. Support through national professional bodies (2)
 - Water New Zealand and or IPENZ grants
 - Ensure that credits can be earned that can go towards other qualifications
 5. Industry employers pay (0)
 6. Council sponsorship (0) Other approaches (1)
 - Work on lead projects should be R&D funded (Callaghan)
 7. Support through educational institutes (1)
 - Collaboration with tertiary institutes
- Other comments
- Best information and presenters for the specialist area being taught
 - use accepted overseas material
 - In-house courses (external trainers if required)
 - look at online learning to lower costs
 - Make them easily available e.g. online and remote learning options
 - set up a national platform for resources

Fourth Priority (5 responses)

- Certification process across all stages
- Mandatory qualifications
- On the job training.
- multidisciplinary
- Design/Construct/Operate/Maintenance/Regs/Compliance/Monitoring... CIWEM??? CEnvP???

Fifth Priority (1 response)

- Employee pays for course, extra wages or salary on completion.

Lack of funding throws up many different barriers to meeting the significant training needs identified by the sector:

- small firms can't afford to pay training fees and associated costs including travel, accommodation and living costs to attend centralised training
- high costs and low numbers of trainees have been a barrier to past uptake of training and frequency of delivery (**Table 9.2**)
- time is a serious constraint: the sector is under pressure and even some of the bigger firms can't always release staff experienced staff to deliver training and other staff to attend it
- training on important topics isn't available: the sector has the necessary the and its members are willing, but the high cost of training development and administration makes it too hard for volunteers to bear all the costs.

At the same time, New Zealand faces the same pressures as other countries, as shown by observations from technical trainers [Job Training Systems Inc](#):

More new employees with no practical exposure to basic tools are joining the work force. An understanding of basic tools is an essential part of mastering basic mechanical tasks.

Training in maintenance fundamentals is essential to competing in a worldwide economy. The impacts of poor stormwater training affect communities all over New Zealand. Any funding options need to deliver a sustainable training program for as long as communities, councils and sector professionals deem it necessary.

Question 6 of the 2018 industry survey asked respondents:

If new training or educational courses are required, how do we make them financially viable in the long term? (For instance: find industry sponsors, support certification through established professional bodies)

Respondents were asked to rank their suggestions in order of first, second, third, fourth and fifth priority. The wealth of ideas is listed in full in **Toolkit 19**, and a summary is in **Table 10.2**.

Sponsorship comes high up in all three levels of priority, as does certification or other support from professional bodies, along with user pays – which confers the subsequent benefit of higher wages, according to one respondent.

A further comment from the survey was:

“Videos: small videos for quick and easy reference and guidance. Series of training videos open source on YouTube. Most impact and spread with lowest cost to trainees.... cost to produce would be an issue though.”

This comment highlights the need to align as far as possible the necessary training and market size with the delivery and funding options to come up with the most cost-effective methods, and these may or may not be the cheapest.

As part of the work of Auckland Council Healthy Waters in introducing the US NGICP (National Green Infrastructure Certification Program) to Auckland as a pilot, a fully commercial funding

model is being developed. The necessary prior investment by the Council is a significant contribution to the industry.

Any such commercial model should not exclude the potential for grants and similar revenue streams to supplement income from the training itself.

There may be other funding opportunities in the pipeline, for example:

- a medium-sized [Envirolink Funding](#) application could support training/outreach for small councils. Jo Martin (Nelson District Council) was investigating this, and other Councils could come on board
- outputs of the [WSUD research program](#) may identify other sources of funding
- the Ministry for the Environment may make funding suggestions as part of promoting its WSUD principles and practices
- the Government's [Construction Skills Action Plan](#).

Toolkit 20 About Learning Management Systems

The information in this section has been drawn from the main sources referenced in the endnotes⁴⁹. These sources will be very helpful for any future action. There are many experienced and well-regarded providers of LMS services in New Zealand and they can be accessed through the NZ Association of Training and Development.

A learning management system (LMS) is a software application for the administration, documentation, tracking, reporting and delivery of educational courses, training programs and learning and development programs. The first LMSs appeared in the 1990s in the higher education sector, but today most LMSs are used in the corporate training market.

The most common purpose of LMS software is to deploy and track online training initiatives. There are three main LMS user groups (some of them may be the same people):

- administrators: the people setting up and configuring the LMS platform from which online training content and other information is distributed and updated
- instructors: the people preparing the training and accessing the learners' progress
- trainees: the people doing the learning.

An LMS delivers and manages all types of learning content via a range of multimedia tools, courses, and documents. Some LMSs have inbuilt authoring tools allowing trainers to develop online training materials without additional third-party software.

Through an online LMS:

- trainers can:
 - create and integrate course materials, articulate learning goals, align content and assessments, track studying progress, and create customised tests
 - communicate learning objectives and organize learning timelines
 - deliver learning content and tools straight to learners
 - reach marginalized groups
- learners can:
 - see in real time their progress and instructors can monitor and communicate the effectiveness of learning.

One of the most important features of LMS is the ability to enable streamlined communication between learners and instructors.

Advanced features include the ability to:

- organize and hold e-conference sessions, with multiple students participating through audio and video
- support online whiteboard functionality, so instructors and students can create and share writings and drawings in real time
- provide discussion boards
- sell courses and integrate with payment processors such as PayPal and Stripe
- use the LMS with mobile devices (smartphones and tablets), including being able to study when offline.

In the education and higher education markets, an LMS will also have features such as:

- rubrics; a scoring guide used to evaluate the quality of trainees' responses
- a syllabus; the subjects in a course of study or teaching, a guide to a course and what will be expected of people who enrol in it. A syllabus should tell trainees nearly everything they need to know about how a course will be run and what will be expected of them⁵⁰.

Corporate LMSs seldom include a syllabus, although courses may start with heading-level index to give learners an overview of topics covered. For Water New Zealand, the development cycle is not a syllabus, because people can't be expert specialists in all of its diverse aspects. However, the training content within each stage may be regarded as a syllabus.

Does the Stormwater Education, Training and Development Plan need an LMS?

From the discussion above, it's clear that the term LMS has come to mean a system that enables online learning, and that the sky is the limit when it comes to technology – and, by implication, budget.

The Stormwater Education, Training and Development Plan will undoubtedly include e-training, but the discussion in the tables in **Toolkit 5** show the many different agencies involved in training and the gap in our knowledge of the level of training of stormwater professionals at all levels of expertise and at all phases of the development cycle.

Particularly difficult to capture for projects like this one is workplace-based training and development, especially in-house training by many member and non-member organisations of Water New Zealand.

On the one hand, we must collect data about the cost-effectiveness of training. On the other, our experience with trying to collect economic data from the industry to assess the costs and benefits of WSUD shows that the usual trajectory of a new initiative is “a first flush of enthusiasm followed by stagnation.”

Trying to collect data on formal and informal education and training is likely to meet the same fate, unless the system is exceptionally easy to use and very well-run.

This raises several questions for the stormwater sector to consider:

- what different LMS hosting and pricing plans are available?
- is investing in a Learning Management System worth the likely investment?
- or will a more manual approach suffice?
- what are the advantages of investing in an LMS?
- which features should we look for?
- who else has an LMS we could use?
- or should we have our own?

Cost-effective training is such an important issue for the stormwater sector that we must acknowledge that we do need an LMS – and that what it might look like is open to discussion.

Toolkit 21 What can be certified and examples of environmental certification schemes

Certification can apply to many things other than trainees⁵¹. Some of the words bandied about include (more or less in order of increasing rigour) assessment, approval, certification, accreditation, qualification, licensing and registration. Some of these can be done in-house while others involve working with external parties.

These terms are briefly explained below so that the Stormwater Water New Zealand can consider which elements of certification merit investigation for use in the medium to longer term.

Assessment

'Assessment' means measuring each trainee's learning as a result of their training, as outlined in **Appendix C**. It's also important to distinguish between assessment of learning and assessment of workplace performance or environmental and business outcomes, because no matter how well trainees learn, they may not always be able to apply their learning in their workplace (as described in s, and should not be penalised if this happens.

Approval

Many trades and professional bodies require their members to complete a specified number of hours or points of approved or endorsed training per year, as part of their continuing professional development (CPD). Depending on the content and duration of the training, these bodies allocate varying numbers of CPD points to approved training courses and members who attend can claim these towards the total required. These points are much-valued by people who belong to membership organisations, such as engineers, planners, surveyors, ecologists, landscape architects, contractors and many other occupational groups whose work has environmental components.

Certification and accreditation

Certification is a formal procedure in which an authorised third party assesses and verifies that an individual, organisation, process, service, or product meets certain established criteria, requirements or standards, and issues a certificate to say so. There may be eligibility requirements (such as education or years of experience), an examination and a fee. For example, this is the case for people wanting to become a Certified Professional in Erosion and Sediment Control, or CPESC, making this a professional certification. There are also usually ongoing requirements that need to be met, such as retesting or participating in a minimum number of continuing education activities. The decision for someone to become certified is often a voluntary one.

Options include certification of:

- **trainees**, e.g. with a diploma or degree, or the NGICP or equivalent, such as the IECA's CPESC (Certified Erosion and Sediment Control Professional) certification
- **trainers**, e.g. with a Train the Trainer certificate issued by the NGICP or other recognised body. Another example is that WEF and other environmental training is delivered by [StormwaterONE](#) as the preferred provider
- **courses**, such as the NGCIP training course

- **products**, for example as was envisaged by GD03, the Auckland Councils' draft Proprietary Device Evaluation Protocol for Stormwater Devices
- **infrastructure**, for example the [Infrastructure Sustainability Rating Scheme](#), Australasia's only comprehensive rating system for evaluating sustainability across the four wellbeings and across the planning, design, construction and operational phases of infrastructure programs, projects, networks and assets. Green Roads and Living Buildings are similar examples.

Organisations can set up their own certification or accreditation systems and then certify or accredit other agencies and also people, products or processes. There are also more and more well-regarded third-party certification programs available for a rapidly-expanding range of products and services, including, in some countries, for civil engineering projects.

Qualifications

Formal educational qualifications are conferred by a recognised institution such as a university, polytechnic or industry training body. People with university degrees are often happy to get CPD (continuing professional development) points for attending training: if they want to get a higher degree or a specialist diploma, they are usually motivated enough to organise this for themselves, and won't generally need to get such recognition from any environmental training they attend.

Qualifications from polytechnics or industry training bodies are usually more suitable for people who are unqualified and want to gain a qualification, those who are undergoing further education, or those who want the satisfaction of achieving a particular specialist skill. Gaining a qualification can give a huge sense of achievement for people with no formal qualifications yet who are very skilled operators who take pride in their job – these people are the often unsung heroes of front-line environmental work.

However, existing qualifications may not cover environmental performance to the standard the organisation needs or wishes. In that case, these institutions are happy to work with other organisations to develop appropriate content and resources.

Licensing or registration

Licensing or registration is compulsory in some professions such as law, medicine, architecture and engineering, to ensure that their members are fully qualified to practice. In most such cases, practising certificates can be withdrawn on the grounds of professional misconduct. This is often a system backed up by legislation that can include legal sanctions against those concerned. Such systems are much more formal and enforceable than an environmental certification: most of us can continue to carry out our work without undergoing recommended environmental training, though we may in some places find it hard to win work without it.

Other certification programs

Running even one certification program is demanding of administrative resources. Sections 4.3.1 and 2 have referred to several programs run by reputable bodies with a New Zealand presence, and some of these will be suitable for those phases of the development cycle to which the NGICP doesn't apply. As with the NGICP, it will be much more cost-effective to subscribe to some of these than to replicate them.

In the longer term, the Stormwater Education, Training and Development Plan could examine

the following certification systems in addition to those mentioned above, as the need arises:

- EnviroCert International Inc® (ECI) offers internationally recognized professional [certifications](#) that could be adapted to New Zealand if needed, including the CPESC, Certified Professional in Erosion and Sediment Control mentioned above, as well as:
 - Certified Professional in Industrial Stormwater Management™ ([CPISM™](#))
 - Certified Professional in Municipal Stormwater Management™ ([CPMSM™](#))
 - Certified Professional in Stormwater Quality™ ([CPSWQ®](#))
 - Certified Erosion, Sediment and Stormwater Inspector™ (CESSWI™)
- the Environmental Institute of Australia and New Zealand (EIANZ) offers several [certifications](#) for environmental professionals. Certified practitioners are also listed in the EOANZ website. The certifications include recognition of prior skills and experience in the following fields, starting with the entry-level Certified Environmental Practitioner (CEnvP), and moving on to the more demanding certifications for:
 - CEnvP Site Contamination Specialist
 - CEnvP Land Rehabilitation Specialist
 - CEnvP Heritage Specialist
 - CEnvP Climate Change Specialist
 - EnvP Ecology Specialist
 - CEnvP Impact Assessment Specialist
- EIANZ also runs a [Qualifications Accreditation Scheme](#): environmental science and environmental management are two categories of undergraduate and post graduate study in Australia and New Zealand by which people enter environmental professions, and the Scheme covers qualifications in these areas. These disciplines are not the only entry pathway, but they are a useful starting point for the scheme.

Other certification schemes in New Zealand include Enviro-Mark, CarboNZero and Environmental Choice, and many organisations run sustainable business awards, including the Sustainable Business Network and many more.

As well as the WEF National Green Infrastructure Certification Program, other overseas examples include:

- the UK-based CIWEM (the Chartered Institution of Water and Environmental Management) also confers professional accreditation to [tertiary educational programs](#) which have had their curriculum and facilities subjected to a demanding evaluation against external standards commonly held by the profession concerned
- the UK-based ICE (Institution of Chartered Engineers) offers a lot of [support](#) for professional development and training on its Careers and Training webpage including a qualification as a Chartered Environmentalist ([CEnv](#))
- the state of Oregon and the Oregon Department of Environmental Quality's (DEQ) Water Quality Program offers a large number of online and face to face [training](#) opportunities provided by StormwaterONE. These include the following Oregon-specific qualifications:

- Qualified Preparer of Stormwater Pollution Prevention Plans
- Qualified Preparer of Stormwater Pollution Prevention Plans Recert
- Qualified Compliance Inspector of Stormwater
- Qualified Compliance Inspector of Stormwater Recert.

There will of course be many more, and in the medium-long term, it would be useful to collate an assess the best examples.

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Toolkit 22 List of suggested and other potential partners

These potential partners will need to be assessed in terms of the levels of influence and interest Water New Zealand shares with them, as shown in **Figure 22**.

Central government

Ministry for the Environment MfE, especially the Urban Water Principles team
National Urban Development Authority (UDA)
Treasury, in terms of its wellbeing dashboard and the new National Infrastructure Unit
New Zealand Transport Agency
Department of Conservation
Ministry of Health

Local government

Regional, city and district councils (planning, regulatory and operations, including parks)
Council controlled organisations (water, transport and development).

Mana whenua

Government bodies
Iwi businesses
Urban Māori agencies

Related professional associations in New Zealand

ACENZ (Association for Consulting and Engineering Professionals of NZ)
Civil Contractors New Zealand
Engineering New Zealand
Engineering New Zealand's Sustainability Society
Engineers for Social Responsibility
Engineers without Borders New Zealand
Environmental Institute of Australia and New Zealand
IPWEA
ISCA
LGNZ
NZ Institute of Architects
NZ Institute of Landscape Architects
NZ Planning institute
NZ Institute of Surveyors
SOLGM

*See also the list of agencies in **Toolkit 10***

Tertiary education providers

Particularly engineering, environmental management, landscape, engineering, surveying and planning schools

Other parties

WSUD Aotearoa research team
Canterbury Regional Stormwater Forum Best Practice Working Group

Other stakeholder groups

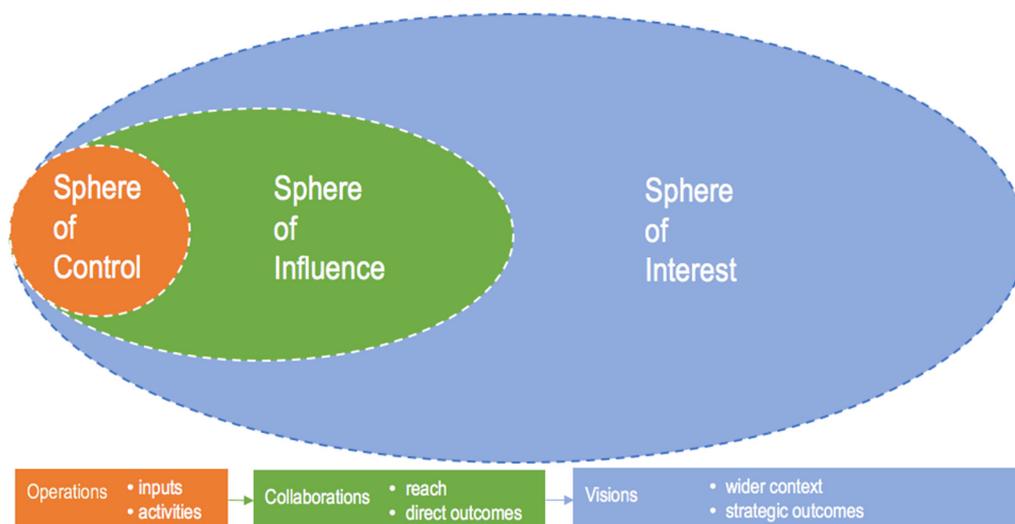
Land developers (iwi, public and private) and their associations
Property Institute of NZ
Infrastructure New Zealand

Overseas related professional associations

See the list of agencies in **Toolkit 11**

Figure 22 Identifying strategic partnerships

Source: Adapted from Simon Hearn, UK Overseas Development Institute⁵²



Partners a lead agency could work with

Again reflecting the complexity of stormwater, it will be impossible for any agency to take a lead in stormwater education and training without the commitment, capability and capacity to foster a large number of strong partnerships.

Respondents to the 2018 survey and Stormwater Conference Forum made the following comments about partnership needs:

- Identify other professions to liaise with in WSD space
- Not sure who we should be targeting with information/initiatives. Owners/managers or prospective attendees? But it does need to be cross-sector
- MfE Urban Water Principles team
- Canterbury Regional Stormwater Forum Best Practice Working Group
- WSUD Aotearoa research team
- WSUD target groups, including:
 - land developers (iwi, public and private)
 - design engineers, architects, landscape architects, urban planners

- tertiary education providers, particularly landscape, engineering and surveying schools
- construction and maintenance contractors
- iwi and urban Māori agencies
- central government bodies such as the Ministry for the Environment, Treasury, New Zealand Transport Agency, Department of Conservation, Ministry of Health and the new National Urban Development Authority (UDA)
- regional councils (planning, regulatory and operations)
- city and district councils (planning, regulatory and operations, including parks)
- council controlled organisations (water, transport and development)
- professional associations and institutes such as:
 - Water New Zealand
 - Engineering New Zealand (formerly IPENZ) and its subsidiary groups Engineers without Frontiers and The Sustainability Society
 - Civil Contractors New Zealand (CCNZ)
 - NZ Institute of Architects (NZIA)
 - NZ Institute of Landscape Architects (NZILA)
 - NZ Planning institute (NZPI)
 - NZ Institute of Surveyors NZIS)
 - Property Institute of NZ
 - Local Government New Zealand (LGNZ)
 - Society of Local Government Managers (SOLGM)
 - Association for Consulting and Engineering Professionals of NZ (ACENZ)
 - Institute of Public Works Engineering Australasia (IPWEA)
 - Infrastructure Sustainability Council of Australasia (ISCA)
 - Infrastructure New Zealand
 - Environmental Institute of Australia and New Zealand
- the different public and private sector training providers listed in **Tables 2.4-2.13**.

Other strategic and industry development partnerships could include key local and international agencies with similar interests and with whom New Zealand could exchange training and technical resources, such as:

- the Australian Water Association
- US-based professional associations such as:
 - the American Society of Civil Engineers and its technical Environmental & Water Resources Institute (EWRI)
 - American Public Works Association
 - National Groundwater Association
 - American Water Works Association
- other overseas organisations including those listed in **Task 3 s2.4**.

Other significant industry and career development partners include diversity organisations such as the National Association of Women in Construction ([NAWIC](#)), Women's Infrastructure Network NZ ([WIN](#)), [Young Water Leaders](#) and many others.

There are many more potential technical and strategic partners, and Water New Zealand will need to assess the value/effort investment to determine short, medium and longer term partnership priorities.

As an example, WEF members such as Water New Zealand can receive a 10% discount on stormwater training by going to the WEF [Knowledge Center](#) page and visiting the StormwaterONE and IECA pages from there, and by emailing onlinetraining@wef.org for a promotional code.

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Toolkit 23 The industry's call for national coordination of stormwater education and training

There was a powerful call for national co-ordination of stormwater management and training from many respondents to the 2018 survey and those attending the May 2018 Stormwater Education and Training Forum.

These are listed in detail in **Toolkit 22**.

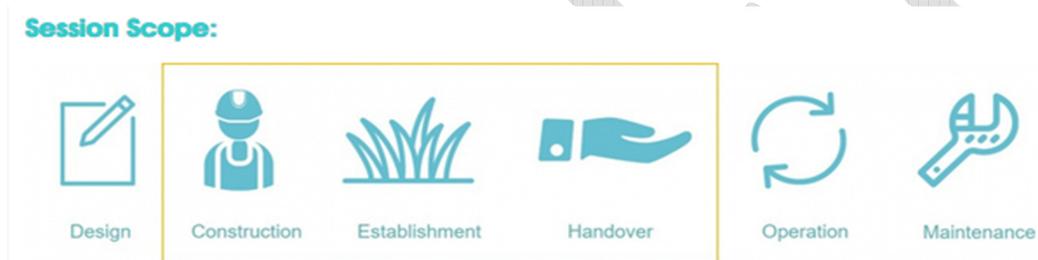
Comments on national coordination included:

- we need an IT system and other supports to help with:
 - communication across the sector
 - people being able to readily find out what training is available
 - maintaining a national database of devices, designers and maintainers
 - upskilling people on how to use the really good resources already available and implement them properly
 - overcoming the difficulty of finding New Zealand-based resources, training and information on standardised industry processes (it's much easier to find overseas resources)
- nation-wide consistency of:
 - requirements for stormwater treatment (not just in some regions)
 - stormwater training
 - design criteria
 - commitment to industry input to specifications and guidelines and the ability to appropriately challenge them
 - a New Zealand standard for soakage on-site stormwater management - including soakage testing in variable soils retention design principles
 - case studies, with a template that answers the questions people most want to know and includes positive, negative and neutral results. A panel of practitioners could develop the questions so that everyone can write up case studies in a consistent way, with the template, completed case studies and marketing of them available through, for example, Water New Zealand
- a nation-wide approach to:
 - training that helps people move beyond basic stormwater engineering (e.g. from the Rational Method, pipes with HGL at pipe grade and E1 Surface Water compliance document) to more complex stormwater management
 - a multi- and trans-disciplinary approach to WSUD: WSUD is critical as it is not just a technical discipline but also a planning issue. Stormwater infrastructure sits at the intersection of planning and technical design. Stormwater design requires a strong bond between urban planning and engineering. This is a team-playing exercise which cannot be trained in a course alone
- we need to set up a Centre of Excellence – a “mini-Monash” – where people could go for training and from where training could be delivered across the regions. The centre of excellence could:
 - deliver stormwater training
 - initiate and oversee cadet programmes

- attract young people to pre-apprenticeships or internships with TLAs to get exposure to SW challenges in a practical sense
- develop the national guidelines on stormwater management suggested above
- suggestions for responsible agencies included:
 - a centre of excellence associated with a university or several universities
 - Water New Zealand: there are guidance documents covering many of the training needs raised. Although this doesn't replace training, there is the opportunity for Water New Zealand to act as a repository or knowledge sharing platform to link people with the technical information they need (e.g. via the website)
 - the WSUD group
 - Ministry for the Environment.

Figure 22 The development cycle as a training navigation tool

Source: Inspired by Clearwater's example below



Toolkit 24 Pros & cons of Water New Zealand (or other body) as lead agency

Water New Zealand has taken the lead in stormwater education and training as part of its wider capacity and capability review. This reflects its own strategic direction as one of the country's leading professional associations responsible for some of New Zealand's most important infrastructure. It also reflects the views of the diverse and self-motivated group of stormwater professionals amongst its membership.

For decades Water New Zealand members have worked closely across many disciplines as the understanding and management of stormwater has become increasingly sophisticated. They are calling for more multidisciplinary awareness and better ways of improving social, cultural, environmental and economic outcomes, as shown in this report.

Yes, the future is uncertain, but it will take time for new water sector arrangements to emerge. The more work the stormwater sector can do right now, through its active membership of Water New Zealand, the better placed the sector will be to continue this important education and training work into whatever emerges in the future.

Stormwater education and training is a complex proposition, as is solving problems where training is not the solution. The next sections look at the pros & cons and the feasibility of a lead agency taking on responsibility for managing it.

Pros and cons of a lead agency

Table 24 is a first attempt to set out some of the pros and cons [SWOT? PESTLE?] of a lead agency taking on the management of stormwater education and training in New Zealand.

In light of the discussion above, **Table 24** assumes that Water New Zealand is the lead agency in at least the short to medium term. Leaving aside any decisions the government may make about a water agency or an independent infrastructure body in 2019, this decision is obviously the prerogative of Water New Zealand.

The main reasons for this assumption are that Water New Zealand has:

- already taken a strong and inclusive lead
- an existing body of relevant expertise
- an existing strategic program for the strategic development of the water sector, including sector workforce capability and training needed for the water supply, wastewater treatment and stormwater sectors⁵³
- a track record of interagency partnerships
- experience with responding to both government and industry calls for action
- continuity: central government arrangements may change and agencies be set up, disestablished or given new mandates, but Water New Zealand as the independent professional body will remain, providing much-needed continuity over a period of significant change.

Table 24 Pros and cons of Water New Zealand as a lead agency for stormwater education and training

Pros	Cons
Has already taken a strong and inclusive lead	May not be an option in the long term under new arrangements for the water sector
Has a track record of good partnerships with other bodies	May not be well enough resourced to step up this level of activity to meet the diverse range of stormwater training needs
Will remain as an independent professional body	May become isolated from strong institutional arrangements in future
Could establish a Stormwater Centre of Excellence (a 'mini-Monash')	Some other entity may be preferred e.g. such as the CRC in Melbourne
Has funded the work so far, with significant in-kind and pro bono support from members	May need more financial support to keep up the desired level of investment in stormwater training

Feasibility of a lead agency

Table 24 indicates that while there is some uncertainty about the effects of water sector reform, any lead agency, including Water New Zealand, would need additional support to do justice to this nationally important work. As a professional membership body, Water New Zealand would need to find secure long term potential sources of funding in order to provide an adequate budget.

The precise arrangements for managing stormwater-related education and training will be heavily depended on the funding described in **Section 10** and any additional funding that may be needed.

Toolkit 3 described how bodies similar to Water New Zealand deliver their training and has proposed a framework for and draft content of stormwater training. This is compatible with an LMS and the supporting systems that any training system will need, as outlined in **Toolkit 17**.

Toolkit 25 How training strategy informs effective implementation

This Stormwater Education, Training and Sector Development Plan is a **strategic training plan**. As shown in **Section 3**, stormwater is a complex discipline with many very different technical skills. A strategic approach is needed to see the sector in its entirety and work out training priorities before developing training materials on the different topics.

Figure 25 shows the difference between a strategic approach to training and operational training delivery.

Most training happens at the operational level, where a need is identified for performance improvement on a given topic and the training is simply developed and delivered (and sometimes evaluated).

The two strategic levels shown are largely ignored. Sometimes this is for defensible reasons, where identifying and meeting the training need is simple and straightforward.

However, this does not always apply to environment and sustainability training, especially for a complex topic like stormwater.

For example, the **strategic context** of stormwater management is one where environmental stresses have triggered an array of fast-moving water reforms by the government (**Section 2.2**) and where the costs of poor stormwater management (**Section 2.1**) are becoming obvious and significant. Stormwater managers must deliver better environmental outcomes to their communities and the risks of not doing so, such as those posed by climate change, are immense. This also offers opportunities for the stormwater sector to innovate and enhance its capability. Situational analyses such as PEST (Political/legal; Economic; Social/demographic and Technological contexts; some people add Environmental, Ecological, Ethical, Legal and Demographic factors) and organisational analyses like SWOT (Strengths, Weaknesses, Opportunities and Threats) are commonly used to help define the strategic context. The DPSIR model is also used to identify environmental drivers, pressures, states and impacts to inform responses relating to environmental values.

Developing a **training strategy** means implementing core best practice principles that support good learning outcomes, such as the ADDIE model (**Section 5**), Kolb's learning cycles⁵⁴ (concrete experience, reflective observation, abstract conceptualization and active experimentation) and the 70:20:10 model⁵⁵, which acknowledges that 70% of what people learn is from informal experiences in the workplace, and enables trainers to make the most of this. It also relates to the strategic business and environmental context and ensures workplace support for new practices learned in training.

Once these two strategic analyses are done, the training can then be developed, delivered and evaluated. This is the **operational** aspect of the training, and its quality and value depend on the quality of the strategic analyses.

Figure 25 The difference between training strategy and operational training delivery



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- 35 (1) Alexander, B. (2006, March–April). Web 2.0: A new wave of innovation for teaching and learning? Educause Review, 33–44 (2) Solomon, G., & Schrum, L. (2007). Web 2.0 new tools, new schools. USA: International Society for Technology in Education. Cited on p4 of Mark Nichols, 2009. Online discourse. No. 4 in the E-Primer Series.
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- 37 Coastal CRC, Australia (no date) Citizen Science Toolbox. An evaluation of the outcomes, costs, benefits and logistics of 63 methods of public engagement. (no date). Also known as The Cooperative Research Centre (CRC) for Coastal Zone, Estuary and Waterway Management, the Coastal CRC was established in July 1999. It received funding for a period of seven years and ceased operation in 2006. In their website, June 2002, the CRC stated that "the Coastal CRC exists to improve the health of Australia's coastal waterways."

- 38 The International Association for Public Participation (IAP2) Federation has developed a Spectrum to help groups define the public's role in any public participation process. The IAP2 Spectrum is quickly becoming an international standard. Download the spectrum [here](#). Please see requirements to gain approval for use at <https://www.iap2.org.au/About-Us/About-IAP2-Australasia-/Spectrum>.
- 39 Pers comm, Troy Brockbank, report edits in email of 8 November
- 40 <https://www.canterbury.ac.nz/engineering/contact-us/people/susan-krumdieck.html>
- 41 This interview, "The Science of Building new cities and towns" is an excellent example of connected walking and connected waters:
<https://www.radionz.co.nz/national/programmes/ninetoonoon/audio/2018671489/the-science-of-building-new-cities-and-towns>; listen duration 16':47"; from [Nine To Noon](#), 16 November 2018
- 42 Pers comm [Sharon Middleton](#), Product Marketing Advisor, Marketing Department, Unitec Institute of Technology, www.unitec.ac.nz, in an email of 15 November 2018
- 43 Dr Andy Erickson, University of Minnesota and St. Anthony Falls Laboratory pers comm in an email to Troy Brockbank of 2 November 2018
- 44 From Kyle Vander Linden, BSc. MES Program Manager at Credit Valley Conservation Links:
mailto:<https://lnkd.in/eJC4fgj> mailto:<https://lnkd.in/e6CT4da> [hashtag#training](#) [hashtag#sustainability](#) [hashtag#elearning](#) [hashtag#step](#) [hashtag#stormwater](#) [hashtag#naturalresources](#) [hashtag#greeninfrastructure](#)
- 45 Pers comm Noel Roberts, WaterNZ, email to Clare Feeney of 24 October 2018
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- 47 Barton, Chris. 2011. Hey look, my teacher's on YouTube. An article on the New Zealand Herald website downloaded November 2011 from
http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10768801.
- 48 Water New Zealand Stormwater Education and Training Water New Zealand (2017) [Stormwater group training plan](#). Version 0.3 Draft November 2017
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- (1) https://en.wikipedia.org/wiki/Learning_management_system
 - (2) [https://en.wikipedia.org/wiki/Rubric_\(academic\)](https://en.wikipedia.org/wiki/Rubric_(academic))
 - (3) [https://en.wikipedia.org/wiki/Rubric_\(disambiguation\)](https://en.wikipedia.org/wiki/Rubric_(disambiguation))
 - (4) <https://www.talentlms.com/what-is-an-lms#menu-1>
 - (5) <https://elearningindustry.com/what-is-an-lms-learning-management-system-basic-functions-features>
- 50 A syllabus conveys expectations and functions as a contract between you and your students. By enrolling, students are agreeing to the terms of the contract. It is crucial then that the terms of the contract are clear and students know what is expected of them. Valuable information about how to construct a comprehensive and ethical syllabus is at
<https://dl.sps.northwestern.edu/blog/2016/03/the-importance-of-a-syllabus/>.
- More information is also available from <https://undergrad.stanford.edu/advising/student-guides/what-syllabus>.

The SOLGM [Competency Framework](#) is also excellent

https://www.solgm.org.nz/Category?Action=View&Category_id=1244

- 51 Clare Feeney (2013) How to Change the World – a practical guide to successful environmental training programs. Global Professional Publishing, UK.
- 52 Adapted from Simon Hearn, UK Overseas Development Institute and the Indian and Northern Affairs Canada and Canadian Polar Commission from files accessed at <https://www.slideshare.net/sihearn/om-for-policy-influencing> and <http://www.aadnc-aandc.gc.ca/eng/1100100010463/1100100010505> (now at <https://www.canada.ca/en/crown-indigenous-relations-northern-affairs.html> and <https://www.canada.ca/en/indigenous-services-canada.html>).
- 53 Water New Zealand (The New Zealand Water & Wastes Association) Annual Report to 30 June 2017
- 54 Kolb David A (1984) Experiential Learning: experience as the source of learning and development. Englewood Cliffs, Prentice Hall.
- 55 <https://trainingindustry.com/wiki/content-development/the-702010-model-for-learning-and-development/>. Retrieved 12 March 2019.