Title	**Design micro-hydro systems**		
Level	**4**	**Credits**	**15**

Purpose	People credited with this unit standard are able to demonstrate skills to design micro-hydro systems for residential and small community applications. People credited with this unit standard are able to: – determine design requirements for a micro-hydro system; – evaluate the suitability of a site for locating a micro-hydro system; – determine the most cost effective option for a micro-hydro system including the cost of site works and all installed equipment, by undertaking a life cycle costing according to Standard AS/NZS 4536; – determine the suitability of a micro-hydro system for a particular application in terms of its characteristics and the application; and – specify the size, characteristics and system configuration for a micro-hydro system which will provide a given load at a site with specific head and water flow rate data.

Classification	Renewable Energy Systems > Renewable Energy Systems - Installation and Maintenance

Available grade	Achieved

Guidance information

1 This unit standard has been developed for learning and assessment off-job.

2 References
All Australian/New Zealand Standards (AS/NZS) may be found at http://www.standards.org.nz;
AS 4777.1:2005, *Grid connection of energy systems via inverters – Part 1: Installation requirements*;
AS 4777.2:2005, *Grid connection of energy systems via inverters – Part 2: Inverter requirements*;
AS 4777.3:2005, *Grid connection of energy systems via inverters – Part 3: Grid protections requirements*;
AS/NZS 3000:2007, *Electrical Installations (known as the Australian/New Zealand Wiring Rules)*;
AS/NZS 4509.1:2009, *Stand-alone power systems - Part 1: Safety and installation*;
AS/NZS 4509.2:2010, *Stand-alone power systems - Part 2: System design*;
AS/NZS 4536:1999, *Life cycle costing – An application guide*;

and all subsequent amendments and replacements.

3 Definitions
a.c. – alternating current.
Current regulations and standards – in this unit standard this term is used to refer to the requirements of the above references.
d.c. – direct current.
Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.

4 Range
a All measurements are to be expressed in Système Internationale (SI) units, and where required, converted from Imperial units into SI units.
b Candidates shall be supplied by the assessor with formulae involving more than three quantities.
c Use of a calculator during assessment is permitted.
d All activities must comply with any policies, procedures, and requirements of the organisations involved.
e All activities and evidence presented for all outcomes and performance criteria in this unit standard must be in accordance with legislation, enterprise policies and procedures, ethical code, current regulations and standards, industry practice; and where appropriate, manufacturer's instructions, specifications, and data sheets.

5 It is recommended that candidates have been assessed against Unit 27426, *Demonstrate knowledge of d.c. and a.c. machines used for small scale renewable energy systems* prior to assessment to this unit standard.

Outcomes and performance criteria

Outcome 1

Determine design requirements for a micro-hydro system.

Range may include but is not limited to – design criteria, demand assessment, load management, cost of system KWh over lifecycle.

Performance criteria

1.1 Determine system design criteria in consultation with a client.

1.2 Assess end-use services and energy demand for each service.

1.3 Perform a detailed load assessment in accordance with AS/NZS 4509.2.

Range assessment of total daily energy, maximum demand, surge demand and load management requirements.

1.4 Produce daily load profiles to illustrate average demand and maximum demand, based on time of use data for all electrical loads.

1.5 Produce daily load profiles based on given load data with consideration of likely variations in usage patterns.

1.6 Measure load profile using a.c. power logging equipment.

1.7 Determine load management strategies and/or energy source switching options to reduce the maximum and surge demand, based on load profile analysis.

Outcome 2

Evaluate the suitability of a site for locating a micro-hydro system.

Range may include but is not limited to – head, flow rate, seasonal variation for the site.

Performance criteria

2.1 Measure the available head at a site using a dumpy level or theodolite, altimeter, pressure gauge and contour maps.

2.2 Measure the flow rate of a given site using a range of methods.

Range may include but is not limited to – catchment area calculations, water diversion to fill a container, stream velocity/area measurement, weir construction method.

2.3 Estimate long term usable flow rate from long term stream flow taking into account environmental considerations.

2.4 Identify effects of seasonal variation using long term weather data over three years.

2.5 Calculate typical daily and seasonal energy consumption profiles.

2.6 Estimate the effect on system sizing of daily and seasonal energy demand profiles.

2.7 Identify government regulatory requirements that relate to the positioning of micro-hydro systems.

Range environmental legislation, water resource legislation.

2.8 Identify environmental constraints at a site.

Range minimum stream flow rates, ecological impacts, visual and noise impacts.

Outcome 3

Determine the most cost effective option for a micro-hydro system including the cost of site works and all installed equipment, by undertaking a life cycle costing according to Standards AS/NZS 4536.

Range may include but is not limited to costs to consider, life cycle, capital, external costs.

Performance criteria

3.1 Identify major micro-hydro system costs to be considered in the life cycle costing method.

3.2 Calculate capital and life cycle costs that include the cost of various system configurations for a micro-hydro application.

3.3 Describe external costs that might impact on the cost effectiveness of a micro-hydro system are described.

3.4 Determine the most cost effective micro-hydro system options on the basis of life cycle costing analysis.

Outcome 4

Determine the suitability of a micro-hydro system for a particular application in terms of its characteristics and the application.

Range may include but is not limited to – costs to consider, life cycle, capital, external costs.

Performance criteria

4.1 Explain the reason for selecting a particular type of primary mover.

Range Pelton, Turbo Impulse, Francis, propeller type, Michell or Banki cross flow turbines, PATs (pumps as turbines).

4.2 Calculate operational parameters and efficiency of the selected turbine.

4.3 Determine battery storage requirements.

Outcome 5

Specify the size, characteristics and system configuration for a micro-hydro system which will provide a given load at a site with specific head and water flow rate data.

Range may include but not limited to – micro-hydro system characteristics, losses, energy output, water delivery structures, associated components, environmental impacts.

Performance criteria

5.1 Select suitable micro-hydro system characteristics to suit site load, hydraulic head and stream flow rate characteristics.

5.2 Select a suitable type of commercially available micro-hydro system.

5.3 Calculate frictional losses in delivery pipes using manufacturer's data.

5.4 Calculate energy output of the selected micro-hydro system at the site from water flow rate, head and manufacturer's data, allowing for seasonal variations in performance and environmental constraints.

5.5 Design required water control structures to meet AS/NZS 4509.

Range weirs, dams, open races, penstocks, strainer systems, intake systems.

5.6 Optimise the positioning of the micro-hydro system and size of the micro-hydro system for the site.

5.7 Select suitable system components.

Range delivery pipe and fittings, transmission cable and voltage, voltage and frequency regulation, battery storage type and capacity, battery charger, inverter, back-up generator, load dump.

5.8 Outline likely environmental impacts of the micro-hydro system and appropriate measures to minimise these impacts.

5.9 Produce a design specification with diagrams to meet AS/NZS 4509.

Planned review date	31 December 2024

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	21 July 2011	31 December 2019
Review	2	24 October 2019	N/A

Consent and Moderation Requirements (CMR) reference	0003

This CMR can be accessed at http://www.nzqa.govt.nz/framework/search/index.do.

Comments on this unit standard

Please contact The Skills Organisation at reviewcomments@skills.org.nz if you wish to suggest changes to the content of this unit standard.