Higher National Unit specification

General information for centres

Unit title: Water Operations: Waste Water Treatment Processes

Unit code: F53M 34

Unit purpose: This Unit is designed to enable the candidate to develop the skills and knowledge associated with the principles and processes commonly used in the Primary, Secondary and Tertiary treatment of Waste Water and the treatment and disposal of Waste Water Sludges.

It is suitable for candidates who wish to understand the principles and processes involved and who are currently employed in, or who are seeking employment in a water treatment environment or a related role.

On completion of the Unit the candidate should be able to:

1 Explain the Primary Treatment Processes used in Waste Water Treatment.
2 Explain the Biological Treatment Processes used in Waste Water Treatment.
3 Explain the main Tertiary Treatment Processes used in Waste Water Treatment.
4 Explain the main methods used for the treatment and disposal of sludge.

Credit points and level: 1.5 HN credits at SCQF level 7: (12 SCQF credit points at SCQF level 7*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

Recommended prior knowledge and skills: It would be beneficial though not essential if candidates had some Water Industry experience in Waste Water Treatment or Networks.

Core Skills: There are opportunities to develop the Core Skills of *Communication, Information and Communication Technology* and *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

General information for centres (cont)

Assessment: It is possible to assess candidates on an individual Outcome basis, by combinations of Outcomes, or by a single holistic assessment encompassing all Outcomes. Assessment should be conducted under supervised conditions. The assessment(s) should consist of an appropriate balance of restricted response and structured questions. If a single assessment covering all Outcomes is used, it should not exceed three hours in duration.

The sections of the Unit stating Outcomes, knowledge and/or skills, and Evidence Requirements are mandatory.

Higher National Unit specification: statement of standards

Unit title: Water Operations: Waste Water Treatment Processes

Unit code: F53M 34

The sections of the Unit stating the Outcomes, Knowledge and/or Skills, and Evidence Requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Explain the Primary Treatment Processes used in Waste Water Treatment

Knowledge and/or Skills

- Primary Treatment Process
- Collected Wastewaters
- Gross Solids
- Grit
- Storm water
- Primary Sedimentation Tanks

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- describe at least four quantity and quality characteristics of a Collected Wastewater and explain how they affect the type of treatment processes required. The description must include the concept of Dry Weather Flow (DWF) and classifications of solids.
- describe the methods used for the treatment and disposal of Gross Solids. The description must include the need for the removal of solids, disposal options and potential problems.
- describe the main methods used for the treatment and disposal of Grit. The description must include the need for the removal of grit, disposal options and potential problems.
- explain the rationale behind the separation, treatment and discharge of Storm water and describe how it is affected.
- explain the three main types of Primary Sedimentation Tanks. The explanation must include how each type works, explain what effects each may bring about, what affects their efficiency and effectiveness and their suitability to different circumstances.

Higher National Unit specification: statement of standards

Unit title: Water Operations: Waste Water Treatment Processes

Assessment Guidelines

For this Outcome, it is suggested that the assessment could be a combination of a report and a closed-book end of Unit assessment.

The questions used in the closed-book assessment should take the form of an appropriate balance of multiple choice and restricted response type.

The report could be combined with that of Outcomes 2 and 4 of this Unit and evidence for the report could be drawn from a suitable employer's current or historical practice in Waste Water Treatment.

Outcome 2

Explain the Biological Treatment Processes used in Waste Water Treatment

Knowledge and/or Skills

- Biological Treatment Processes
- Efficiency and Effectiveness
- Micro organisms
- Biological and Percolating Filters
- Aeration and Activated Sludge systems
- Package plants
- Secondary Sedimentation

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- explain how the main types of micro organisms involved in the Biological Treatment of Waste Waters bring about the purification of Waste Waters. The explanation must include: Aerobic, Anaerobic, Facultative, Nitrifying, Denitrifying bacteria, Protozoa, Fungi, insect larvae, and worms.
- describe the main factors which affect the efficiency and effectiveness of micro organisms covered in the previous Evidence Requirement in the Biological Treatment of Waste Waters.
- explain the types and principles of operation of Biological and Percolating filters and the factors which affect their efficiency and effectiveness. The explanation must include circular and rectangular filters, at least two advantages and two disadvantages of each and typical operational problems.
- explain at least three types of operation of Aeration and Activated Sludge systems. The explanation must include for each system: the principles of the system, at least two advantages and at least two disadvantages, typical operational problems and the factors which affect the efficiency and effectiveness of the system.
- explain those Package plants which are based on modifications of Biological and Percolating filters.

- explain those Package plants which are based on modifications or adaptations of Aeration and Activated Sludge processes.
- explain the function and role of Secondary sedimentation within biological treatment. The explanation must included Radial Flow, Horizontal Flow, and Vertical Flow Final Sedimentation and Humus Tanks. The principles of operation of these tanks, retention times, scraping mechanisms, desludging frequency, and strategies must also be included.

Assessment Guidelines

For this Outcome, it is suggested that the assessment could be a combination of a report and a closed-book end of Unit assessment.

The questions used in the closed-book assessment should take the form of an appropriate balance of multiple choice and restricted response type. Assessment via the report could be combined with that of Outcomes 1 and 4 of this Unit and evidence for the report should if possible be drawn from a suitable employer's current or historical practice in Waste Water Treatment.

Outcome 3

Explain the main Tertiary Treatment processes used in Waste Water Treatment

Knowledge and/or Skills

- Tertiary Treatment Processes:
  - Sedimentation
  - Filtration
  - Biological Treatment
  - Nitrogen and Phosphorous

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can for tertiary treatment processes:

- describe the circumstances that may lead to Tertiary Treatment being required. The description must include at least two instances of where Tertiary treatment may be required.
- explain at least three Tertiary Treatment systems that involve sedimentation as the main principle. The explanation must include at least two advantages and disadvantages of each.
- explain at least three Tertiary Treatment systems that involve Filtration of some kind as the main principle. The explanation must include at least at least two advantages and disadvantages of each.
- explain at least two Tertiary Treatment systems that incorporate Biological Treatment as a main principle.
- explain the systems and processes used to control and remove Nitrogen and Phosphorous.

Assessment for this Outcome must be conducted under closed-book conditions.

Higher National Unit specification: statement of standards (cont)

Unit title: Water Operations: Waste Water Treatment Processes

Assessment Guidelines

Assessment for this Outcome could be a closed-book end of Unit assessment and questions used to elicit candidate response should take the form of an appropriate balance of multiple choice and restricted response in order to meet the Evidence Requirements.

Outcome 4

Explain the main methods used for the treatment and disposal of sludge

Knowledge and/or Skills

- Waste Water
- Drinking water
- Sludge Types, Origins and Composition
- Natural drying and dewatering systems.
- Mechanical thickening and dewatering systems.
- Sludge Digestion systems.
- Sludge disposal methods.

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- describe the Composition, types, and origins of Sludges within both Waste Water and Drinking Water Treatment systems. The description must include Primary, Humus, Surplus Activated, Iron and Aluminium Sludges, Organic, Inorganic and solids percentage composition.
- explain the systems used for the natural drying and dewatering of Sludges. The explanation must include the use of lagoons and drying beds.
- explain the systems used for the mechanical thickening and dewatering of Sludges. The explanation must include aluminium, iron, lime, polymer addition as well as consolidation, dewatering, picket fence systems, centrifuges, filter presses, and belt presses.
- explain the principles and mechanisms of Sludge Digestion and the systems used. The explanation must include Anaerobic Digestion (heated & cold), Mesophilic and Thermophilic Digestion, Aerobic digestion.
- describe the main options and methods of final Sludge disposal. The explanation must include landfill, agricultural, composting, thermal drying, pelletisation, incineration.

Higher National Unit specification: statement of standards (cont)

Unit title: Water Operations: Waste Water Treatment Processes

Assessment Guidelines

For this Outcome, it is suggested that the assessment could be a combination of a report and a closed-book assessment.

The questions used in the closed-book assessment could take the form of an appropriate balance of multiple choice and restricted response type and could reflect a representative sample from the content detailed in the support notes.

Assessment via the report could be combined with that of Outcomes 1, 2 and 4 of this Unit and evidence for the report should if possible be drawn from a suitable employer's current or historical practice in Waste Water Treatment.

Administrative Information

Unit code: F53M 34

Unit title: Water Operations: Waste Water Treatment Processes

Superclass category: TL

Original date of publication: August 2008

Version: 01

History of changes:

Version	Description of change	Date

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre for further details, telephone 0845 279 1000.

Higher National Unit specification: support notes

Unit title: Water Operations: Waste Water Treatment Processes

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 60 hours.

Guidance on the content and context for this Unit

This Unit is designed to give the candidates a sound underpinning knowledge of the principles of Waste Water Treatment to facilitate them to function or develop as Water Industry Team Leaders and Technicians, or to enable them to progress to more advanced study.

It is suitable for those who are currently employed in, or who are seeking employment in a relevant Water Industry environment or a related role. This Unit is intended as part of the framework for the HNC in Water Operations but it may be suitable for inclusion in other HNC/HND awards.

The following notes provide guidance on the content of the Unit and recommended time allocations to each Outcome are given as guidance towards the depth of treatment that might be applied to each topic.

Outcome 1 Explain the Primary Treatment Processes used in Waste Water Treatment **(15 hours)**

This Outcome requires candidates to explain primary treatment processes used in Waste Water treatment. Candidates should consider the quantity and quality characteristics of a wastewater. This should include typical daily flow and variations, and the concept of DWF to describe flows.

Classification of solids into Gross Solids, Suspended Solids, Colloidal Solids, Dissolved Solids with examples of each and outline of systems to remove or deal with them should be covered. This could also cover Chemical composition Organic, Inorganic and Biological Oxygen Demand (BOD), Suspended Solids (SS), Chemical Oxygen Demand (COD), NH3, NO_3.

The needs for the removal of Gross Solids should be covered and methods of removal such as: Hand raked screens, mechanically raked screens, Step screens, Drum screens, particle size.

Removal and Disposal, Removal disintegration and return to flow, and disintegration within flow Screenings disposal options and problems could also be included.

Types of grit removal systems and Grit disposal options and problems should be considered.

Types, strategies and settings of Storm Overflows. Methods of Storm water Treatment and disposal are also covered.

The principles of operation of the three main types of sedimentation tanks namely: Radial Flow, Horizontal Flow, Vertical Flow Sedimentation Tanks should be explored. This could include fat/grease removal, scraping mechanisms, desludging frequency and strategies, Retention times, efficiency/effectiveness of Suspended Solids removal and typical operational problems.

Higher National Unit specification: support notes (cont)

Unit title: Water Operations: Waste Water Treatment Processes

Outcome 2 Explain the Biological Treatment Processes used in Waste Water Treatment **(20 hours)**

This Outcome covers the Biological treatment processes used and could include the following:

- Aerobic, Anaerobic, Facultative, Nitrifying, and Denitrifying bacteria and action. Role of Protozoa, Fungi, insect larvae, worms.
- Coagulation Oxidation of Colloidal Solids, Nitrification and Denitrification, Trade effluent toxicity, Dissolved Oxygen levels.
- Circular & rectangular Filters, Distribution, media type and size, loadings, ventilation, drainage systems, dosing, ponding, maintenance, single pass, recirculation, Average Daily Flow (ADF), Nitrification. The advantages/disadvantages and typical operational problems of circular and rectangular filters must be covered.
- Surface Aeration, Compressed Air systems, Oxygen systems. Plug flow, step Aeration, tapered Aeration, retention times, loadings, Mixed Liquor Suspended Solids (MLSS), Return Activated Sludge (RAS), Settled Activated Sludge, Dissolved Oxygen (DO) levels, Nitrification, Sludge Bulking, advantages/disadvantages and typical operational problems. Rotating Biological Contactors (RBCs) Biological Aerated Flood Filters (BAFFs), Submerged Aerobic Fixed Film (SAFF), Sequential Batch reactor (SBR's), Oxidation Ditches, Extended Aeration, Contact stabilisation, Oxigest.
- Radial Flow, Horizontal Flow, Vertical Flow Sedimentation Tanks, including the principles of operation, scraping mechanisms, desludging frequency and strategies, and Retention times.

Outcome 3 Explain the main Tertiary Treatment processes used in Waste Water Treatment **(15 hours)**

The Reasons and need for Tertiary Treatment should be covered and should include:

- Types, Banks, Brush, Copa, Wedge wire clarifiers, Lagoons, Facultative and Clarification ponds.
- Rapid Gravity Filters (RGFs), deep bed sand filters, Upward flow filters, Microstrainers, grass plots, Reed beds, UV.
- Lime, Aluminium and Iron compounds for Phosphorous removal, Biological Anoxic processes for Nitrogen and Phosphorous removal.

Outcome 4 Explain the main methods used for the treatment and disposal of sludge **(10 hours)**

This Outcome could include:

- Primary, Humus, Surplus Activated, Iron and Aluminium Sludges. Organic, Inorganic & solids and % composition.
- Lagoons, Drying beds, Sludge removal.
- Aluminium, Iron, Lime, Polymer addition. Consolidation, dewatering, Picket Fence systems. Centrifuges, Filter Presses, Belt Presses.
- Anaerobic Digestion (heated & cold), Mesophilic and Thermophilic Digestion, Aerobic digestion.
- Landfill, Agricultural, composting, thermal drying, Pelletisation and Incineration.

Higher National Unit specification: support notes (cont)

Unit title: Water Operations: Waste Water Treatment Processes

Guidance on the delivery and assessment of this Unit

This Unit is likely to form part of a Group Award which is designed to increase the understanding of existing or potential Water Industry Team Leaders and Technicians or to enable Water Industry employees currently involved in other functions, to move into a more operational related role. The emphasis should therefore be on ensuring that candidates comprehend the principles of Waste Water Treatment Processes and have a thorough understanding of how the processes work.

It is recommended that evidence for Outcomes is achieved through well planned course work structured reports and site visit(s) to an operational Waste Water Treatment Works preferably accompanied by a course tutor or someone with knowledge of the content of this Unit in order that the visit is appropriately structured.

During such a visit the candidates should be encouraged to work in groups to collect relevant information for dissemination amongst them later. This will assist candidates in providing evidence particularly in relation to any reports.

However if for practical reasons the candidate cannot access employer sites and data, evidence could be provided by means of a desk top study and/or literature search and review of appropriate material which might include, employers future or proposed procedures or strategies in relation to Waste Water Treatment, or the investigation and resolution of relevant current or historical quality problems relating to Waste Water Treatment.

The assessment for Outcomes 1, 2 and 4 could by a combination of closed-book assessment and a combined report. Outcome 3 is assessed by closed-book.

Opportunities for developing Core Skills

There are opportunities to develop the Core Skills of *Communication, Information and Communication Technology* and *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Outcomes 1, 2, and 4 require candidates to produce a report that considers the effective treatment of wastewater. If this report is presented as a written report that explores the issues relating to wastewater treatment processes and is presented in an appropriate format this may offer candidates the opportunity to develop the Written component of the Core Skill *Communication* at SCQF level 6.

This Unit may also provide opportunities to develop the Core Skill *Information and Communication Technology* at SCQF level 6 as candidates may utilise *Information and Communication Technology* to research and understand different water treatment processes. They may also use information technology to present information including tables, graphs and diagrammatical representations of treatment processes in their report for Outcomes 1, 2 and 4 of this Unit.

Should the report require candidates to investigate issues relating to water treatment processes with a view to making conclusions and recommendations for the resolution of those issues then there may be opportunities to develop all three components of the Core Skill *Problem Solving* at SCQF level 6.

Higher National Unit specification: support notes (cont)

Unit title: Water Operations: Waste Water Treatment Processes

Open learning

This course may be delivered in a flexible/distance/open learning format. In this case, a considerable amount of independent study will be required and will need to be supported by appropriate materials. The use of a Virtual Learning environment as a means of supporting Open learning delivery would be beneficial.

To relate the knowledge gained to the industrial practice, it is recommended that the candidate should make at least one site visit to an operational water treatment works preferably accompanied by a course tutor or someone with knowledge of the content of this Unit. This would enable the visit to be appropriately structured to Unit requirements.

However with regard to assessment, planning would be required to by the centre concerned to ensure the sufficiency and authenticity of candidate evidence and arrangements put in place to ensure that assessments were conducted under controlled, supervised conditions.

Candidates with disabilities and/or additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* **(www.sqa.org.uk)**.

General information for candidates

Unit title: Water Operations: Waste Water Treatment Processes

This is a 1.5 credit SCQF level 7 Unit intended to be delivered as part of the HNC Water Operations Qualification. It is designed to give you a good understanding of the principles and practices involved in Waste Water Treatment Processes.

This Unit is designed to enable you to develop the skills and knowledge associated with the principles and processes commonly used in the Primary, Secondary and Tertiary treatment of Waste Water and the treatment and disposal of Waste Water Sludges. It is suitable if you who wish to understand the principles and processes involved and are currently employed in, or are seeking employment in a water treatment environment or a related role. Ideally, whilst undertaking this Unit you will have access to Waste Water treatment sites.

There are four Outcomes in this Unit and these are outlined below.

In Outcome 1 you will cover the Primary Treatment Processes used in Waste Water treatment. This will include the main quality and quantity characteristics of wastewater including flows and classification of solids. The Outcome will look at the treatment of gross solids, grit and storm water as well as the operation of primary sedimentation tanks.

Outcome 2 covers the Biological Treatment Processes used in Waste Water. This Outcome covers the use of micro-organisms in the treatment of Waste Waters as well as the use of Biological and Percolating filters, Aeration and activated sludge processes and secondary sedimentation.

Outcome 3 looks at the main Tertiary Treatment Processes used in Waste Water Treatment. The reasons why tertiary treatment may be required is covered and the processes used explained.

The final Outcome includes the main methods used for the treatment and disposal of Sludge The different types of sludge and the methods used to teat sludge and to dispose of sludge are covered.

Outcome 1, 2 and 4 may be assessed by a combination of report and questioning under closed-book conditions whilst Outcomes 3 is be assessed by questioning under closed-book conditions..

There are opportunities to develop the Core Skills of *Communication, Information and Communication Technology* and *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.