



## Higher National Unit specification

### General information for centres

**Unit title:** Water Operations: Water Resources

**Unit code:** F53S 34

**Unit purpose:** This Unit is designed to provide candidates with an understanding of the principal factors involved in the management of water resources.

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

- 1 Explain the concepts of hydrology.
- 2 Explain and calculate flow measurement.
- 3 Explain key design features of water abstraction methods and how legislation impacts on them.
- 4 Explain the factors affecting yield of water resources and factors involved in demand forecasting,
- 5 Explain the practical management of water resources.

**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 is recommended that candidates have communication and numeracy skills level 4 or equivalent.

**Core Skills:** There are opportunities to develop the Core Skills of *Information and Communication Technology, Problem Solving, Numeracy, and Working with Others* and the Written component of Core Skill *Communication* 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.

**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.

## Higher National Unit specification: statement of standards

**Unit title:** Water Operations: Water Resources

**Unit code:** F53S 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 concepts of hydrology

#### Knowledge and/or Skills

- ◆ Hydrological cycle
- ◆ Pathways of precipitation
- ◆ Infiltration and run-off
- ◆ Hydrological measurement
- ◆ Hydrographs
- ◆ Surface and groundwater flow
- ◆ Flood and drought estimation

#### Evidence Requirements

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

- ◆ describe the pathways of precipitation and explain the relationship between rainfall, infiltration and run-off.
- ◆ describe methods of measuring losses, inputs and movement of water in the hydrological cycle through evaporation, transportation and rainfall.
- ◆ explain methods of measuring surface and groundwater storage and flow, At least one of each.
- ◆ interpret three hydrographical representations of rainfall and flow.
- ◆ explain methods of estimating floods/droughts. Two of each.
- ◆ calculate the probabilities of flood and drought from given data. Two calculations for each.

Closed-book statement for theoretical.

#### Assessment Guidelines

For this Outcome, it is suggested that part of the assessment could consist of a report which might be combined with that of Outcomes 3 and 5, as a closed-book assessment. Questions used to elicit candidate response could take the form of an appropriate balance of multiple choice and restricted response type and should reflect the Evidence Requirements.

## **Higher National Unit specification: statement of standards (cont)**

**Unit title:** Water Operations: Water Resources

### **Outcome 2**

Explain and calculate flow measurement

#### **Knowledge and/or Skills**

- ◆ Flow classification
- ◆ Open channels
- ◆ Closed pipes
- ◆ Flow measurement devices
- ◆ Flow calculation formulae

#### **Evidence Requirements**

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

- ◆ explain four classifications for types of flow. Must include the criteria for classification.
- ◆ describe four flow measuring devices for open channels and calculate the flow for each device using apt calculation. The description must include how the devices operate.
- ◆ describe three flow measuring devices for closed pipes. The description must include how the devices operate.
- ◆ calculate flow in a closed pipe from given data using two different formulae.

Assessment for this Outcome is a closed-book end assessment.

#### **Assessment Guidelines**

Questions used to elicit candidate response could take the form of an appropriate balance of multiple choice and restricted response type and should reflect the Evidence Requirements.

## **Higher National Unit specification: statement of standards (cont)**

**Unit title:** Water Operations: Water Resources

### **Outcome 3**

Explain key design features of water abstraction methods and how legislation impacts on them

#### **Knowledge and/or Skills**

- ◆ Dams
- ◆ River Abstraction intakes
- ◆ Groundwater abstraction
- ◆ Borehole
- ◆ Spring boxes
- ◆ Legislation

#### **Evidence Requirements**

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

- ◆ describe three types of dam and for one dam explain the key design features to include construction and the benefits of that
- ◆ describe at least two river abstraction intakes and explain their key design features including construction and appropriateness to their setting
- ◆ describe two methods of drilling and constructing boreholes used for groundwater abstraction
- ◆ describe four features of at least one spring box. The collection, abstraction, protection and screening
- ◆ identify relevant legislation pertaining to water abstraction and explain how these impact upon the design of each of the above

#### **Assessment Guidelines**

For this Outcome, it is suggested that the assessment could consist of a report, which might be combined with that of Outcomes 1 and 5.

## **Higher National Unit specification: statement of standards (cont)**

**Unit title:** Water Operations: Water Resources

### **Outcome 4**

Explain the factors affecting yield of water resources and factors involved in demand forecasting

#### **Knowledge and/or Skills**

- ◆ Groundwater sources
- ◆ Surface water sources
- ◆ Methods of measuring consumption
- ◆ Demand forecasting

#### **Evidence Requirements**

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

- ◆ five factors that affect yield from groundwater and surface water sources. Must include reasons.
- ◆ one from each the main methods of increasing and maintaining yield from groundwater and surface water sources. The explanation must include infrastructure and conservation.
- ◆ factors that contribute to current water demand industry, agr, dom and explain how measuring of water consumption for each of these.
- ◆ the factors that contribute to future demand and the importance of demand forecasting for three above.

Evidence should be gathered using closed-book assessment under supervised conditions.

#### **Assessment Guidelines**

Assessment for this Outcome could be a closed-book assessment and questions used to elicit candidate response could take the form of an appropriate balance of multiple choice and restricted response type.

## **Higher National Unit specification: statement of standards (cont)**

**Unit title:** Water Operations: Water Resources

### **Outcome 5**

Explain the practical management of water resources

#### **Knowledge and/or Skills**

- ◆ Potential threats
- ◆ Catchment area
- ◆ Pollution control
- ◆ Legislation

#### **Evidence Requirements**

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

- ◆ explain potential threats to raw water quality and quantity. The explanation must include both natural and man-made issues and describe control measures that can be put in place to mitigate them.
- ◆ identify management guidelines for the practical management of a water resource and its catchment area. Explain the application of these guidelines and any improvements that may be made in their application.
- ◆ explain current legislation driving management practices in the protection of water resources.

#### **Assessment Guidelines**

For this Outcome, it is suggested that the assessment could consist of a report which might be combined with that of Outcomes 1 and 3.

## Administrative Information

**Unit code:** F53S 34

**Unit title:** Water Operations: Water Resources

**Superclass category:** TL

**Original date of publication:** August 2008

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### History of Changes:

Version	Description of change	Date

**Source:** SQA

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## **Higher National Unit specification: support notes**

### **Unit title:** Water Operations: Water Resources

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 water resources and the various disciplines that are required to effectively manage a water source and its catchment. It is suitable for those who are currently employed in, or who are seeking employment in the water industry or related occupational areas, or for those wishing to progress to more advanced study.

Recommended contexts for each Outcome are given as guidance towards the depth of study that might be applied to each topic.

#### **Outcome 1**

Study of the hydrological cycle and the pathways of precipitation with reference to the effect on infiltration and run-off. Measurement of the movements of water through the hydrological cycle and the relationship between inputs and outputs. The general principles involved in the estimation of floods/drought.

#### **Outcome 2**

Study of types of flow and their classification in both open channels and closed pipes, with reference to hydraulic energy, friction. Flow measurement devices such as weirs and flumes, and flow formula, allowing for frictional losses in open channels. Flow measuring devices commonly used for closed pipes, and relevant formula to account for frictional losses.

#### **Outcome 3**

The key design features of abstraction works, to include: types of embankment and concrete dams used for impounding water; types of river intake; boreholes and the main drilling techniques, and types of spring box. Reference to relevant legislation governing the maintenance and upkeep of any works.

#### **Outcome 4**

Various factors affecting the yield from groundwater and surface water sources and methods deployed to increase or maintain yields. The components that contribute to the current demand of water in terms of domestic, industrial and agricultural and methods used to measure this. The factors involved in determining future demand for domestic, agricultural and industrial uses.



## Higher National Unit specification: support notes

**Unit title:** Water Operations: Water Resources

### Outcome 5

Measures taken to manage the quality and quantity of raw water in a source alongside factors such as recreational use and general amenity. Particular reference to current pollution control measures and Good Management Guidelines. Will include managing the wider catchment area of a water source and current legislation that governs the practical management of water sources.

### Guidance on the delivery and assessment of this Unit

This Unit forms part of the HNC and is designed to increase the understanding of existing Water Company employees currently involved in other functions, of the wider issues involved in the management of a Water Resource. Emphasis should therefore be on ensuring that candidates comprehend the principles of the various disciplines involved in managing a catchment area and have a thorough understanding of current good practices and legislative developments.

It is recommended that evidence for learning Outcomes is achieved through well planned course work structured reports and site visit(s) to a suitable source, involving a flow measurement and analysis of the catchment area, 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 visits candidates should be encouraged to work in groups to collect information for dissemination amongst them later.

Assessment may be formative and summative and both may feature as part of the process. Although assessments must be focussed on the individual achievement of each candidate, group work and role-play activities may contribute to the assessment. Material gathered for the Unit might contribute to other Units.

Outcomes 1, 3 and 5 could be assessed by candidates producing a report combined with a closed-book assessment. Questions used to elicit candidate response could take the form of an appropriate balance of multiple choice and restricted response. The evidence for the report should if possible be drawn from a water source with suitable catchment area that the candidate can get physical access to. However if for practical reasons the candidate cannot access a suitable water source, evidence could be provided by means of a desk top study and/or literature search and review of an appropriate location as long as the Evidence Requirements are met.

#### *Opportunities for developing Core Skills*

There are opportunities to develop the Written component of the Core Skill of *Communication* and the Core Skill *Problem Solving* to SCQF level 6 and the Core Skill *Information and Communication Technology* to SCQF level 5, although there is no automatic certification of Core Skills or Core Skills components.

Candidates may have the opportunity to develop the Written component of the Core Skill *Communication* at SCQF 6 through the assessment for Outcomes 1, 3 and 5 where they may have to research, write and develop a report that meets the requirements of the three Units.

## Higher National Unit specification: support notes

**Unit title:** Water Operations: Water Resources

Other opportunities for the opportunities development of Core Skills are indicated in the table below by a ✓

Core Skill	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5
<b>Numeracy</b>					
Using Number	✓	✓		✓	
Using Graphical Information	✓			✓	
<b>Information and Communication Technology</b>					
Using Information and Communication Technology	✓		✓		✓
<b>Problem Solving</b>					
Critical Thinking	✓		✓		✓
Planning and Organising	✓		✓		✓
Reviewing and Evaluating	✓		✓		✓
<b>Working with Others</b>					
Working with Others	✓		✓		✓

### Open learning

Given that appropriate materials exist, this course may be delivered in a flexible/distance/open learning format with a limited physical tutor support. In this case, a considerable amount of independent study will be required and to relate the knowledge to real events, it is recommended that the candidate should make at least one visit to a Catchment Area for a water source, preferably accompanied by a course tutor or someone with knowledge of the content of this Unit.

Candidate on-line support via e-learning such as BLACKBOARD or similar and email could be beneficial.

Arrangements would be required to be 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](http://www.sqa.org.uk)).

## **General information for candidates**

### **Unit title: Water Operations: Water Resources**

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 provide students with an understanding of the principle factors involved in the Management of a Water Resource.

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

- 1 Describe the basic concepts of Hydrology.
- 2 Understand the key elements of flow and flow measurement.
- 3 Describe key design features of hydraulic structures used to obtain and control water.
- 4 Describe the factors affecting yield of a water source and factors involved in demand forecasting.
- 5 Understand the practical management of a water resource and its catchment with relevant legislative drivers.

The main components of the Unit are described in more detail below:

#### **Outcome 1**

Study of the pathways of precipitation in the hydrological cycle and their effects on infiltration and run-off. Hydrological measurements of the movements of water in the hydrological cycle and the relationship between losses and inputs. The measurement of surface and groundwater flows and the estimation of floods/drought.

#### **Outcome 2**

Study of types of flow and their classification in both open channels and closed pipes. Flow measurement devices such as weirs and flumes, and flow formula, allowing for frictional losses in open channels. Flow measuring devices commonly used for closed pipes, and relevant formula to account for frictional losses.

#### **Outcome 3**

The key design features of abstraction works, to include: types of dam used for impounding water; types of river intake; types of boreholes; types of spring box, with reference to relevant legislation governing the maintenance and upkeep of any works.

#### **Outcome 4**

Various factors affecting the yield from groundwater and surface water sources and methods deployed to increase or maintain yields. The components that contribute to the current demand of water and methods used to measure this. The factors involved in demand forecasting and predicting future demand.

#### **Outcome 5**

Measures taken to manage the quality and quantity of raw water in a source alongside factors such as recreational use and general amenity. Good practises in managing the wider catchment area of a water source and current legislation that governs the practical management of water resources.