



Level 3

**Certificate in
Geographical Information
Systems**



ASET Level 3 Certificate in Geographical Information Systems

Award Specification

Title of Award

The ASET Level 3 Certificate in Geographical Information Systems.

Level

Level 3

Accreditation Criteria

Vocationally Related Qualification

Guided Learning Hours (in units of 30 or 60 GLH)

60 Guided Learning Hours

ASET Award Code (GIS3/1.0)

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1. Rationale

1.1 AIMS AND BROAD OBJECTIVES OF THE QUALIFICATION AND ITS DISTINCTIVE CONTRIBUTION TO THE RAFT OF QUALIFICATIONS OFFERED:

1.11 Aims of the programme

The ASET Certificate in Geographical Information Systems has been designed to provide students with an understanding of the practical procedures and underlying concepts used in the collection, manipulation, analysis and communication of geographical information using information technology. It was originally developed as a 'Centre Devised' programme in response to demand in a large College of Further Education, to compliment A level studies, and to provide a vehicle for training of staff from local industry.

Central to the module is the development of skills in the use of computers to process geographical data, explore relationships, solve problems and make decisions.

The overall aims of the programme are :

To offer contemporary vocational complementary studies to students of Advanced Level Geography and related subject areas.

To introduce students to the principles of Geographical Information Systems.

To develop Information technology skills in capturing, analysing, and using geographical data to identify and address issues on the natural and human environment.

1.12 Objectives of the programme

The specific objectives of the programme are to:

- Provide information on the characteristics and key principles of geographical information systems.
- Develop the students' understanding of uses, organisation and analysis of geographical data
- Provide opportunities to develop skills in Information Technology data handling and data presentation
- Enable an understanding of geographical information systems data capture, storage and manipulation.
- Develop understanding and skills in fundamental operations of geographical information systems
- Provide information on the application of geographical information systems by organisations, in the management of a range of service provision within the human and natural environment
- Enable an understanding of the use of Geographical Information Systems in solving

problems and decision making within society and business.

- Develop an understanding of the GIS applications into the future
- Develop skills in the use of software to simulate use of GIS in organisations

1.13 Methods of assessment

The learning outcomes of the programme will be assessed through a combination of a short answer external test which will have a pass percentage but will not be graded, internal assignment work which will be graded. A pass is required in both parts of the assessment to obtain the qualification. The grade for the qualification will be given as the grade obtained in the practical application of the GIS principles. The external assessment will test the understanding of the principles of GIS developed in the programme and the assignment work will assess the use and application of GIS to an environmental or social question or problem. The assignment will be a review activity.

1.14 Distinctiveness of the Programme

Geographical Information Systems (GIS) represent one of the most rapidly growing forms of information technology. They involve using computers to capture, store, analyse, and display geographical information in order to make decisions about the nature and distribution of features in the world within which we live. Geographical Information Systems enable different kinds of data describing our world to be brought together and analysed in an integrated way to assist in decision making. Recent developments in computer technology have made this task possible and GIS is now playing a valuable role in identifying, monitoring and tackling problems and, indeed, opportunities in the natural and human environments.

1.2 CLEAR EVIDENCE THAT THE QUALIFICATION ENABLES PROGRESSION DIRECTLY INTO EMPLOYMENT, TO FURTHER LEARNING OPPORTUNITIES WITHIN EMPLOYMENT OR TO FURTHER STUDY:

1.21 Evidence that the programme enables progression into employment

GIS is now routinely used by government departments, local authorities commercial organisations and environmental groups for an enormous range of tasks. These include land-use planning, market analysis, business development, the management of emergency

services, utility provision, transport planning, environmental impact assessment, crime analysis, epidemiology, wildlife conservation and resource management. Employment opportunities for people for people who can utilise computing skills in a geographical context have increased significantly in recent years and it is for this reason that an introductory qualification in the subject is proposed.

Employment needs in this emerging field are predicted to rise substantially in the future.

Specific jobs which students from this programme have accessed include:

Working as technical assistants in the government HQ Defence Geographic, Imagery, and Intelligence Agency and Ordnance Survey Recruitment into the Police - with the potential of using GIS skills in future.

Other potential work includes:

- cartographic officer
- local authority planning officer
- photographic interpreter
- surveying assistant
- data-processing operator
- GIS technician

1.22 Evidence of further learning opportunities within employment

Students obtaining this qualification whilst employed have progressed to further part time level 4 studies in Higher National Certificates in GIS and in Business. This or similar routes of progression are likely to be available in the future.

1.23 Evidence of further study

The introduction of a Level 3 qualification in this field reflects major growth both within the geographical information industry and the growth of HND and BSc qualifications in GIS available within the higher education sector. There are presently eight universities in the UK providing single honours degree programmes in GIS with a far larger number offering combined degrees with Geography and Information Technology/Information Systems/Computing. A number of higher education establishments also run HND programmes in GIS or closely related subjects.

Although the ASET Introduction to GIS course would provide an ideal element in the learning programmes of those students wishing to study GIS at university, the majority of students will use the course as a basis for progression to a broad range of more loosely-related higher level programmes. The development of skills and understanding in computing, the management of information, decision making and problem solving are highly relevant to many sectors

of higher level study. Such opportunities would include degree programmes in business management, marketing, information systems, conservation, environmental management, earth science, operational research, land and estate management, town planning and public administration.

1.3 CLEAR EVIDENCE THAT THE QUALIFICATION HAS THE SUPPORT AND INVOLVEMENT OF RELEVANT EMPLOYMENT AND EDUCATION INTERESTS:

1.31 Employment support

Industrial organisations which support the programme include the government HQ Defence Geographic, Imagery, and Intelligence Agency and Ordnance Survey.

1.32 Educational support

The programme is supported by the Universities which offer Geographical Information Qualifications and students who have completed this programme have progressed to programmes at a higher level.

Written support for the programme has been given by Dr D Chapman - Senior Lecturer in Geographical Studies at University College London. (Annex 8)

Verbal support has been given to the programme from:

Dr J Elgy - Senior Lecturer in Geographical Studies - Aston University

Dr D Melton - Senior Tutor in Geographical and Related Studies - Oxford Brookes University.

Written confirmation of this support will hopefully follow.

1.4 Relationship with national occupational standards

GIS is a relatively new field and no national standards for Level III qualifications presently exist. However, the qualification is consistent with the arrangements for the statutory regulation of external qualifications in England, Wales and Northern Ireland (QCA, 2000). The A.G.I. has given it's endorsement to the qualification.

2. Aims and Objectives of the Qualification

2.1 Aims

The overall aims of the programme are :

To offer contemporary vocational complementary studies to students of Advanced Level Geography and related subject areas.

To introduce students to the principles of Geographical Information Systems.

To develop Information technology skills in capturing, analysing, and using geographical data to identify and address issues on the natural and human environment.

2.2 Objectives

- Provide information on the characteristics and key principles of geographical information systems.
- Develop the students' understanding of uses, organisation and analysis of geographical data
- Provide opportunities to develop skills in Information Technology data handling and data presentation
- Enable an understanding of geographical information systems data capture, storage and manipulation.
- Develop understanding and skills in fundamental operations of geographical information systems
- Provide information on the application of geographical information systems by organisations, in the management of a range of service provision within the human and natural environment
- Enable and understanding of the use of Geographical Information Systems in solving problems and decision making within society and business.
- Develop and understanding of the GIS applications into the future
- Develop skills in the use of software to simulate use of GIS in organisations

3.2 Unit Specifications

3.21 Unit 1 Specifications - Annex 2

3.22 Unit 2 Specifications - Annex 2

4. Recommended Prior Learning

4.1 What learners will need to know before starting the programme

The ASET User Certificate in Information Technology - Introduction to GIS is a Level III (Advanced) qualification. It is therefore designed for students who have successfully completed a programme of study at Level II. The normal pre-requisite would be five GCSE passes at C or above or an intermediate GNVQ. The qualification would be offered to students following a variety of learning programmes.

The certificate would be suitable to sit alongside GCE AS/A2 level qualifications and/or vocational qualifications such as Advanced Single/Double Award AVCEs and BTEC National Diplomas.

The ASET Certificate would also provide an appropriate element in Access programmes for adult learners with an interest in IT and as the basis for an intensive short course for employees working in organisations which use spatial data who require training in this field.

Before studying Unit 1 learners will be expected to be able to:

- demonstrate a knowledge and understanding of a range of places, environments and geographical patterns at a range of scales from local to global;
 - outline the main physical and human processes that influence places, environments and geographical patterns;
 - appreciate the role and significance of computers and information technology as a key feature of modern society;
 - perform, interpret and present results from simple calculations;
- contribute to discussions, read and summarise information and communicate ideas in a variety of document forms;
- use information technology to retrieve, explore, develop and present information.

It is recommended that students have completed Unit One before commencing Unit Two.

4.2 What level of key skills will be required

It is expected that students studying for the Certificate will have level 2 skills in the use of computers, including the manipulation of a mouse, text entry with a keyboard, execution of commands from a menu or tool bar and the ability to perform basic file management operations. A level 2 or equivalent in application

of number and communication is desirable for students taking this course.

4.3 What physical requirements will the programme demand of the student e.g. is this programme suitable for visually impaired students?.....

The programme is suitable for all students who are capable of using a keyboard.

4.4 What restrictions are there on candidate entry e.g. entry with other qualifications in the ASET range / overlap with other ASET qualifications.

Students following a full- time programme of study in GIS or a closely related field should not be permitted to take the ASET Certificate in GIS.

5. Assessment

5.1 Assessment methods

All assessment will be conducted according to the requirements of the Regulatory Authority (Ref. Arrangements for the Regulation of External Qualifications in England, Wales, and Northern Ireland. - 2000), with the Common Code of practice and in accordance with the ASET assessment policy and procedures as stated in the Centre Handbook.

Assessment methods will be appropriate to the skills knowledge and understanding which is to be assessed.

5.2 Assessment of the programme

There are two elements of assessment - external assessment and internal assessment. Students will be required to pass both elements to achieve the qualification.

5.21 External Assessment

This will be a short answer question paper which is set, scrutinised and marked by ASET. This will cover knowledge of the principles of GIS. The pass mark for this external assessment will be set at 50%

The external assessment paper will be available at two points in the year - June and November. It will be a ONE HOUR paper, which will be completed by the student under strict, supervised examination conditions laid down by the Regulatory Authority, in the Common Code of Practice and ASET. This test will have a pass mark (50%) but will not be graded further.

5.22 Internal Assessment

Assignments will require students to demonstrate skills and application of knowledge in GIS. A review assignment will give the opportunity for the student to work on a problem and find solutions to the problem using GIS information technology sources and data bases. This internal assessment will be graded according to the criteria given in Annex 4.2 section 10 of Unit 2 specifications.

5.3 Assessment and Grading Criteria

Unit title	Unit Specification Section	Page number
Principles of GIS	10	Annex 2 page
Applications of GIS	10	Annex 2 page

5.4 Examples and Exemplars

An example of an end of unit one examination is given in Annex 3 together with the mark scheme for the examination

A sample review assignment is in Annex 4

6. Progression

See section 1.1, 1.2, 1.3 of the rationale. Students who have completed the programme under schedule 2(d) have either been students who are completing a full time A level programme or those who have been completing this as a day release course whilst in employment - mainly so far from the DGIA. The use of geographical information systems in environmental planning, demographic trend analysis ensures that students completing this programme are equipped to work not only in the DGIA but in aspects of town planning, police data analysis and prediction, environmental planning and data analysis companies.

7. Other issues

In addition to developing knowledge, understanding and practical skills in the field of geographical data handling, the ASET Certificate, Introduction to GIS will promote a range of other broader developments in students. These include:

- An enhanced awareness of the problems facing our environment, the interaction of elements in the natural and human environment and the role society can play in addressing and managing these issues.
- An appreciation of the broader context of information and communications technologies as a critical element in modern culture.
- An appreciation of the diversity of cultures, peoples and places through the retrieval , querying and examination of information contained in geographical databases.
- An awareness of the social and ethical issues relating to the collection, storage, analysis and application of socio-economic data relating to the population.
- An understanding of the scope for examining issues, solving problems and promoting mutual understanding across internal and international boundaries through the application of information technology.

8. Awarding and Reporting

All ASET qualifications are developed in accordance with the Arrangements for the statutory regulation of external qualifications in England, Wales and Northern Ireland and in particular with the common code of practice section B assessment and awarding. The ASET awarding and assessment quality policy and procedures are available in the ASET handbook and on the ASET website (www.aset.ac.uk)

9. Candidates with Particular Requirements

All ASET qualifications are developed in accordance with the Arrangements for the statutory regulation of external qualifications in England, Wales and Northern Ireland, and in particular with the common code of practice - section C arrangements for candidates with particular assessment requirements.

The ASET awarding and assessment quality policy and procedures include a section on candidates with special requirements and are available in the ASET Handbook for Centres and on the ASET website (www.aset.ac.uk)

10. Language

ASET qualifications and assessment materials will be provided through the medium of English. External assessment materials in Welsh or Irish will be provided on evidence of demand in Wales or Northern Ireland

Annex 1: Unit Specifications

Unit Specification: UNIT 1

1. Title of Unit: Principles of Geographical Information Systems
2. Level: Level 3
3. Guided Learning Hours (in units of 30 or 60 GLH): 60 GLH
4. ASET Unit Code (please leave blank)
5. ASET Award(s) of which this unit is a component:

Award Title	Optional or Mandatory	Value of Unit as proportion of Award
ASET level 3 Certificate in Geographical Information Systems		
Principles of Geographical Information Systems	M	30%
Applications of Geographical Information Systems	M	70%

6. About this unit

Unit One provides an overview of the underlying concepts behind GIS. It outlines the principles involved in the capture, storage, manipulation, analysis, presentation and output of digital geographical data in a computer-based GIS and provides opportunities for the development of practical skills in processing data with a GIS. By the end of the unit students will understand the key principles associated with the handling of geographical data in a GIS environment and have acquired a range of skills in processing digital geographical data with a GIS

7. Key Skills

A key skills development map is included in annex 6 of the specifications.

8 . Learning Outcomes

To achieve this unit learners must:

- 1 Understand the meaning of the term geographical information systems (GIS) and identify the key features of a GIS;
- 2 Identify the available sources of geographical data and capture digital geographical data in a variety of ways;
- 3 Differentiate between raster and vector methods for geographical data storage;

- 4 Understand the operations used to manipulate, query, analyse and output data in a GIS.

9. Content

All content in this section is knowledge based.
Learning Outcome 1

- **Computer information systems.** Characteristics and roles of the key elements of computer systems (input devices, central processing unit, memory, storage, output devices).
- **Characteristics of geographical data.** Differences between spatial and attribute data. Concepts of scale, coverage, content, accuracy and precision.
- **Uses of geographical data.** Application of geographical data in addressing issues, questions and problems in both natural and human environments (e.g. global climate change, disaster relief, business planning, site selection, crime analysis, defining school catchment areas)

Learning outcome 2

- **Sources of geographical data** (e.g. field surveys, aerial photography, satellite images, government surveys, commercial databases).
- **Geographical information systems.** Characteristics and roles of the key elements (data capture, storage, manipulation, query, analysis, presentation and output) and outline of major trends in historical development (mainframe, PC, Windows and Internet eras).
- **Capture of digital geographical data.** Methods for acquiring spatial and attribute geographical data in digital format (keyboard entry, scanning, digitising, data logging, remote sensing).

Learning Outcome 3

- **Organisation of digital geographical data.** Characteristics, applications, advantages and disadvantages of the vector and raster models for storing spatial data.

Learning Outcome 4

- **Fundamental operations of GIS.** Principles and applications associated with reclassification operations (e.g. land-use classification); overlay operations (e.g. optimum site selection); distance and connectivity measurements (e.g. buffering); and neighbourhood operations (e.g. slope analysis).
- **Data output from GIS.** Methods and products for presenting geographical information after manipulation in a GIS. Concepts associated with digital map design.

10. Assessment

To pass this unit you must show that you have achieved the learning outcomes for the Unit listed in section 3 'Learning Outcomes' .

Learning outcome and weighting	How assessed	Assessment criteria to achieve Learning outcomes.	Grading Criteria, for Merit ,and Distinction.
1. Understand the meaning of the term geographical Information systems(GIS) and identify the key features of a GIS	Written examination, short answer questions - see annex 5	Please refer to annex 5 for the mark scheme	Pass mark - 50%. There is no grading of the short answer test.
2. Identify the available sources of geographical data and capture digital geographical data in a variety of ways.	‘ ‘		
3. Differentiate between raster and vector methods for geographical data storage	‘ ‘		
4. Understand the operations used to manipulate, query, analyse and output data in GIS	‘ ‘		

11. Guidance on Delivery

The aim of this unit is to provide students with an understanding of the fundamental concepts associated with GIS. No previous knowledge of GIS and little experience of computing should be assumed.

It is suggested that the unit is delivered over the first half of the course (13-17 weeks if 2 hour sessions are used).

A variety of teaching strategies will be appropriate to deliver the unit, including lecture presentations, class discussion, demonstrations of practical techniques, guided practical exercises and problem solving seminars. It is anticipated that approximately 30% of the guided learning time is spent on whole class teaching, to cover concepts and principles. The remaining 70% of the time should be spent with students engaged in practical activities.

The whole class teaching strategy should be used by the teacher to introduce the unit and course, cover fundamental concepts, introduce the practical exercises, address problems that may arise, draw out conclusions from the practical work, set assessment tasks and summarise key areas of learning. The "theory" sessions may be best placed at the start of each session although it is recognised that some sessions, for example at the beginning and end of the unit, may require rather more theoretical input.

Unit Specification: Unit 2

- 1 Title of Unit: Applications of Geographical Information Systems
- 2 Level: Level 3
- 3 Guided Learning Hours (in units of 30 or 60 GLH) 30 GLH
- 4 ASET Unit Code (please leave blank)
- 5 ASET Award(s) of which this unit is a component:

Award Title ASET level 3 Certificate in Geographical Information Systems	Optional or Mandatory	Value of Unit as proportion of Award
Principles of Geographical Information Systems	M	30%
Applications of Geographical Information Systems	M	70%

6. About this unit

Unit Two provides develops an awareness of the contemporary application of GIS in addressing issues and questions in the world around us. It outlines the wide range of organisation which are involved in the processing of digital geographical data using GIS and examines the role these organisations have in tackling environmental problems. The unit provides opportunities for extending the skills developed in Unit One in processing data with a GIS within an applied context. By the end of the unit students will understand how and why GIS is used in modern society and will have acquired a range of skills in using GIS to investigate an environmental issue, question or problem.

7. Key Skills

The practical nature of this unit offers a wide range of opportunities for students to acquire and demonstrate key skills in Communication, Application of Number and Information Technology. The assessment of these activities for this unit provide an opportunity for students to develop portfolio evidence for Key skills attainment.

The key Skills map if given in Annex 5

8 . Learning Outcomes

To achieve this unit learners must:

- 1 Understand how GIS is used in addressing the major questions, issues and problems in the natural and human environment.
- 2 Analyse how GIS is used in a variety of different types of organisation in the public, private and voluntary sectors.
- 3 Be able to use practical GIS techniques of data capture, manipulation, query and analysis to address an environmental issue, question or problem and communicate the results in a clear and effective manner.

9. Content

The key areas of content are:

Learning Outcome 1

- **GIS applications in the human environment.** Review of major applications of GIS in planning and management of issues in the build environment (e.g. market analysis and business planning, transport planning, site selection, management of emergency services).
- **GIS applications in the natural environment.** Review of major applications of GIS in planning and management of issues in the physical environment (e.g. modelling soil erosion, disaster relief, wildlife conservation, flood prediction, agricultural production).

Learning Outcome 2

- **GIS and organisations.** Institutional issues associated with the use of GIS (budgeting, procurement, implementation, management, training, impact on efficiency and effectiveness and strategic planning).
- **The GIS industry today.** A review of the key fields where GIS is presently being deployed (e.g. central government, local authorities, private companies, scientific research, voluntary organisations).

Learning Outcome 3

- **The future of GIS.** Key trends in the GIS industry and likely outcomes over the next few years (e.g. GIS and the Internet, integration of GIS functionality in mainstream software, new user interfaces, real-time GIS, GIS and consumer electronics)
- **GIS in problem solving and decision making.** The role of GIS in addressing issues, questions and problems facing society. Stages involved in using GIS to solve real world problems (problem definition, project planning, data acquisition, data correction and editing, data manipulation, data query and analysis, data interpretation, data presentation). Advantages and limitations of GIS as a decision making tool.

10. Assessment

To pass this unit you must show that you have achieved the learning outcomes for the Unit listed in section 3 'Learning Outcomes'.

Learning outcomes	How assessed	Assessment criteria	Internal or external assessment?	Weighting (proportion of the whole Unit Assessment?)
1. Understand how GIS is used in addressing the major questions, issues and problems in the natural and human environment.	Review (see Annex 6)	Pass: <ul style="list-style-type: none"> ● Content is relevant with a description of the nature of the application area and of the role of GIS in addressing it. ● Information is communicated in a clear way, exhibiting an understanding of issues relating to the selected issue. ● Limited use of terminology. ● Presentation is adequate for the designated purpose with an appropriate organisation of material, some use of graphics and clear layout. 	Internal	25%
2. Analyse how GIS is used in a variety of different types of organisation in the public, private and voluntary sectors.		Merit: <ul style="list-style-type: none"> ● Content is relevant with a clear explanation of the characteristics of the selected topic and the role of GIS in addressing it. ● An evaluation of the merits of using GIS. Information is communicated in a well-organised and lucid way, exhibiting a good understanding of all fundamental issues. ● Good use of key technical terms. ● Presentation is clear and appropriate for the purpose, with a logical organisation with good use of graphics and effective layout. 		25%
2. Analyse how GIS is used in a variety of different types of organisation in the public, private and voluntary sectors.		Distinction: <ul style="list-style-type: none"> ● An entirely relevant, clearly argued and accurate examination of the application area together with an in-depth analysis and evaluation of the role of GIS in addressing it. ● Information is communicated in a highly effective way using a range of styles ● Full use of technical terms, displaying a consistent, accurate and deep understanding. ● Presentation of a very high standard involving a range of methods, very clear graphics and a professional looking layout. 		

<p>3. Be able to use practical GIS techniques of data capture, manipulation, query and analysis to address an environmental issue, question or problem and communicate the results in a clear and effective manner.</p>	<p>Pass:</p> <ul style="list-style-type: none"> ● Evidence is presented indicating that relevant data has been input, manipulated, and presented. Most ● GIS functions have been executed correctly although some operations may have been used inappropriately. ● A fair understanding of the basis for the practical GIS activities is communicated. Assistance may be required to complete important tasks. ● The most important elements of review are presented in a logical and structured manner. 	<p>50%</p>
	<p>Merit:</p> <p>Merit:</p> <ul style="list-style-type: none"> ● Clear and of the relevant data has been effectively input, manipulated, analysed and presented. ● All of the key GIS functions have been executed correctly and efficiently. ● A good understanding of the meaning and significance of the practical stages in using the GIS is communicated. ● The report is well structured and clearly presented. Limited assistance may be required to complete the activity. 	
	<p>Distinction:</p> <ul style="list-style-type: none"> ● All data is utilised effectively. ● GIS operations are performed efficiently, correctly and without assistance ● A full understanding of the meaning and significance of the practical stages in the GIS activity is evident. ● Alternative ways of performing the GIS operations have been examined and evaluated. ● The report is very well structured and professionally presented. 	

11 Guidance on Delivery

The aim of this unit is to provide students with an appreciation of the key ways in which GIS can contribute to the management of problems confronting society. It should provide an overview of the range of issues that GIS is presently involved as well as the opportunity to examine one specific application area in greater detail. There should be an opportunity for students to build on the practical skills developed in Unit One and apply them in the context of a selected application area.

It is suggested that the unit is delivered over the second half of the course (13-17 weeks if 2 hour sessions are used).

As in Unit One, a variety of teaching strategies will be appropriate to deliver the unit, including lecture presentations, class discussion, demonstrations of practical techniques, guided practical exercises, problem solving seminars, student presentations and peer appraisal. It is anticipated that approximately 20% of the guided learning time is spent on whole class teaching, to cover concepts and principles. The remaining 80% of the time should be spent with students engaged in practical activities. The "theory" sessions, covering general issues associated with the applications of GIS, may be best placed at the start of each session although it is recognised that some sessions, for example at the beginning and end of the unit, may require rather more theoretical input.

The whole class teaching strategy should be used by the teacher to introduce the unit, review the role of GIS in problem solving, cover key themes in GIS applications within the human and natural environments, introduce a major practical exercise, address problems that may arise, draw out conclusions from the practical work, set assessment tasks and summarise key areas of learning.

It is suggested that a visit is organised to an organisation or company presently using GIS as part of its operations to learn about the issues associated with deploying GIS in an institutional setting and to gain an insight into the practical applications GIS can be used for in the real world. Many large institutions now use GIS and may be approached to organise such a visit. These include local authorities, utility companies, retail companies, environmental organisations and universities.

It is suggested also that a single practical exercise is used to enable students to explore the problem solving capabilities of GIS. The practical exercise should be used to enable students to build on the "hands-on" skills developed in Unit One and apply them in a new context. The exercise should therefore include elements of data capture, manipulation, query, analysis and presentation. The practical exercise should be selected to address a major application area such as business planning, flood management, crime pattern analysis, transport planning or resource management. Students should be required to examine the nature of the problem, develop solutions, implement GIS operations, refine their methods and complete the task with the minimum of direct input from the teacher. The results of their work will form the basis of the assessment for this unit in the review assignment.

12 Links to Learning Resources

See Section 12.3 Annex 2 award specification.

Annex 2 Example of end of Unit Examination

End of unit examination.

Unit One - Principles of Geographical Information Systems

[Dateline]

Instructions

Time allocation: 1 hour.

Answer all questions.

Fill in the boxes at the top of your answer booklet

Use only blue or black ink or ball-point pen.

Information

This examination assesses Unit One, Principles of Geographical Information Systems.

Mark allocations are shown in brackets.

The maximum mark for this paper is 60.

Wherever possible refer to personal experience of situations using GIS.

1. (a) Explain what geographical information systems are, what they are designed to do and what information produced by the systems describes. (3 marks)

- (b) Study **figure 2** which shows the stages involved in using a geographical information system to examine a geographical issue, question or problem.

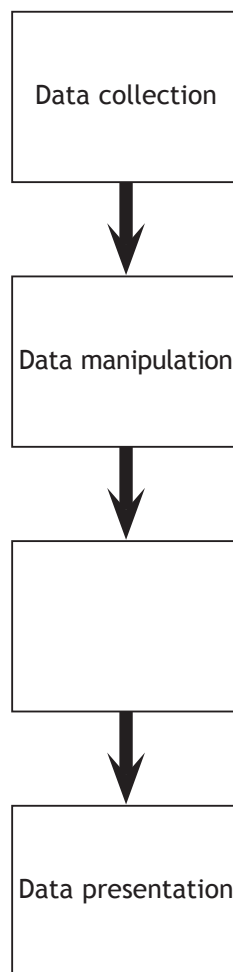


Figure 1

- (i) Complete **Figure 1** by adding the missing term into the blank box. (2 marks)
 (ii) A map is an example of a product that may be used to represent geographical information. State two other products that may be used to represent geographical data. (2 marks)

Product 1: _____

Product 2: _____

2. Figure 2 shows examples of devices used to collect geographical data.

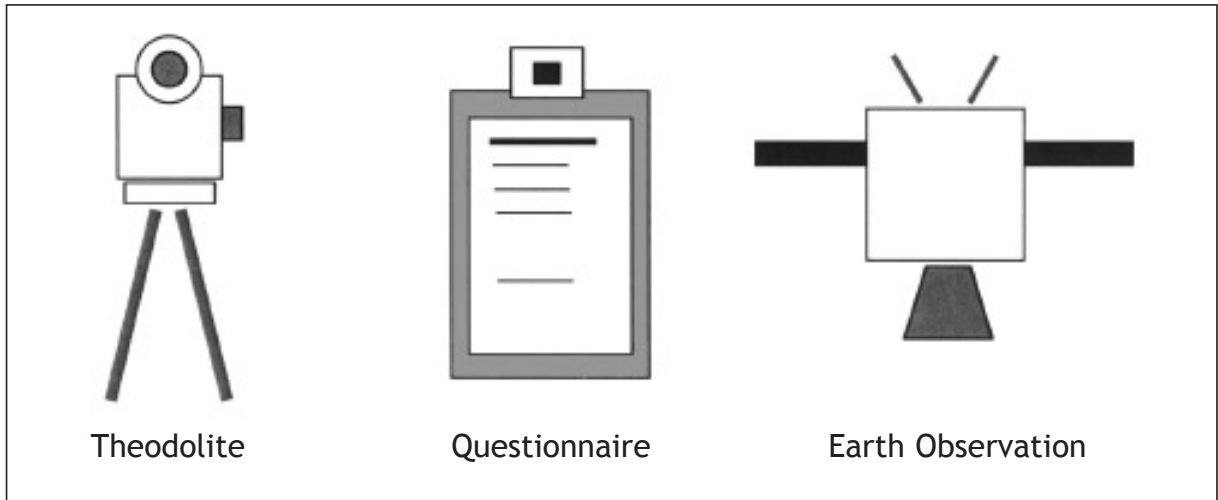


Figure 2

(a) What is meant by the term geographical data? (2 marks)

(b) For any one of the data collection devices shown in **Figure 2** outline three characteristics and one application of the geographical data it is used to collect.

Data collection device

(i) Characteristics (3 marks)

(ii) Application (3 marks)

3. Study **Figure 3** which shows a buffer zone around a simple stream network.

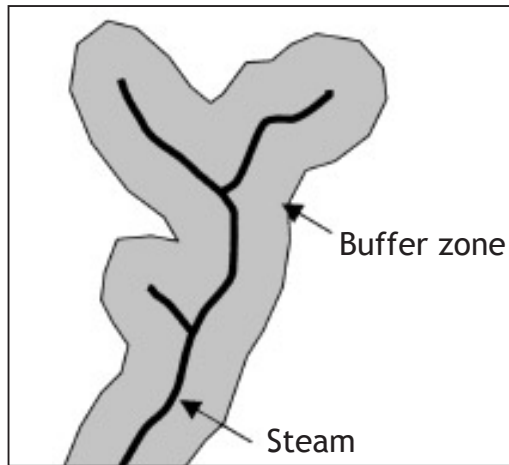


Figure 3

(a) What is meant by the term buffer zone? (2 marks)

(b) **Figure 3** shows a buffer zone around a stream network. Give examples of two other features that a buffer zone be created for? (2 marks)

Feature 1:

Feature 2:

(c) Give an example of the use of buffering and explain why buffering is a frequently performed operation in a geographical information system? (4 marks)

(d) Comment on the limitations of buffering as a GIS operation. (7 marks)

4. Study **Figure 4** which shows a diagrammatical representation of the raster data structure used to represent an imaginary landscape.

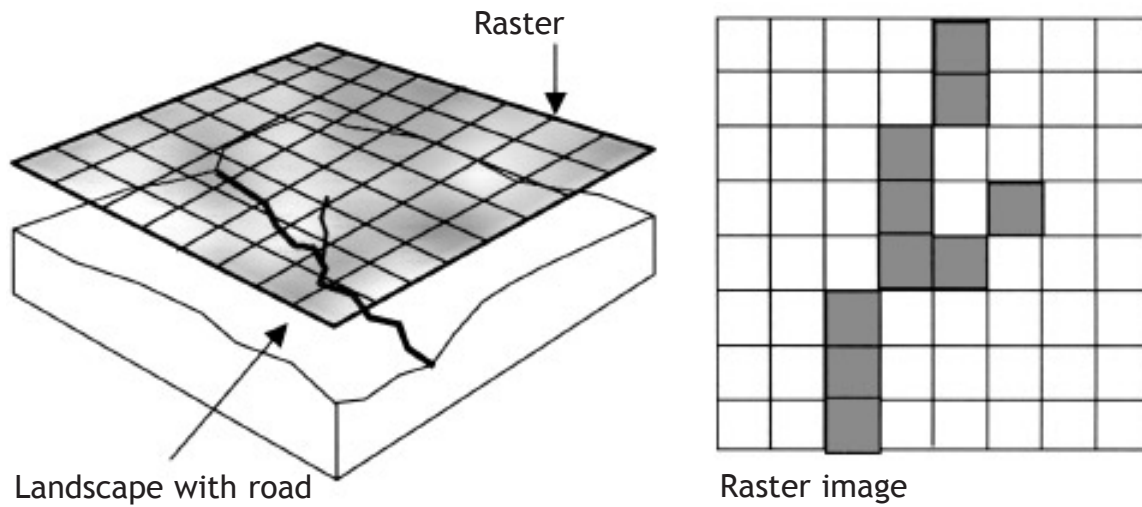


Figure 4

- (a) Explain the meaning of the following two terms used to describe data stored in a raster structure. (6 marks)

Pixel: _____

Resolution: _____

- (b) Outline advantages and disadvantages of using the raster data structure in a geographical information system. (6 marks)

Advantages: _____

Disadvantages: _____

Assessment Guidance for end of Unit One examination.

Standard of Written Work

Some answers within this assessment require answers in continuous prose. (Answers where 6 or more marks are allocated). Such answers must be written using a form and style of writing appropriate to the subject material, and must be structured in a clear and logical way including relevant information and specialist vocabulary where it is required. All continuous prose answers must be legible, have accurate spelling, punctuation and grammar.

The answers given which will fall into the top third of the mark range will:

- Show consistent accuracy in applying knowledge and understanding to the question
- Use technical terminology relating to GIS, accurately and in context
- Present information in a logical and fluent manner
- Use standard conventions of spelling, punctuation and grammar.

The answers given which fall into the centre third of the mark range will:

- Show clear understanding in applying knowledge and understanding to the question
- Use a range of technical terminology relating to GIS
- Present information in a structured and logical manner
- Use standard conventions of spelling , punctuation and grammar with acceptable accuracy to convey meaning.

The answers given which fall into the bottom third of the mark range will:

- Show some understanding in applying knowledge and limited understanding to the question.
- Communicate answers in conventional but generally non technical language
- Present information to address the requirements of the question
- Use standard conventions of spelling, punctuation and grammar with limited accuracy.

When marking continuous prose text examiners must take these conditions into account when arriving at an overall assessment of the answer.

Question guidelines

1. (a) **Explain what geographical information systems are, what they are designed to do and what the information produced by the systems describes.**

Definition; A GIS is a collection of hardware and software designed to collect, store, manipulate, query, analyse and present geographical information. This information describes the characteristics and location of features in the world around us.

- (i) hard ware and software systems 1 mark
- (ii) designed to store, manipulate, query analyse and present geographical information. (logical sequence described) 1 mark
- (iii) information and location of geographical features(both) 1 mark

- (b) (i) **Complete fig 1 by adding the missing term into the blank box**
Data analysis 2 marks.

(Award only 1 mark for analysis, data interrogation, data interpretation)

- (ii) **State two products, in addition to maps, that may be used to represent geographical data**
Accept any two from image-s, aerial photographs, census reports, 3d models, hypertext documents, web pages, layouts, charts, graphs, reports, tables. Accept other closely related terms to those listed.

2 marks

- (c) (i) **Name one geographical issue question or problem which might benefit from GIS analysis**

Relevant issue named

2 marks

(ii) **Name four key stages in the GIS process and outline the role of GIS in each of these stages**

4 stages - Collection, manipulation, analysis, and presentation named and role described

4 marks

(iii) **Suggest the benefits GIS will bring to the situation**

Benefits of GIS - accept - description and classification of features of interest, mapping the location of resources, clarification of patterns in the distribution of features, evidence of relationships between features, identification of new relationships, assist in making decisions about the location of a new feature, cost-savings in processing data, assist in the communication of the key points relating to the issue, question or problem.

2 marks

TOTAL 15 marks

2 (a) **What is meant by the term geographical data**

Geographical data is data describing the location and characteristics of features on the earth's surface.

2 marks (both)

(For less clearly worded definitions give 1 mark for use of the word "where" e.g. data about where features are, or for examples e.g. population census data, maps, building surveys).

(b) i) **Outline three characteristics of the data collection device selected.**

Characteristics refers to the qualities or attributes of the data. This could include the data format (analogue or digital), type (numerical, text), volume (very large in the case of satellite images), storage medium used, features recorded or cost of collection.

3 marks

ii) **Outline one application of the data collection device selected.**

Applications should refer to the uses to which the data can be put. Examples include development of plans for a new building or and map revision (theodolite), retail sphere of influence survey or visitor preferences (questionnaire), weather forecasting or agricultural monitoring (earth observation satellite).

3 marks

(c) **List the procedures that must be carried out before geographical data can be used effectively within a geographical information system and comment on the significance of each stage.**

Level 1: 1-2 marks - answers that refer to more than one procedure and comment on each stage within the context of GIS. Procedures may include data entry (transfer of raw data into digital format in a computer), data conversion (creation of appropriate file formats), data editing (involving checking, correcting and reformatting the data), data classification (using an appropriate classification scheme or scoring system) and data registration (to ensure multiple data sources can be integrated in a GIS). Other closely-related terms could be used.

Level 2: 3-4 marks - Answers which refer to more than one procedure and comment on the significance of GIS systems within each stage and context.

Level 3: 4-7 marks -Full marks should be awarded for a sound overview of two of these processes . Credit should be given for reference to the candidate's own practical work and for the standard of the written prose. (see standard of work)

7 marks

TOTAL 15 marks

3. (a) **What is meant by the term buffer zone.**

A region of fixed distance around a geographical feature or set of features.

1 mark

The concept of a zone whose boundary is at a constant distance from an object or collection of objects

1mark

(b) **What two other features may a buffer zone be created for?**

- accept any meaningful point line or polygon features e.g. oil wells, road and other transport networks, vegetation zones. Features may be selected from the natural or built environment.

2 marks

(c) **Give an example of the use of buffering and explain why buffering is a frequently performed operation in a geographical information system/**

Example given - eg , the identification of schools catchments, environmental impact assessment, contamination zones, flood regions, service regions

1 mark

Buffering is an important processes in GIS because solutions to geographical problems frequently involve an examination of spatial proximity (i.e. what is near a particular feature)

Buffering involves the creation of zones defined by being within a specified distance of a feature or features of interest.

Buffer zones may be created around point, line or polygon features and are readily created in most GIS software applications. They can be generated in both raster and vector GIS environments. Examples include the identification of schools catchments, environmental impact assessment, contamination zones, flood regions, service regions Buffers may be used for a variety of purpose and ecological zones.

3 marks

Give credit to coherent, well-organised responses that demonstrate an understanding of the meaning, creation and importance of buffers in GIS. Reference to practical activities and actual examples should be credited.

(d) **Comment on the limitations of buffering as a GIS operation.**

Answers to this question should refer to a number of different issues relating to the construction and application of buffering in GIS. The following areas may be examined:

- technical difficulties in performing buffering (some GISs do not have this function),
- computational complexity (may be a time-consuming operation on some computers),
- selection of appropriate features (target objects for buffering around may not exist as discrete features in a GIS database),
- a spatial buffer may represent inappropriate selection criteria (simple distance measurements from a feature may not be meaningful, e.g. travel time may be more appropriate)
- relationship of buffer zone to real-world phenomena (uniform buffer may not correspond to actual distribution of features),
- problems involved in selecting features partially contained within buffer zones (for example overlapping polygons),

Level 1: 1-2 marks

Answers show a limited understanding of the concept of buffering and its associated limitations. May make brief and/or ambiguous reference to some of the above issues. Information communicated with limited accuracy and fluency.

Level 2: 3 4 marks two factor described and explained

Answers show a clear understanding of the concept of buffering and its associated limitations. Will make some reference to a number of the above issues. Information communicated with accuracy and fluency.

Level 3: 5 - 7 marks three factors described and explained with practical applications

Answers show a full understanding of the concept of buffering and its associated limitations. Will make detailed reference to a number of the above issues. Information communicated with a high degree of accuracy and fluency.

To answer this question candidates require an appreciation of the problems associated with simplifying the real world and modelling it in a GIS database. It is rarely the case that an area of interest is defined strictly in terms of distance from a given feature. Many phenomena, frequently represented using the buffer concept, such as pollution, animal movements, visitor behaviour, market penetration etc. do not obey strict laws based on distance from a specific point. Other factors such as environmental gradients (terrain, wind speed) or economic conditions may alter the distance a given influence may be found from a feature of interest. Variation in the phenomena of investigation may occur within the buffer region which makes the coherent appearance of a buffer misleading. Similarly the concept of a sharp boundary limiting the edge of a buffer region may not be appropriate in modelling certain geographical processes.

7 marks

Once again, reference to examples of real-world problems associated with buffering. Credit should also be given to the candidate's own practical experience, and to the standard of prose used. (standard of work)

TOTAL 15 marks

4 (a)

(i) **Pixel**

A pixel (picture element) is the smallest indivisible unit in the raster data structure. Pixels equate to the individual cells in the grid that can be used to represent the area of interest.

1 mark

Each pixel has a number associated with it representing the value of the phenomena shown in the image (e.g. terrain elevation, vegetation type, land-use code). These numbers are stored in a pre-defined sequence in the raster data structure and used by the computer to determine the display characteristics (e.g. colour) of the pixels when the image is presented.

2 marks

(ii) **Resolution**

The area on the ground covered by a pixel will define the resolution of a raster image.

1 mark

A high resolution image will contain a lot of pixels, each one covering a small area on the ground. These images display a lot of detail. A low resolution image will contain fewer pixels and thus require less data storage on a computer. However as resolution decreases detail is lost from the image.

2 marks

(b) **Outline the advantages and disadvantages of using raster data structure in geographical information systems.**

(i) Raster data has a number of advantages. These include:

- Data provides complete coverage of a study area (therefore suitable for representing features which exhibit continuous variation such as climate and vegetation).
- Much spatial data is collected in raster format (e.g. satellite images)
- Wide range of spatial analysis methods available to process raster data.
- Ease of data integration through image overlay techniques.
- Structure of raster data corresponds to many field-based survey methods

Award one mark for each of issue referred to.

3 marks

(ii) The disadvantages of raster data include its inability to contain more than one attribute for any feature and the large data volume it creates.

- Raster data is poor at representing discrete features such as points, lines and areas.
- Raster data contains no topological information about the relationship between features
- Only one feature attribute can be represented in an individual data layer using raster data.
- Raster data does not support network analysis.
- Data volumes and computer processing times are often very large for raster data.

Award one mark for each of issue referred to.

3 marks

(c) **Briefly describe one data structure other than the raster data structure that may be used to store geographical information.**

Vector data is the other major structure used in GIS

3 marks

Reference to points/lines/polygons without the use of the word vector allow 1 mark

TOTAL 15 marks

Annex 3: Example of Practical Assignment - Unit 2

Practical assignment. Unit Two - Applications of Geographical Information Systems

[Date set]

[Deadline]

Review activity

The application of GIS in mapping patterns of criminal activity

Instructions

Introduction

Crime is a highly geographical phenomena with marked variations in type and incidence rates according to location. Patterns of criminal activity may be relate to a wide range of social, economic and environmental factors. GIS provides an effective tool to examine the distribution of crime within a given region and analyse the associations between criminal activity and other characteristics of the population.

In this review activity you will explore the use of GIS in crime analysis through a combination of hands-on and research activities. These will involve:

- A practical GIS exercise focusing on the geographical pattern of crime in the local borough.
- A research-based task which will explore the use of GIS in the police force in the UK and further afield.

You will also have the opportunity to hear from an officer from our local police force who will visit the school. He will explain how GIS was used to investigate the pattern of burglary in our district over a five year period.

Practical GIS activity

You are provided with the following data

- Crime statistics for the local borough for 1995-1996 and 2000-2001 in a database (.dbf) file. Crime incidents are stored as separate records with national grid co-ordinates used to locate the scene of the crime. The crimes are classified by type (theft, burglary, assault, vandalism, affray, domestic violence, drug possession and fraud).
 - A digital map of the wards for our borough. The map is in shape file format and can be opened in the ArcView GIS software.
 - Census data from the 2001 census for the wards in the Borough. Selected census variables have been extracted including total population, age profile, unemployment, occupational class, health and housing tenure.
 - Other digital cartographic data such as major roads, areas of open space and shopping centres in the borough.
-

Your task

Using the data provided you are required to examine the pattern of crime in the Borough by focusing on significant variations over space and time. You are to use the ArcView GIS software application to perform this task. Your analysis should address the following questions:

- Where are the locations of greatest overall crime incidence today?
- How has the distribution of these incidences changed over the last five years?
- What is the relationship between patterns of criminal activity and socio-economic characteristics within the borough?
- What is the relationship between patterns of criminal activity and features such shopping centres within the borough?
- What are the most important differences between crime type in terms of their variation over space or time?

Research activity

You should supplement your activities by investigating the broader context of GIS in crime mapping. You will find the following websites contain useful information:

- University of Leeds presentation on GIS in mapping health and crime patterns:
<http://www.geog.leeds.ac.uk/presentations/97-2/sld001.htm>
- Association of Geographic Information Crime and Disorder Special Interest Group: <http://www.agi.org.uk/cdsig/>
- UK Government Crime Reduction Toolkits: <http://www.crimereduction.gov.uk/toolkits/index.htm>
- US National Institute of Justice Crime Mapping Research Centre
<http://www.ojp.usdoj.gov/cmrc/>

Review report

You should present the results of your review in a word processed report of no more than 1000 words. The report should cover the following aspects of your investigation:

- Nature and scope of GIS in the field of crime mapping.
- Techniques involved in using GIS for crime mapping.
- Patterns of crime in the local borough.
- How GIS is used by organisations involved in tackling crime
- An evaluation of the benefits of GIS in analysing the patterns of criminal activity.

Information

This assignment constitutes the assessment for Unit Two, Applications of Geographical Information Systems. It forms 70% of the total assessment of the qualification and will be graded according to the grading criteria given in section 10 of the unit specifications.

Annex 4: Key Skills Map

Level III Key Skills Map
Communication

ASET LEVEL 3 CERTIFICATE IN GEOGRAPHICAL INFORMATION SYSTEMS (Unit 2)

You must:	To show you can:	What you will do:	Evidence you will produce:
C3.1a Contribute to a group discussion about a complex subject.	<ul style="list-style-type: none"> i. Make clear and relevant contributions in a way that suits your purpose and situation. ii. Listen and respond sensitively to others, and develop points and ideas. iii. Create opportunities for others to contribute where appropriate. 	<ul style="list-style-type: none"> ● Discuss the benefits and limitations of GIS in the context of an specific application area during a group discussion. 	<ul style="list-style-type: none"> ● Summaries of group discussions.
C3.2 Read and synthesise information from two extended documents about a complex subject. One of these documents should contain at least one image.	<ul style="list-style-type: none"> i. Select and read material that contains the information you need. ii. Identify accurately, and compare, the lines of reasoning and main points from texts and images. iii. Synthesise the key information in a form that is relevant to your purpose. 	<ul style="list-style-type: none"> ● Read information about the characteristics, advantages and disadvantages of raster and vector data structures. 	<ul style="list-style-type: none"> ● Summaries of reading activities.
C3.3 Write two different types of documents about complex subjects. One piece of writing should be an extended document and include at least one image.	<ul style="list-style-type: none"> i. Select and use a form and style of writing that is appropriate to your purpose and complex subject matter. ii. Organise relevant information clearly and coherently, using specialist vocabulary when appropriate. iii. Ensure your text is legible and your spelling, grammar and punctuation are accurate, so your meaning is clear. 	<ul style="list-style-type: none"> ● Write a report outlining the procedures used to apply GIS techniques to the study of a specified environmental issue, question or problem. 	<ul style="list-style-type: none"> ● Report text, containing a map output from a GIS-based investigation. <p>Level III Key Skills Map ASET LEVEL 3 CERTIFICATE IN GEOGRAPHICAL INFORMATION SYSTEMS (Unit 2)</p>

Level III Key Skills Map
Application of Number

ASET LEVEL 3 CERTIFICATE IN GEOGRAPHICAL INFORMATION SYSTEMS (Unit 2)

You must:	To show you can:	What you will do:	Evidence you will produce:
N3.1 Plan and interpret information from two different types of sources, including a large data-set.	<ul style="list-style-type: none"> i. Plan how to obtain and use the information required to meet the purposes of the study. ii. Obtain relevant information. iii. Choose appropriate methods for obtaining the results you need and justify your choice. 	<ul style="list-style-type: none"> ● Develop and implement a data collection method (e.g. questionnaire) to investigate an environmental or social issue, question or problem. 	<ul style="list-style-type: none"> ● Completed data collection (e.g. questionnaire response) sheets.
N3.2 Carry out multi-stage calculations to do with: <ul style="list-style-type: none"> a) amounts and sizes; b) scales and proportion; c) handling statistics; d) rearranging and using formulae; 	<ul style="list-style-type: none"> i. Carry out calculations to appropriate levels of accuracy, clearly showing your methods. ii. Check methods and results to help ensure errors are found and corrected. 	<ul style="list-style-type: none"> ● Manipulate primary (e.g. questionnaire) and secondary (e.g. census) data relating to an environmental or social study in a GIS. ● Undertake GIS analysis to map data and to determine relationships between variables. Check and evaluate procedures. 	<ul style="list-style-type: none"> ● Printouts of GIS data analysis (e.g. tables, graphs, maps)
N3.3 Interpret results of your calculations, present your findings and justify your methods. You must use at least one graph, one chart and one diagram.	<ul style="list-style-type: none"> i. Select appropriate methods of presentation and justify your choice. ii. Present your findings effectively. iii. Explain how the results of your calculations relate to the purpose of your activity. 	<ul style="list-style-type: none"> ● Present Interpret and evaluate results of GIS investigation of a selected environmental or social issue, question or problem. 	<ul style="list-style-type: none"> ● GIS investigation review

Level III Key Skills Map
Information technology

ASET LEVEL 3 CERTIFICATE IN GEOGRAPHICAL INFORMATION SYSTEMS (Unit 2)

You must:	To show you can:	What you will do:	Evidence you will produce:
<p>IT3.1 Plan, and use different sources to search for, and select, information required for two different purposes.</p>	<ul style="list-style-type: none"> i. Plan how to obtain and use the information required to meet the purposes of your activity. ii. Choose appropriate sources and techniques for finding information and carry out effective searches. iii. Make selections based on judgements of relevance and quality. 	<ul style="list-style-type: none"> ● Identify, collect and digitise primary and secondary geographical data requirements for your environmental investigation. 	<ul style="list-style-type: none"> ● Appendices and references in report.
<p>IT3.2 Explore, develop and exchange information and derive new information to meet two different purposes.</p>	<ul style="list-style-type: none"> i. Enter and bring together information in a consistent form, using automated routines where appropriate. ii. Create and use appropriate structures and procedures to explore and develop information and derive new information. iii. Use effective methods of exchanging information to support your purpose. 	<ul style="list-style-type: none"> ● Manipulate and analyse primary and secondary digital geographical data GIS software. 	<ul style="list-style-type: none"> ● Statistical maps produced from GIS analysis. ● Results of data computer-based GIS analysis included in review materials.

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