Programme Specification

A statement of the knowledge, understanding and skills that underpin a taught programme of study leading to an award from The University of Sheffield

1	**Programme Title**	Geographical Information Systems (GIS)
2	**Programme Code**	GPLT009 / TRPT22
3	**JACS Code**	100369
4	**Level of Study**	Postgraduate
5a	**Final Qualification**	Master of Science (MSc)
5b	**QAA FHEQ Level**	Level 7
6a	**Intermediate Qualification(s)**	Postgraduate Certificate (PGCert), Postgraduate Diploma (PGDip)
6b	**QAA FHEQ Level**	Level 7
8	**Faculty**	Social Sciences
9	**School**	Geography and Planning
10	**Other Schools involved in teaching the programme**	None
11	**Mode(s) of Attendance**	Full-time
12	**Duration of the Programme**	1 year
13	**Accrediting Professional or Statutory Body**	None
14	**Date of production/revision**	November 2019, January 2022, December 2022, December 2023

15. Background to the programme and subject area

The University of Sheffield's **MSc in Geographical Information Systems** provides students with the mix of technical skills, practical experience and theoretical knowledge they need to launch a successful career in the fields of GIS, applied policy research, or spatial data analysis. The programme focuses on GIS from a socio-economic and socio-environmental perspective and draws upon the teaching and research strengths of the School of Geography and Planning, where the links between research and practice are a central feature of the approach to postgraduate teaching. The majority of students graduating from this programme will go on to work in the public and private sectors, with some progressing to PhD study.

The course has a strong 'applied' emphasis, which means that in addition to developing strong analytical and technical GIS and spatial analysis skills using the latest proprietary and open-source software, students will be immersed in the practical applications of GIS and its utility in helping to solve real world problems and answer difficult research and policy questions. This draws upon the strengths and experience of the core staff members involved in the delivery of this MSc Applied GIS programme, all of whom have strong policy and practice links as well as being experts in the technical aspects of the discipline. Therefore, students graduating from this programme can expect to find employment not only in more technical roles, but also in more applied, policy-oriented analyst posts.

Students enrolling on this programme will be exposed to a wide range of GIS-related topics and will be guided through stimulating subject matter by an enthusiastic and dynamic teaching team. Highlights of the University of Sheffield's MSc Applied GIS programme include:

- An emphasis on the use of GIS and spatial analysis methods as a means to an end in helping solve, or identify, real world problems with cutting-edge geospatial technology.
- A focus on emerging debates and developments in the fields of 'open data', 'big data' and their links to spatial data analysis more widely.
- Exposure to critical perspectives on the limits to what GIS can, and cannot, achieve and why students need to develop a sound understanding of the technical and theoretical lineage of the discipline.
- Hands-on use of a wide variety of proprietary and open-source GIS tools, with a focus on problem-

solving with real world data.

- An emphasis on developing high-level spatial data visualisation skills.
- Continuous assessment throughout the academic year which allows students to use positive feedback to build upon their skills as they progress through the programme.
- Consultancy-style project work involving external clients in the public and private sectors.
- Freedom to choose from a variety of policy-oriented option modules.
- Developing particular expertise in analysing and presenting spatial data in meaningful, interesting and original ways to non-specialists.

About the School of Geography and Planning**:** The School of Geography and Planning is well placed to lead a programme of this nature since it has been at the forefront of urban and regional planning education, particularly at postgraduate level since the 1960s. The School of Geography and Planning was established in 1965 and an MA programme started in 1967. The School rapidly established a reputation for excellence in both teaching and research and was rated as the UK's top planning school in the Research Assessment Exercise in 2008. The Royal Town Planning Institute has accredited Masters' level provision offered by the School since 1980, and the School has therefore built-up strong links with the Institute.

16. Programme aims

The aims of the MSc in Applied GIS are as follows:

1. To use teaching informed by research to provide a stimulating culture of learning, enthusiasm for the subject and opportunities for students to develop research skills.

2. To educate able and well-motivated students from a wide variety of backgrounds.

3. To support students in developing critical thinking, intellectual curiosity, and independent judgement.

4. To prepare students for GIS, spatial analysis or policy analyst roles by offering a course which meets the technical and analytical requirements of professional practice.

5. To maximise student employability by progressively developing competencies in a range of proprietary and open-source GIS tools.

6. To engender in students an awareness of both the possibilities and limitations of geospatial technology in solving and identifying real world problems.

17. Programme learning outcomes

Knowledge and understanding:

Upon completion of the MSc in GIS, MSc, PG Dip and PG Cert students will have developed:

K1	A systematic understanding of the core theories and methods in the fields of GIS and spatial analysis.
K2	An understanding of the importance, and practical utility of, quantitative research methods in addressing policy problems.
K3	A comprehensive understanding of the wide variety of potential applications of GIS in socio-economic and socio-environmental analysis.
K4	The ability to critique and objectively assess the limitations of geospatial technology in addressing policy problems and challenges.
K5	A practical and conceptual understanding of the world of professional practice in GIS and how such tools are used in a wide range of situations.
K6	An awareness of the wide range of potential uses of leading proprietary and open-source GIS software packages.
K7	Systematic knowledge of the sources, properties and potential uses of geospatial data.
K8	A thorough understanding of the principles of effective communication with geospatial data.
In addition, students achieving the award of Masters' will have developed:	
K9	A high level of research-based knowledge in a specialised area of GIS or spatial analysis.

Skills and other attributes:	
Upon completion of the MSc in GIS, MSc, PG Dip and PG Cert students will have developed:	
S1	The ability to use advanced spatial analysis methods to investigate research questions of relevance to policy and practice.
S2	The ability to analyse and critique the role of geospatial technology in socio-economic and socio-environmental analysis.
S3	A high level of competence in at least two leading, industry-standard GIS software packages.
S4	The ability to source, process, and analyse a wide array of geospatial data using the most appropriate technology.
S5	The ability to visually communicate the results of geospatial analyses in a manner that meets the expectations of professional practice in GIS, spatial analysis and applied research.
In addition, students achieving the award of Masters' will have developed:	
S6	The ability to identify a specific GIS research problem and to design and complete a research project on it, utilising advanced spatial analysis methods.

18. Teaching, learning and assessment

Development of the learning outcomes is promoted through the following teaching and learning methods:

Knowledge and understanding is acquired by means of a series of inter-related compulsory and option modules which have been designed and developed to foster the wide range of technical expertise, practical understanding and theoretical knowledge that students are expected to obtain by the end of the MSc. Since this Masters' programme has a very strong emphasis on skills development and the applied nature of the technology which it often utilises, the teaching and learning methods reflect this and are described in more detail below. *A matrix illustrating the relationship between teaching, learning and assessment components of the programme, and the programme learning outcomes, is provided at the end of this section.*

Lectures will largely be used for imparting essential knowledge and are an important means of engaging students in the theories, critiques and potential applications of GIS. The knowledge and understanding outcomes which are particularly relevant to this method are as follows: K1, K2, K4, K7 and K8. All other knowledge and understanding outcomes (with the exception of K6 and K9) will also, in part, be addressed in lectures. This method of delivery will also help develop the skills identified in S1 and S2. However, no single module on the Applied GIS MSc will be delivered solely through lectures and it is only in combination with other teaching and learning methods that students will be able to acquire the necessary skills and knowledge.

Computer workshops are an absolutely essential part of the Applied GIS MSc programme, and this learning and teaching method in particular relates to a high number of knowledge and understanding learning outcomes *and* skills and attributes outcomes. There is a strong emphasis in the programme on the development of critical thinking and on understanding the analytical and theoretical lineage of the subject matter but, in addition, we also expect students to emerge from the programme as highly skilled analysts capable of using a variety of different proprietary and open-source tools (including industry-standard GIS packages). Therefore, computer workshops relate strongly to K2, K3, K5, K6, K7 and K8 in addition to S1, S3, S4 and S5.

Seminars are an important means of developing students' critical understanding of the core issues related to applications of GIS in practice and offer a more intensive, hands-on learning environment than lectures. Seminar groups will contain a small number (c. 6-8) of students and participants will be required to read, review and critically assess material prior to meetings. This method of teaching will be particularly important in realising the knowledge and understanding outcomes K1, K2 and K4. This method of delivery will also help develop the skills identified in S2 in a way that builds upon the critical perspectives offered in lectures.

Independent study provides students with the opportunity to develop important knowledge and skills at the postgraduate level. For this programme in particular independent study will be particularly important in relation to skills acquisition as students will need to spend a significant amount of time working on their own (with learning material provided by tutors) with the various pieces of software, applications and data which the programme depends upon. Within core modules there is considerable flexibility for students to identify topics that particularly interest them and then to take these forward in study for the Dissertation and/or in choosing assessment topics for core and option modules. This method of learning is expected to contribute to the acquisition of knowledge and skills in relation to K9, S1, S3, S4 and S6 in particular but will of course also play a supporting role in the realisation of all other programme learning outcomes.

Individual tutorials will be used during the supervision of the research tutorial and during the dissertation process. This form of contact is an invaluable way of assessing, on a formative basis, the extent to which students on the programme are working towards the successful achievement of the knowledge and understanding learning outcomes and K2, K3, K4, K9 and S6 in particular.

Group work provides students with the collaborative skills and applied knowledge they will need to ensure that they graduate with sufficient expertise in relation to working in a live project environment. This form of working is particularly important in applied policy analysis and GIS since any technical or empirical work is typically part of a larger body of work based on a particular research or policy problem. Therefore, the programme includes a dedicated core module called 'The GIS Project'; a group work-based, research problem-centred module geared towards the development of applied skills in GIS. This method of learning seeks to address K3, K5, K6 and K7 from a knowledge and understanding perspective and S1 and S5 in relation to skills development.

Opportunities to demonstrate achievement of the learning outcomes are provided through the following assessment methods:

The programme uses a wide variety of continuous assessment methods, organised as a structured mechanism through which skills and knowledge are developed by students. The programme has been designed so that assessments required by different modules fit within the overall structure and progression of the programme.

Essays are used as an assessment method where there is a need to evaluate comprehension of particular concepts, theoretical perspectives on the role of spatial analysis and GIS or critical thinking in relation to the implementation of GIS and spatial analysis in practice. Essays also help to develop students' ability to communicate clearly through fluent writing and the construction of well-developed arguments. Essays are also used by some modules in the demonstration of students' specialist knowledge and skills. In particular, the use of essays in this programme as an assessment method is intended to demonstrate the achievement of K1, K2, K3, K4 and S2.

Project reports are used to test students' knowledge and understanding and skills across a wide range of more applied elements of the programme. They will play an important role in demonstrating understanding of the practical utility of spatial analysis in addressing complex policy problems, and the wide variety of potential applications of GIS in socio-economic analysis. In this programme, however, the main focus of project reports as an assessment method will be in relation to the achievement of K5, K6, K7, K8 and K9, in addition to S1 and S6.

Visualisation is an important assessment method in this programme. This could take a number of different forms, from standard socio-economic choropleth maps to more advanced network flow maps. With students also being provided with an introduction to online GIS methods we also offer the opportunity for students to submit for assessment online visualisations and maps as part of this programme. The use of visualisations by students on this programme is a vitally important part of demonstrating that they have met the programme learning objectives. The achievement of K6, K7, K8 and S3, S5 and S5 in particular will be tested through this assessment method.

Oral presentation is an important part of the overall assessment strategy for the programme since it tests students' ability to verbalise and logically explain the results of their analysis, its implications and limitations in a face-to-face setting and then receive instantaneous verbal feedback which they can then respond to. In this programme, students will be required to give oral presentations as part of The GIS Project module, which is a client-based project. This assessment method is intended to test K1, K2, K3, K4 and S2 and S5.

The Dissertation represents the culmination of the programme as an assessment method and therefore allows students to demonstrate the achievement of a large number of programme learning outcomes. To some extent, the Dissertation allows us to test all knowledge and understanding and skills outcomes but the particular focus on the dissertation is on K2, K3, K4, K6, K7, K8 and K9 in addition to S2 and S6. The Dissertation, therefore, offers all students on the programme the opportunity to put into practice the knowledge and understanding and skills they have developed during the course of the academic year as a result of the combined learning and teaching methods set out above.

The relationship between the teaching and learning methods, assessment methods and the programme learning outcomes is set out in visual form in the next page.

Learning Outcome Code and Synopsis	*Teaching and learning*						*Assessment*				
	Lectures	Computer Workshops	Seminars	Independent Study	Individual Tutorials	Group Work	Essays	Project Reports	Visualisation	Oral Presentation	Dissertation
Knowledge and understanding											
K1 – GIS theories and methods	x		x				x			x	
K2 – addressing policy problems	x	x	x		x		x			x	x
K3 – applications of GIS		x			x	x	x			x	x
K4 – limitations of GIS technology	x		x		x		x			x	x
K5 – understanding professional GIS		x				x		x			
K6 – understanding utility of software		x		x		x		x	x		x
K7 – systematic knowledge of geo data	x	x				x		x	x		x
K8 – effective visual communication	x	x						x	x		x
K9 – research-based knowledge in GIS				x	x			x			x
Skills and attributes											
S1 – use of advanced spatial analysis		x		x		x		x			
S2 – critique role of geo technology	x		x				x			x	x
S3 – competence with GIS packages		x		x					x		
S4 – data processing and handling		x		x					x		
S5 – visualisation with geo data		x				x			x	x	
S6 – complete large research project				x	x			x			x

19. Reference points

The learning outcomes have been developed to reflect the following points of reference:

The programme team has conducted extensive background research into the orientation, content, focus and scale of all current PGT GIS programmes in the United Kingdom. In addition, they have also examined in detail the leading GIS programmes in the United States and consulted with a number of prominent individuals from key sectors relevant to the development of the proposed programme. Details of these reference points are provided below in relation to those *external* to the University of Sheffield, followed by *internal* reference points. These reference points have been the guiding principles in helping us to establish a coherent and relevant set of programme learning outcomes.

Externally, there is a well-recognised need for analysts skilled in the technical and theoretical aspects of GIS and spatial analysis. This has long been recognised by the **Quality Assurance Agency** for Higher Education and is specifically mentioned in their 2014 subject guide to Geography, where they state that: “Geographers study how digital worlds are created and analysed through the study of GISci and apply that knowledge through the use of GIS and remote sensing.” Since 2014, with the rise of open-source tools, open data and the emergence of so-called ‘big data’, the need for skilled analysts in this field has grown, yet the provision of postgraduate education in GIS has not kept pace.

Consequently, in February 2013, the **ESRC/AHRC/RGS-IBG** International Benchmarking Review of UK Human Geography stated that: “More surprising to us has been underinvestment in Geographical Information Science (GIS), a suite of spatial skills developed largely by geographers. The Panel recommends more focused investment in GIS laboratories and renewed commitment to hiring in this sub-discipline” (p. 5). The review notes in particular, under the heading ‘Areas for Improvement’ the ‘Relative weakness in quantitative method and GIS’ (p. 15-16) and notes the growing importance of analysis of ‘big data’ and the power of spatial data visualisation

methods.

Furthermore, in relation to spatial data, one of the goals included in the **ESRC's Strategic Plan** to 2015 includes "developing a common framework for geo-spatial data, which will enable better monitoring, simulation and development of interventions" (p. 16).

Since this programme is an interdisciplinary one, we have been careful to consider both geography and planning external reference points and in this regard the Centre for Education in the Built Environment's 2009 review into spatial literacy in planning education emphasised the importance of GIS for planners and highlighted a growing need to up-skill planning students and practitioners in this area. More widely, the emergence of ever more spatial data sources from the UK agencies responsible for planning (School for Communities and Local Government, Scottish Government, Welsh Assembly, Northern Ireland Executive), and the potential to conduct meaningful analyses with these data, has led to a growing need – within the last three years in particular – for graduates skilled in advanced GIS and spatial analysis methods. At the European level this can also be seen in the continued importance of the European Union's **ESPON** programme and its associated spatial visualisations. Similarly, the EU-wide **INSPIRE** directive (2007/2/EC) of the European Parliament and of the Council of Europe places a strong emphasis on establishing an infrastructure for spatial information in the European Community. In order to achieve this, and for the UK to make a significant contribution to it, more able graduates are needed.

In addition to these more overarching reference points, a number key of organisations and individuals were consulted in the development of this programme, as follows:

- **ESRI**, the world's leading GIS software provider, has provided extremely useful guidance on the development of this programme. In particular, ESRI UK's Training and Education Services Manager, Rob Sharpe, has provided invaluable advice on the kind of skills and knowledge relevant to employers across the GIS industry and more widely in analyst posts in local government, national government and the private sector.
- Key staff members at the **Office for National Statistics'** Data Visualisation unit have also provided invaluable advice on the state of GIS education provision in the UK at present and the kinds of skills that organisations such as ONS need. In particular Alan Smith, Head of Data Visualisation at ONS, has shared his extensive knowledge on the subject and this has helped shape the content of the course and served as a useful sounding board in the development of the learning objectives.
- **Manchester Geomatics** founder and leading light in the field of UK GIS, Bob Barr has also offered invaluable insights into the development of this programme. Professor Barr has over 30 years of experience in the handling and manipulation of geographic information and is a past Chairman of the Association for Geographic Information and an External Examiner at the UK's current leading GIS programme at the University of Edinburgh. Further input from Professor Scott Orford (Cardiff University) has led to refinements of the programme to reflect the rapidly changing landscape of the GIS field.
- From an international perspective, **Waldo Tobler** (University of California, Santa Barbara) and **John Wilson** (University of Southern California) have helped us develop the orientation of the programme so that it is not simply a UK-focused course of study looking at UK issues with UK data. This is seen to be particularly important since our programme aims to recruit from a wide range of countries across the globe.

Given these external reference points, our programme is aimed at making a significant and sustained contribution to the development of enhanced postgraduate GIS training provision in the fields of geography and planning, with a particular focus on the applied aspects of the technology we utilise.

Internally

In developing the learning objectives for this programme, we have ensured that it adheres to the learning and teaching strategies of the School of Geography and Planning. The most important of these internal reference points are as follows:

- To provide quality teaching at undergraduate and postgraduate levels, informed and invigorated by the research and scholarship of academic staff.
- Theoretical and analytical rigour are emphasised and critique is viewed as an essential component of the learning experience for students.
- To provide access to the widest possible range of sources of knowledge, and the resources to enable the pursuit of learning and scholarship.
- To provide an environment in which all members of the School can enhance their skills and apply them to a wide range of theoretical and practical problems in the service of the wider community.
- Knowledge and understanding (e.g. of how to use a particular piece of GIS software) are viewed as

transitory and therefore intellectual curiosity, critical thinking and sound independent judgement are viewed as especially important.

The University's guiding principles – in addition to the learning and teaching strategy – have been particularly important reference points in helping develop our learning objectives for the MSc in Applied GIS. We view these principles not as abstract expressions of intent, or mere rhetoric, but as valuable points of reference which we can use to ensure that our programme is focused appropriately. Therefore, our focus is on:

- **Achieving excellence**, both in relation to our delivery of material but also in the development of students' skills and knowledge so that graduates from our programme are recognised as being of the highest quality and significantly exceeding the norm.
- **Cultivating ambition** is also critically important since we want our students to be pushed to achieve great things and use their advanced GIS and spatial analysis skills to tackle the most difficult social, economic and environmental challenges and the intersections between them.
- **Making a difference** is the core guiding principle that resulted in our focus on 'applied' GIS, rather than on simply the more technical aspects of the technology. Yes, we wish students to be skilled analysts but more than this we want them to understand what the technology is for and what it can – and cannot – do.
- **Working together** is a principle that is enshrined in our programme and students have to work together on a number of modules in order to succeed. We aim to capitalise on the differences and diverse talents within the student body and work together to maximise the potential of individuals.
- **Leading the way** is the final core guiding principle which we believe helps set our programme apart. The staff involved in this programme are all emerging leaders in their fields and have made an impact on their respective disciplines, both within academia but also in the wider world. We therefore are very much focused on helping students see the bigger picture and will encourage students to think how they too can help shape the world now and into the future.

20. Programme structure and regulations

The programme is structured to provide the majority of core knowledge and understanding in the first semester, with more flexibility and opportunities to specialise in the second semester and through the summer period. All MSc students will take modules to the value of 180 credits, including 60 credits in the form of a dissertation.

Students must take four 15 credit core modules in the first semester. In the second semester, three further core modules build upon the knowledge and skills developed in the first semester to enable students to reach an advanced level in terms of GIS skills.

Students will then choose one 15 credit option module in the second semester from within the School of Geography and Planning. Students must choose one to reach a 180-credit balance by the end of the academic year.

The programme is delivered over a twelve-month period. The taught modules are delivered over two semesters (September to February, February to June) and the dissertation is taken, from June to September.

Students successfully completing 60 credits are eligible for the award of the PG Cert in Applied GIS whilst those successfully completing 120 credits are eligible for the award of the PG Dip in Applied GIS. Students successfully completing 180 credits are eligible for the award of the MSc in Applied GIS.

Detailed information about the structure of programmes, regulations concerning assessment and progression and descriptions of individual modules are published in the University Calendar available on-line at http://www.sheffield.ac.uk/calendar/.

21. Student development over the course of study

This programme of study has been carefully designed and organised so that there is clear development in relation to substantive knowledge and key analytical skills over the course of study. The teaching and learning is developmental in focus and we place a high priority on student-centred learning. As the year progresses, we expect students to use their independent study time to build upon the knowledge and skills developed during modules from a variety of teaching and learning methods, whilst being continually supported in their efforts by the teaching team.

In relation to the specific knowledge and understanding of learning outcomes and the development of skills and attributes, these will be realised in a progressive manner over the course of the programme. However, the expectation is that K1, K3, K4, K6, K7 and S2, S3 and S4 are focal points in the first semester and that K2, K5, K8, K9 and S1, S5 and S6 are focal points in the second semester and during the summer dissertation period.

Whilst specific learning outcomes have been associated with a staged process, it is important to note that we view the development of knowledge and skills as continuous rather than separated into discrete stages. Therefore, students are expected to continue developing their core knowledge throughout the programme and are also expected to develop skills from the start of the programme.

22. Criteria for admission to the programme

High entrance requirements for postgraduate taught Masters' degree programmes at Sheffield reflect the quality of the University. The University of Sheffield has been welcoming students from all over the world for many decades and we have substantial experience in assessing and understanding the many different international qualifications.

We require applicants to hold a minimum of an upper second-class honours' degree from a UK University (or an international equivalent) in a relevant subject area including geography, planning, urban studies, civil engineering and environmental management. Candidates with other qualifications or suitable relevant experience will be considered on an individual basis. International students are also required to hold a suitable English language qualification, such as TOEFL (minimum score of 550) or IELTS (an average score of 6.5 with a minimum of 5 in each component).

23. Additional information

This specification represents a concise statement about the main features of the programme and should be considered alongside other sources of information provided by the teaching School(s) and the University. In addition to programme specific information, further information about studying at The University of Sheffield can be accessed via our Student Services web site at http://www.sheffield.ac.uk/ssid.