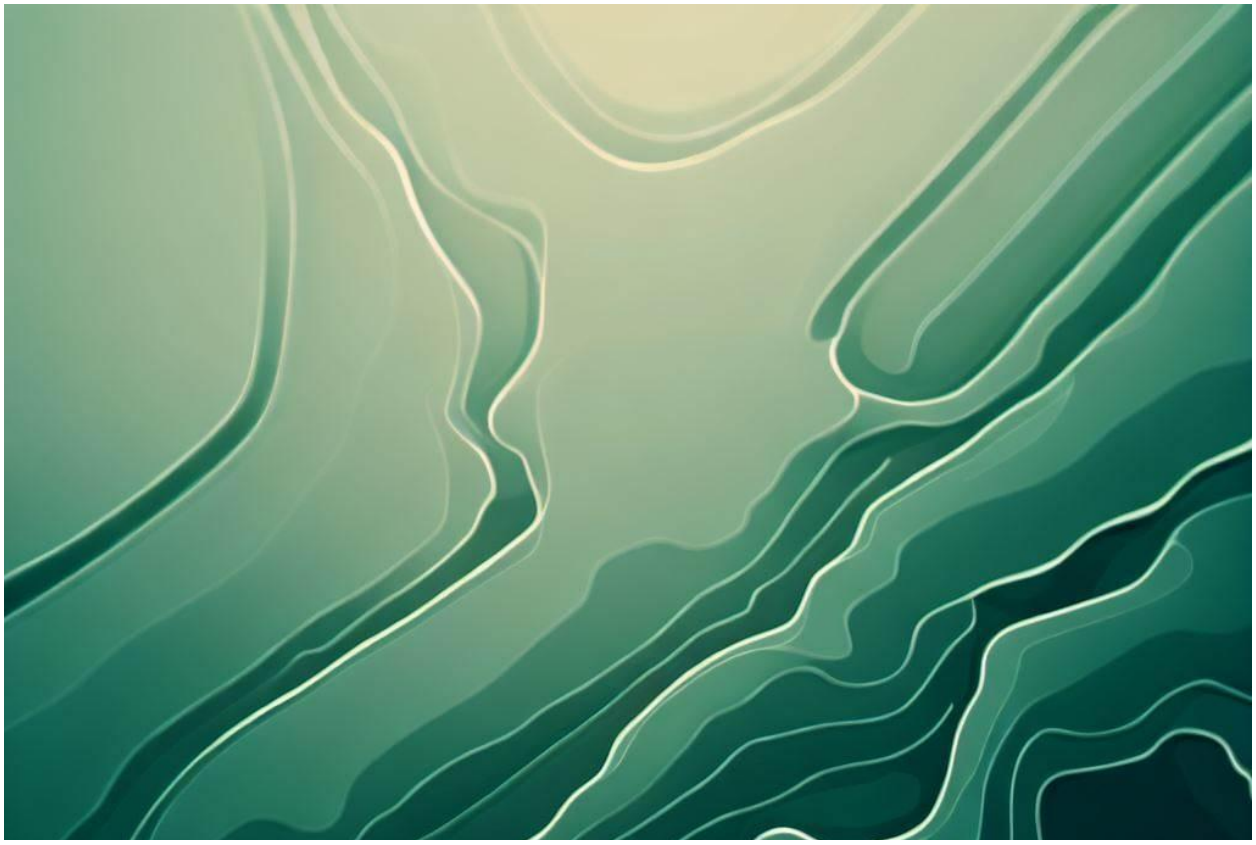
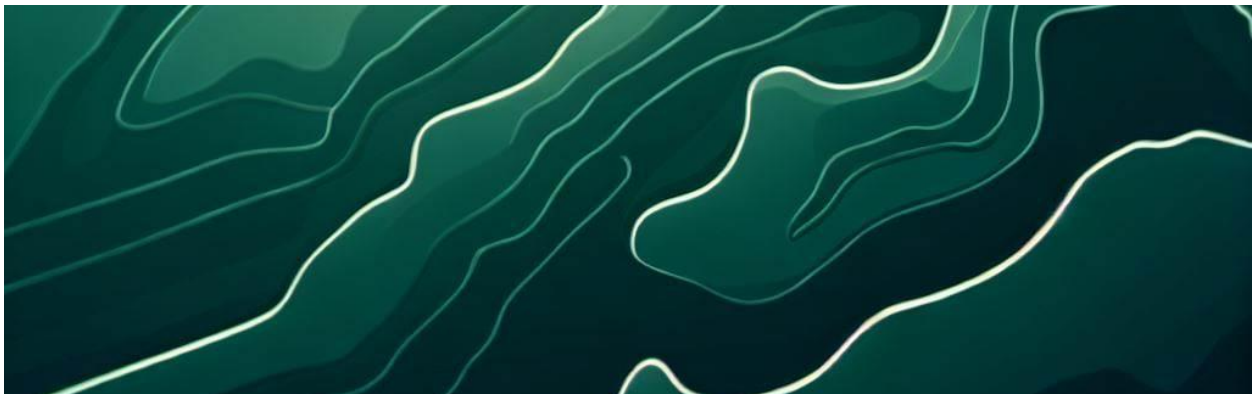


Geospatial Education Provision in Aotearoa New Zealand

Mairéad de Róiste, Scott Pool, and John Lowry



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[1] https://www.linz.govt.nz/gcc

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Executive Summary

The geospatial industry is growing with a significant international market. Both *Surveyor* and *Other Spatial Scientist*[2] remain on the long-term skill shortage list produced by Immigration New Zealand. It is against this background that a review of geospatial education provision is conducted.

Geospatial education encompasses Geographic Information Systems (GIS) and Science (GISc), Surveying, and related terms, such as geoinformatics and geospatial science. This report focuses on formal geospatial education in tertiary institutions as well as spatial analysis standards undertaken in secondary schools in Aotearoa New Zealand.

The report undertakes three work streams.

1. **Trends in geospatial education.** This section explores the number of students taking national standards (NCEA) in spatial analysis and the number of students taking geospatial courses at tertiary level. Spatial Analysis standards over the last 4 years have maintained a relatively constant level and at tertiary level, there is continued growth in geospatial student numbers despite declines in tertiary student numbers overall. A high correlation is observed between the number of students taking Spatial Analysis standards and tertiary student numbers. The conversion is low from undergraduate to postgraduate where additional skills are gained.

2. **International comparison**. In this section, we compare provision of geospatial courses in all Aotearoa New Zealand tertiary institutions in two ways. First, we compare provision **across courses** using course titles and descriptions against selected institutions in 5 other countries: Australia, Germany, the Republic of Ireland, the USA and the UK. Comparisons are made using a framework drawing on the diverse knowledge areas from the GIS&T Body of Knowledge and the Geospatial Technology Competency Model combined with more generic courses, e.g. introduction courses. This framework was also adapted to include a Te Ao Māori category to recognise its importance in national geospatial provision.

   Second, we perform a deeper **within-course** comparison of geospatial course provision in Aotearoa New Zealand against that in the Republic of Ireland. Ireland has a similar size population and number of tertiary institutions. Taking course learning objectives into account for more generic courses (e.g. introduction, general GIS courses), we calculate the proportion of knowledge area focus within each course.

   Geospatial course provision in Aotearoa New Zealand is in step with international provision. Domain applications (e.g, a course in GIS for forestry) comprise the highest number of courses in Aotearoa New Zealand but this proportion is less than the

[2] Other spatial scientist is the government employment classification for those working in the geospatial industry.

proportion of domain application courses in the UK. Internship courses are where the highest difference is observed in Aotearoa New Zealand compared with other countries but the total number of courses is low. Analysis courses are high in Aotearoa New Zealand but only 0.1% (10% versus 9.9%) higher than the next country.

From the more in-depth within-course comparison, Ireland and Aotearoa New Zealand have a similar number of geospatial courses and the focus of that provision is comparable. Data management was identified as the largest difference in knowledge areas.

3. **Geospatial Education Workshop**. A 2-hour workshop was conducted at the New Zealand Geospatial Research Conference with participants from the geospatial industry as well as geospatial educators. The participants explored two questions on 1. the differences between industry and academic expectations for geospatial education and 2. expectations of geospatial education graduates, including specific skills, areas of deficiency or strengths and differences between postgraduates and undergraduates.

In terms of provision of both course and course learning objectives in more general courses, Aotearoa New Zealand is in step with international provision. Three gaps were identified: Data management, Te Ao Māori and soft skills. Data management is under-represented nationally and was a concern identified by participants in our workshop with geospatial professionals and educators. Data management is the process of storing, organising, manipulating, and maintaining geospatial and other data in a structured way. It also includes elements such as metadata and assessing data quality. Te Ao Māori is under-represented in courses with only one course provided nationally. The contextual importance of Mātauranga Māori is valuable for geospatial graduates in understanding and adapting geospatial skills to the unique national setting in Aotearoa New Zealand. Soft skills are valued by industry, particularly communication skills, and a lack of emphasis in course learning objectives may not adequately prepare students for industry.

The analysis provided in this report is a snapshot of tertiary provision. The university sector is currently experiencing a significant workforce contraction. A probable consequence is a reduction in geospatial courses provided in the short term and may mean geospatial provision is out of step with international provsion.

Industry education collaboration initiatives, such as workshops with geospatial professionals and educators, are likely to be of benefit to students, educators, and the overall industry in addressing knowledge gaps of current education provision and identifying current gaps. Universities, in consultation with industry and professional bodies, are well placed to provide lifelong learning opportunities and short courses or micro-credentials may be well received by professionals.

List of Abbreviations

AI: Artificial Intelligence
AUS: Australia
BoK: GIS&T Body of Knowledge
DoLETA: United States Department of Labour, Employment and Training Administration
GER: Germany
GI: Geographic Information
GIS: Geographic Information Systems
GISc: Geographical Information Science
GIS&T: Geographic Information Science and its associated Technologies
GNSS: Global Navigation Satellite System
GPS: Global Positioning System
GTCM: Geospatial Technology Competency Model
HDI: High Development Index
IRE: Republic of Ireland
LBS: Location Based Services
LINZ: Toitū Te Whenua Land Information New Zealand
NCEA: National Certificate of Educational Achievement
NZ: Aotearoa New Zealand
NZQA: New Zealand Qualifications Authority
NZQF: New Zealand Qualifications Framework
OE: Overseas Experience
SA 1, 2, 3: Spatial Analysis standard Levels 1, 2, 3
TEC: Tertiary Education Commission
UK: United Kingdom
USA: United States of America
VFTs: Virtual Field Trips

1. Introduction

Geospatial technology has been identified as a growing industry (Khan et al. 2016, Gentile et al. 2021), with geospatial data increasing in proliferation due to technological advancements (Walter 2020). In 2030, the global Geographic Information Systems (GIS) market is projected to generate $24.6 billion USD in revenue (Prescient & Strategic Intelligence 2021). The COVID-19 pandemic has also accelerated the use of geospatial data in the public sector due to the importance of geospatial infrastructure in the COVID-19 response (Walter 2020). An uptake of geospatial technology particularly in the global south has been observed (Imran & Jabeen 2021). The geospatial digital divide is predicted to shrink between the Global North and the Global South with more affordable technologies and alternative data sources and analytical methods (Walter 2020). Both *Surveyor*[3] and *Other Spatial Scientist*[4] remain on the long term skill shortage list produced by Immigration New Zealand[5].

It is against this background that a review of the higher education sector provision of geospatial education was conducted. This report aims to detail the current provision of geospatial education in Aotearoa New Zealand and identify any gaps within this provision. A better understanding of this provision will help identify where the needs of the geospatial industry may be more difficult to meet as the industry works to address key customer needs and economic, social and environmental challenges.

In this report, we explore the trends in geospatial secondary and tertiary student numbers in Aotearoa New Zealand. Such trends are helpful to identify first, the current and approaching demand for tertiary geospatial provision and second, the number of potential future geospatial professionals.

We compare geospatial course provision in Aotearoa New Zealand against course titles and descriptions in 5 other countries. This comparison allows us to identify the different focus of each country and to explore the potential reasons for any differences identified. Differing needs in each country or the maturity of the geospatial industry may mean different education priorities are appropriate or gaps are present in current provision that would benefit from targeted provision.

Course titles and descriptions may tell an incomplete story. We subsequently analysed course learning objectives to identify the focus of more general GIS courses in Aotearoa New Zealand and the Republic of Ireland. The two countries have a similar population and provide a useful comparison of total provision and educational focus.

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[3] ANZSCO level 1: Plans, directs and conducts survey work to determine, delineate, plan and precisely position tracts of land, natural and constructed features, coastlines, marine floors and underground works, and manages related information systems. https://skillshortages.immigration.govt.nz/surveyor/
[4] ANZSCO level 1: Acquires, integrates, analyses, interprets, presents, manages and distributes information about locations in space and time, and develops related equipment, software and services. https://skillshortages.immigration.govt.nz/other-spatial-scientist/
[5] https://skillshortages.immigration.govt.nz/

A workshop with both geospatial education practitioners and industry professionals was hosted at the New Zealand Geospatial Research Conference in 2022. This workshop sought to elicit some of the shared concerns regarding geospatial education nationally and provide an appropriate lens to assess the results of the national provision.

In Section 2 we provide an explanation of geospatial education more generally. Section 3 describes trends in geospatial education in Aotearoa New Zealand at secondary school through New Zealand Qualifications Authority (NZQA) standards and tertiary institutions through Tertiary Education Commission (TEC) data. In Section 4, we compare Aotearoa New Zealand geospatial provision against 5 selected institutions in each of 4 countries (USA, UK, Australia and Germany) and total provision in the Republic of Ireland (referred to as Ireland). This section also details a more indepth comparison with Ireland of general geospatial courses to identify comparative focus. Section 5 presents a summary of an industry and tertiary education workshop hosted at the New Zealand Geospatial Research Conference in 2022. In Section 6, we discuss the results and provide a conclusion with associated action points in Section 7. The report also includes a number of detailed appendices intended to provide support to academic institutions in Aotearoa New Zealand in planning for future geospatial education or to help revise current offerings.

2. What is Geospatial Education?

The terms used for geospatial education can differ significantly encompassing spatial science, geocomputation, geographic information systems and geographic information science, among others. This section overviews key terms and highlights differences in their interpretation that may be new to some readers. The section also explores the different roles for geospatial education (e.g. as a direct feeder for new graduate geospatial professionals versus providing geospatial skills to graduates in other industries, such as conservation or hydrology) and its link with training and lifelong education. The background information provided by this section will aid to better understand the methods and results of the analyses throughout the report.

Geographic Information Systems (GIS) began in the 1960s and 1970s with the development of the Canada Geographic Information System (Goodchild 2019). University teaching of GIS followed in the 1980s with Burrough's Principles of Geographical Information Systems - one of the most widely used textbooks published in 1986. Teaching in universities expanded rapidly in the late 1980s and early 1990s, particularly with the development of commercial software, such as ESRI's ArcInfo. In 1992, Michael Goodchild proposed the term 'Geographical Information Science' (later abbreviated GISci, GISc and even GIS) to reflect the evolution of GIS from the application of a technology to a broader academic discipline based on principles and theory (Goodchild 2019). Other equivalent terms followed and are used in both tertiary education and industry, including "geoinformatics", "geomatics", "spatial information science", "geoinformation science" and "geospatial science." This report uses "geospatial education" to refer to the

broader academic discipline, which includes both Systems and Science approaches as well as surveying, geomatics and spatial science.

The dichotomy in GI Systems versus GI Science is still reflected in current geospatial education. Some courses focus on how to use or drive geospatial software (software oriented), while others will take a wider view and focus on the concepts, approaches, and techniques behind applying the software (concept-focus). Given the changeable nature of the technology, a greater focus on the concepts supported by an understanding of the software is important for most students. These students are unlikely to apply their skills immediately and the software may have changed significantly before they start employment. Students with a conceptual understanding will also be more capable in dealing with new or evolving geospatial uses once in employment. The fast paced nature of the industry can mean software and hardware requirements can change quickly. A focus on the teaching of skills rather than tools can facilitate a longer shelf life on the educational attainments of graduates. In contrast, professional training, by its nature, should focus more on the specific software as it is likely students will implement such skills in their work practice immediately or quickly afterwards.

An understanding of the geospatial education sector also requires an understanding of student needs. Geospatial skills can be taught as:

- a supporting component of a related course, e.g. modelling using GIS tools in a course on hydrology or GPS for bird tracking in a conservation biology programme,
- a course designed for those who will need more substantive geospatial skills to perform their roles, e.g. GIS for planners, or
- a course which addresses key geospatial concepts, skills, and software targeted at those who intend to enter the geospatial industry, e.g. programming for spatial scientists.

Not every student on a geospatial course intends to or will enter the geospatial industry. Educational pathways vary and geospatial courses or programmes often need to appeal to a wide cohort of students with different needs and interests. Geospatial skills are valued both in the industry and in other sectors where these skills are a valuable tool within a larger toolkit and supporting skills may not be required. The conservation biologist may need introductory GIS but not programming.

Even within the geospatial industry, employer needs and employee interests may mean different skills are developed. The conservation biologist may benefit from understanding field data collection and associated data analysis while its relevance is limited to a geospatial professional specialising in back end systems. Based on a survey of geospatial organisations in Aotearoa New Zealand, de Róiste (2016) reported that remote sensing skills were required for 31% of the recently advertised geospatial positions and familiarity with server-client architecture or field/surveying skills required for 47.9% and 43% respectively.

At undergraduate level where introductory geospatial courses are predominantly taught, courses must meet the needs of multiple types of students, as geospatial courses are often

electives for students from a variety of majors. Whereas at postgraduate level, courses are likely to be more specialised and more (but not all) of the student cohort are interested in entering the geospatial industry. Geospatial programmes, in contrast to geospatial courses, comprise a number of core and elective courses. This division means that each course does not need to cover all geospatial aspects. Many programmes cover cartography, spatial analysis and programming as well as other fundamental skills.

While this report focuses on formal geospatial education, other education opportunities are required to keep pace with the rapid changes in the geospatial industry. Changes in the geospatial industry are currently being driven by rapid advances in Big Data and data science (Goodchild 2019) and a recent increase in the use of Artificial Intelligence (AI). Big Data refers to the volume, velocity, and variety of data that are now available through new sensors (remote and *in situ*) and "volunteered geographic information" or geographic information provided via the internet. Data science is a rapidly growing discipline involved with the extraction (mining) of information from these data using complex algorithms and high powered computers. These and other changes mean geospatial professionals will need to advance and update their knowledge through short courses and workshops offered by industry and tertiary education providers as well as through informal personal lifelong learning. Such short courses or workshops may be entirely online or in-person, through paid enrolment or free of charge. Such spaces are outside the scope of this report.

3. Trends in Geospatial Education in Aotearoa New Zealand

NCEA is a set of national qualifications for senior secondary students in Aotearoa New Zealand[6] and is administered by New Zealand Qualifications Authority (NZQA). The spatial analysis standards are part of the geography curriculum and comprise 3 standards (91014, 91247, and 91433). Secondary school students normally obtain three levels of NCEA during secondary school: levels 1, 2, and 3. In this section, we compare the number of students completing National Certificate of Educational Achievement (NCEA) spatial analysis standards against the number of students completing different geospatial qualifications. By making this comparison, we can identify whether patterns in those taking spatial analysis standards are correlated to enrolment patterns in undergraduate and postgraduate programme selection.

As geospatial qualifications are usually completed a number of years after the NCEA spatial analysis standards, we account for this time lag by staggering the years on the graphs in this section (i.e., a student can complete their secondary school studies and normally take a further 3 years to complete a bachelor's degree). The number of students who did and did not complete and those still enrolled in a tertiary programme with at least 3 geospatial courses (GIS or surveying) was provided by the Tertiary Education Commission (TEC) on the 8th of December 2021 at the request of Toitū Te Whenua Land Information New Zealand (LINZ). Details of data

[6] https://www.nzqa.govt.nz/ncea/

format requested are provided in Appendix 1. The list of courses included in the analysis by TEC is provided in Appendix 2. Further information on what the NCEA is is provided in Appendix 3. Appendix 4 details the data assumptions used in the data analysis for this section.

Numbers of students were rounded to the nearest multiple of 5 to ensure privacy in the supplied data. We used median values between the possible maximum and minimum values to better reflect the true value. For example, if less than 5 students completed a bachelor's degree programme in 2004 with 3 or more GIS courses, the true value can be between 1 and 4 and our analysis uses a median of 2.5. We refer to a bachelor's degree programme with at least 3 geospatial courses as a geospatial bachelors and the equivalent postgraduate programme with at least 3 geospatial courses as a geospatial postgraduate. This threshold was selected as 3 geospatial courses (dependent on level) may constitute a minor specialisation at undergraduate. It is worth noting that formally prescribed geospatial minors are not common at Aotearoa New Zealand tertiary institutions.

Students completing National Certificate of Educational Achievement (NCEA) spatial analysis standards at levels 1 to 3 from 2011 to 2020 was provided by the New Zealand Qualification Authority (NZQA) on the 14th of June 2021 at the request of LINZ. Generally, secondary school students in year 11 will study for NCEA level 1 and obtain their qualification that same year and year 12 and 13 (final year) students normally study and achieve levels 2 and 3 respectively. However, students may leave secondary school before completing year 11 or year 12.

Although total enrollments in tertiary education are declining in Aotearoa New Zealand, the number of students taking GIS courses at both the undergraduate and postgraduate tertiary level are increasing (Figure 1). The number of students taking NCEA spatial analysis level 1 (SA 1) has increased from 1395 in 2011 to 2871 in 2020. A comparison with the number of students completing a geospatial bachelors 5 years later has a correlation coefficient of 0.873 showing a very strong positive linear relationship between the two variables (Figure 2). Five years is the approximate amount of time for a SA 1 student to complete secondary school and then a 3 year undergraduate degree. Adding a year for a one-year postgraduate programme (Figure 3) has a correlation coefficient of 0.841. Again indicating a strong positive relationship between the number of students completing SA 1 and those completing a relevant postgraduate qualification 6 years later.

Figure 1: Tertiary students in NZ institutions

Total enrolled tertiary students across all NZ tertiary institutions compared with student's final year of a postgraduate programme or bachelor's degree programme with at least 3 geospatial courses

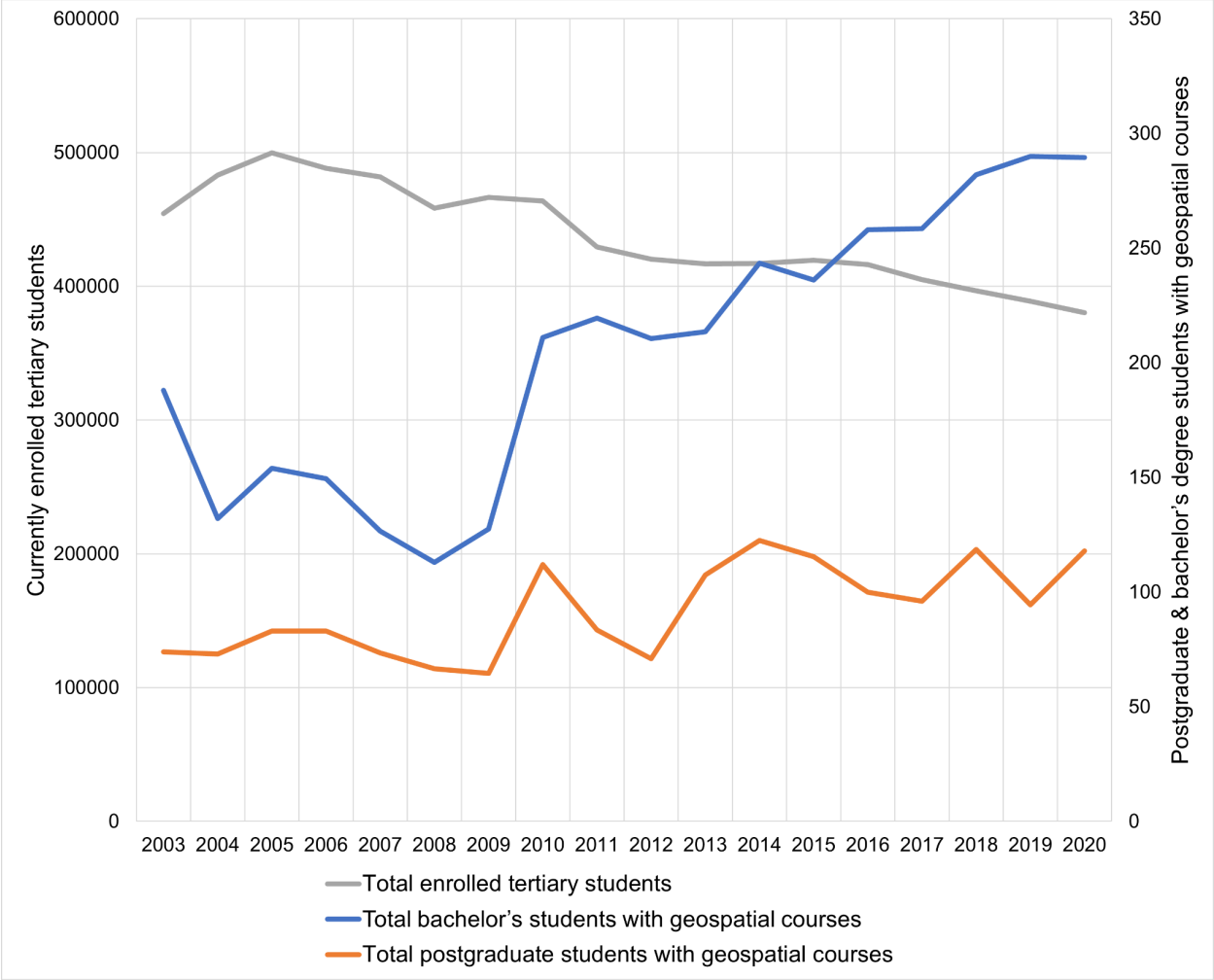


Figure 2: Final year geospatial bachelors compared with NCEA level 1 spatial analysis standards

The 5-year time lag assumes a student finishing NCEA level 1 will be in their final year of a bachelor's degree programme (comprising at least 3 geospatial courses) 5 years later.

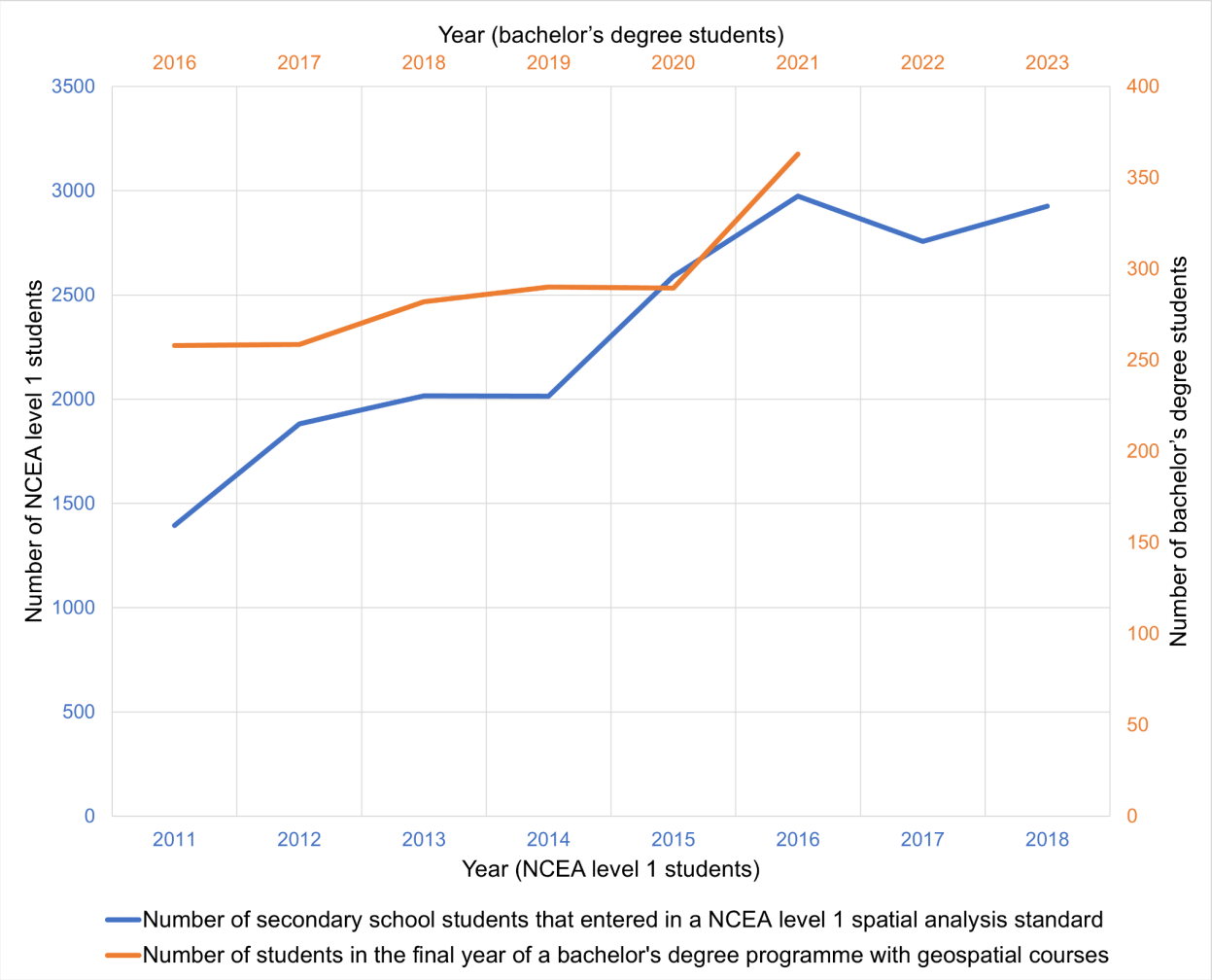


Figure 3: Final year geospatial postgraduate programme compared NCEA level 1 spatial analysis students

A 6-year gap accounts for the time lag between a student finishing NCEA level 1 and their final year of a postgraduate programme with at least 3 geospatial courses.

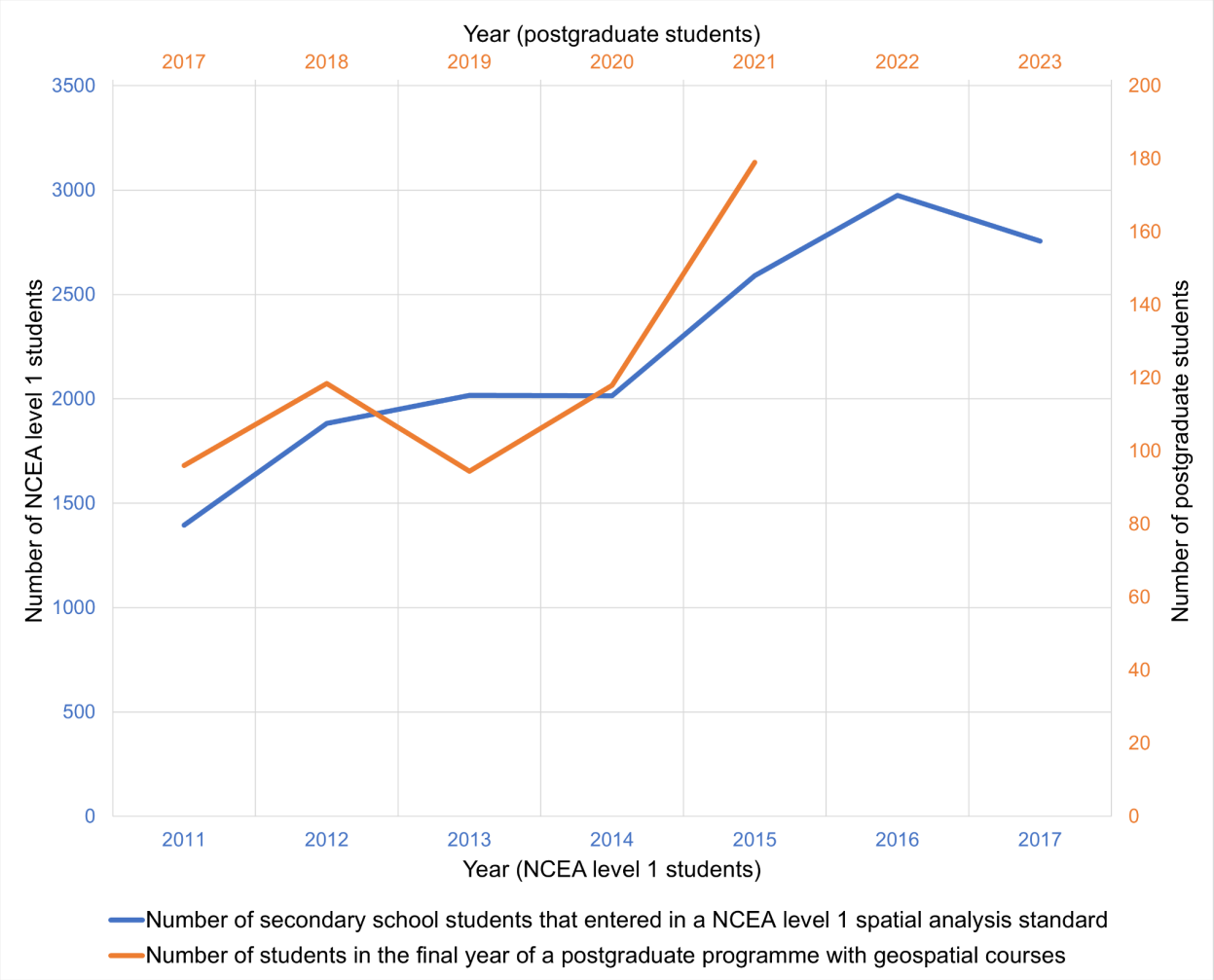
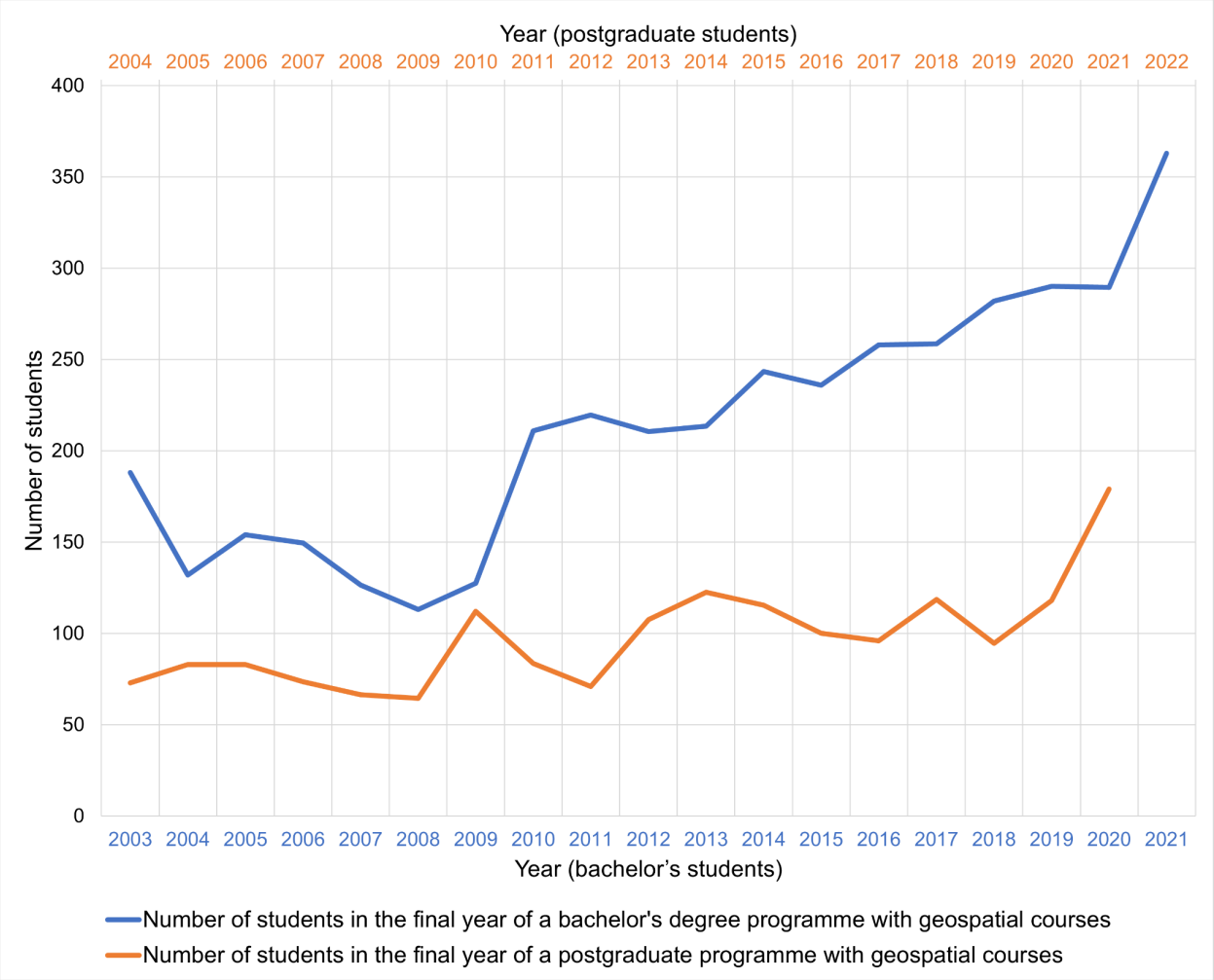


Figure 4 compares the number of students in the final year of a geospatial bachelors programme against the students completing a geospatial postgraduate programme one year later. The correlation coefficient is 0.63 indicating a positive linear relationship between the two variables. However, this relationship is not as strong as for SA 1. This relationship may be influenced by students leaving tertiary education to take a role in either the geospatial industry or elsewhere. Given the strength of the geospatial employment market at present, graduates may not need postgraduate qualifications to gain a position in the geospatial industry. The conversion from geospatial bachelors to postgraduate may also be impacted by OE (overseas experience) where students take some time off after undergraduate to go overseas, the completion of a 4 year undergraduate (common in double major qualifications), or students completing a longer postgraduate qualification (e.g. a 2 year masters with a thesis year).

Figure 4: Students in final year of a geospatial bachelors compared with students in final year of a geospatial postgraduate programme 1 year later

A 1-year gap assumes a student starts their 1 year postgraduate programme immediately after completing their undergraduate degree



In summary, the correlation between all cohorts is positive with a general trend toward an increasing number of students involved in geospatial education at all levelsIt is important to note that these analyses are based on aggregated cohort data. It does not imply, however, that individual students who completed SA 1 went on to complete bachelor degrees or postgraduate programmes in geospatial science, nor does it imply causation–that a student who takes SA 1 will choose a tertiary programme in geospatial science.

The number of students completing NCEA spatial analysis standards is reflected in the number of students selecting programmes with geospatial components. While the growth in SA 1 numbers stalled in 2016 at 2974, they have maintained a similar level for the following 4 years

at just under 3000 (2756, 2925, 2990 and 2871 respectively). The factors underlying the growth in the number of students taking standards are worth exploring and are likely to include[7]:

- Geospatial Virtual Field Trips (VFTs) for schools. These LINZ funded annual VFTs are run by CORE Education under its established LEARNZ Programme aimed at upper primary school students. The availability of such material can encourage teachers to include spatial analysis standards in their class curriculum.
- Regional secondary teacher GIS Champions programme. This programme is run by Eagle Technology in conjunction with the Association of Geography Teachers and funded by the Ministry of Education. The programme is complemented by the development of free lesson plans. These plans relate to NCEA Geography Spatial Analysis Achievement Standards at Levels 1, 2, and 3 and specifically reference use of GIS.
- Profiles of recent GIS graduates in the Leaving School magazine (funded by LINZ and LocationTech). This magazine is available to secondary school students in Years 11-13 and covers career and study options.

There is good news in the trends for geospatial students across secondary school through the taking of the Spatial Analysis standards and the universities' continued growth in numbers despite declines in tertiary student numbers overall. While we cannot imply causation, we can report positive relationship between the number of students taking Spatial Analysis standards and those taking geospatial courses at tertiary level. Spatial Analysis standards over the last 4 years have maintained a relatively constant level. It is worth noting that Spatial Analysis standards are within the Geography curriculum in secondary schools so will be impacted by student numbers in this area and the curriculum is currently in review and overall Geography student numbers in secondary school are declining.

The conversion of students taking geospatial courses at undergraduate level to postgraduate is weaker than that of secondary school to undergraduate level. More advanced geospatial skills are normally taught at postgraduate level, e.g. programming. The lower conversion may point to a gap between industry preference for more qualified graduates (de Róiste 2014) and graduate perceptions of the need for further study. It may also indicate that many students are able to gain employment with a bachelor's qualification and the demand for postgraduate qualifications is not as strong. We return to the main points of this section in the discussion.

[7] More information on these developments are available at:
https://www.linz.govt.nz/our-work/location-information/geospatial-capability/geospatial-schools

4.Geospatial Education in Aotearoa New Zealand and Internationally

Comparing the provision of geospatial education in Aotearoa New Zealand against provision in other countries allows us to identify where differences exist and to explore possible explanations for differences. Both students and the geospatial industry in Aotearoa New Zealand are likely to have certain unique needs that require local solutions and, in other areas, benefit from similar education opportunities and courses to their peers overseas.

In this section, we summarise a snapshot of geospatial education for 2021 in Aotearoa New Zealand. We compare this snapshot to 5 selected education institutions in Australia, Germany, the USA and the UK and as well as all geospatial education provision in the Republic of Ireland, a country with a population similar to Aotearoa New Zealand. Our focus on selected institutions in four countries reflects the greater number of tertiary education institutes in those countries and provides an efficient mechanism for meaningful comparison and benchmarking. These comparisons reveal differences between geospatial course provisions between Aotearoa New Zealand, Australia, Germany, Ireland, the UK, and the USA. The results covered in this section demonstrate what areas of geospatial education are emphasised in the comparision countries, e.g. Germany and the USA more strongly emphasise cartography and visualization[8] courses compared with Aotearoa New Zealand, with more than double the proportion.

4.1 International comparison with Australia, Germany, UK, USA and Ireland

The comparison of Aotearoa New Zealand educational provision to international counterparts was approached in two ways. First, five tertiary education providers were selected for each of four comparison countries: Australia, Germany, UK and USA. In these four countries, each education provider offers a geospatial master's programme as well as undergraduate geospatial courses. Consequently, the choice of comparative institutions are those with a greater emphasis on geospatial education than the average institution in each of those countries and are more likely to be leaders in this area. This selection resulted in an average of 117 courses in each of the 4 comparison countries.

Second, full geospatial education provision at tertiary level was surveyed for Aotearoa New Zealand and Ireland as a comparable nation. The 2021 population of both Ireland and Aotearoa New Zealand is approximately 5 million[9]. Both countries have a high development index (HDI), a composite measure of life expectancy, education attainment, and per capita income. The HDI for Ireland is 0.945 and that of Aotearoa New Zealand is 0.937[10]. An important difference

[8] Visualization rather than visualisation is used here and throughout the report to fit with the GIS&T Body of Knowledge categories.
[9] https://www.worldometers.info/world-population/population-by-country/
[10] https://hdr.undp.org/data-center/human-development-index#/indices/HDI

between Aotearoa New Zealand and Ireland is Ireland's close proximity to the United Kingdom and other European countries. Geographic proximity to other countries and membership of the European Union may influence course and programme offerings in Ireland as the relative ease with which Irish students can go overseas for their education may lower demand for Irish courses and programmes. Aotearoa New Zealand's unique geopolitical situation may influence the state of its geospatial education as overseas travel is more expensive and requires travel documentation.

Geospatial courses were identified using the education provider's website in each country (see Appendix 6 for Aotearoa New Zealand courses and Appendix 7 for overseas courses). For Aotearoa New Zealand, 2022 academic calendars were also used and if unavailable, 2021 was substituted. Searches for geospatial courses and programmes were conducted using Google search with the keywords "GIS", "Geo", "Geospatial", "Spatial", "Remote", "GNSS", "Map", "Cartography", "Geovisual", "Visual", "Modeling", "Modelling", "GPS", "Navigation", "Data", "Environmental", "Satellite", "Photogrammetry", "Observation", "GI" "Geomatics", "Geodesy", "GIScience", "Systems", "Geographic", "Geoinformatics", "Geoinformatik", and "Geodäsie". The overarching programmes for the geospatial courses returned by these searches were also examined to find other geospatial courses. Programmes that may also include geospatial courses were also examined for each university. Programmes searched were geography, environmental science, surveying, archaeology, agriculture, forestry, geology, biology, ecology, ecosystems, urban planning, land management, and data science.

The geospatial courses in each country were categorised by course type based on available online information about each course. In this report, "course" refers to an education module that makes up a programme[11]. We did not distinguish between the value of different courses (e.g. 15 or 20 credit[12] courses).

A course was considered to be a geospatial course if:

1. A course description or learning outcomes could be matched with defined geospatial competencies. These competencies are discussed below.
2. The course was offered in 2021 or 2022.

Not all providers' websites (8 of 44) had a course catalogue with a search bar. For these websites, keywords could not be used to find geospatial courses and we were limited to analysing programme outlines. One provider in Aotearoa New Zealand also did not include any information about the courses that made up the programme. In this case, it is likely at least one programme had a geospatial component, but without supporting course information, courses could not be used in our analysis. Some geospatial courses (48[13]) did not have online

[11] For example, a student may take eight courses in their first year of a bachelor's degree. Other countries use different terms. In Australia, the term "unit" is often used by tertiary education providers, while in the UK, Ireland and Germany, "module" is used instead. Both Aotearoa New Zealand and the USA use the term "course". Although "course", "module" and "unit" are interchangeable, this report will use the term "course" for consistency.

[12] The New Zealand Qualifications Framework ([NZQF], n.d.) defines a credit as equivalent to 10 hours of study for the average person to achieve the relevant course outcomes.

[13] Aotearoa New Zealand (0), Ireland (46 of 133), Australia (0), Germany (20), UK (0), USA (2). Although the proportion in Ireland was high, it did not impact course categorisation to the same extent as most course titles were clear. For the later course contents

descriptions or learning outcomes, which meant such courses were either categorised by a clear title or removed from the analysis. Most German providers did not list the year when the course was offered. Consequently, we assumed all the geospatial courses identified in Germany were offered within the constraints of our review (2021 or 2022).

In Aotearoa New Zealand, 102 geospatial courses were identified and 111 in Ireland. In the 5 selected institutions for each country, 75 geospatial courses were identified in Australia, 163 in Germany, 93 in the UK, and 135 in the USA.

Once a geospatial course was identified, it was categorised by geospatial focus, e.g. cartography or remote sensing. The categories were primarily determined based on domain designations from the GIS&T BoK[14] (Geographic Information Science and Technology Body of Knowledge). The additional category, Earth Geometry & Geodesy, was obtained from the Geospatial Technology Competency Model[15] (GTCM) produced by the United States Department of Labour, Employment and Training Administration (DoLETA). Both of these competency models address technical and soft skills and do not account for the common learning approach, which starts with an overview or introductory course, and then learners can delve deeper into more defined content areas. Introductory GIS/GISc and Surveying courses, applied geospatial courses, and GIS internship/work placement courses were also added to the categorisation. Course categories are mutually exclusive, and a course is only assigned to one category. Table 1 outlines the course categories used and provides a brief description.

It is important to acknowledge that our use of the GIS&T BoK may overemphasise geospatial elements less relevant to Aotearoa New Zealand, as Prager and Plewe (2009) explain that the GIS&T BoK “may be predisposed toward a North American view of GIS&T”. However, in the absence of a similar comprehensive resource describing geospatial competencies for Aotearoa New Zealand, or Australasia, the GIS&T BoK provides the best resource for a structured analysis of educational provisions for geospatial knowledge and skills.

Where possible, we have differentiated between GISystems and GIScience general courses. A course was considered a “GIS” course when its course outline had an emphasis on the tools and systems of geospatial science above introductory level. A course was considered a “GISc” course when its course outline described an emphasis on the geospatial science concepts above introductory level, rather than the tools. This distinction allows us to reflect on software or concept-oriented approaches described in Section 2.

The full list of categories is given in Table 1. Each course was placed in the appropriate category where a specialised emphasis was identified based first on course title and where course title was inconclusive based on course description. The courses were initially categorised by one author and were reviewed by the other two authors. Any inconsistent categorisation was discussed, and a category was agreed on by all three authors.

analysis, most of these courses were not in the categories compared with Aotearoa New Zealand and only 9 of the 46 courses were problematic.

[14] Further detail on these frameworks are available in Appendix 5.

[15] Further detail on these frameworks are available in Appendix 5.

A course was considered a “Domain Applications” course when it applied geospatial knowledge or skills to a particular domain (e.g., health). Courses that applied geospatial knowledge or skills to multiple domains were categorised as “Applied geospatial” courses.

Courses categorised as either “Capstone”, “Data Management”, “Design & Implementation of GIS&T”, “Earth Geometry & Geodesy”, “GIS Internship/Work Placement”, “GIS&T & Society”, “Research Methods”, and “Thesis/Research” courses collectively made up the “Other” category. Courses. Categorisation was based on course titles and/or descriptions and this approach may have excluded certain thesis or dissertation courses within wider geospatial programmes of study where neither title nor description refered to geospatial knowledge. Courses listed as a ‘special topic’ were not included as they can vary year to year and often detailed course descriptions were unavailable. Authors’ knowledge was not used to verify if courses were or were not offered as this approach could not be consistently applied across all countries. Title took priority over the course description. Where a course could be classified as domains applications/applied, or another specialised course type (such as Geodesy, Data Capture), the specialised course type was prioritised, e.g. Applications in Geodesy is categorised as a Geodesy course.

Table 1: Course Categories

Categories based on domains from the GIS&T Body of Knowledge or the Geospatial Technology Competency Model are noted by their respective acronyms (BoK or GTCM)

Categories (source)	**Description**
Intro GIS/GISc	Courses that introduce the foundational concepts and technology of geospatial science.
GIS	Non-introductory GISystems courses with a primary focus on GIS tools and technology, and less of a focus on geospatial scientific concepts. General courses that cover multiple knowledge areas of GI systems.
GISc	Non-introductory GIScience courses with a primary focus on geospatial scientific concepts, and less of a focus on the GIS tools and technology. General courses that cover multiple knowledge areas of GI science.
Intro Surveying	Introductory, general surveying courses that focus on the general concepts, methods and tools of surveying.
Surveying	General surveying courses that focus on the general concepts, methods and tools of surveying.
Applied Geospatial	Courses that apply GIScience & GISystems to solve real-world problems without being restricted to a specified domain.
Domain Applications (BoK)	Specialised courses where the primary focus is incorporating a component of GIS or GISc into a specific domain.
Analytics & Modeling (BoK)	Specialised courses that focus on the analysis of spatial data and geocomputation.
Cartography & Visualization (BoK)	Specialised courses primarily focus on map design aspects and the visualization of spatial data.

Programming & Development (BoK)	Specialised courses with a focus on programming and development within the context of GIS (including Web-based GIS).
Data Capture (BoK)	Specialised courses with a focus on spatial data capture methods and technologies, such as remote sensing, land surveying and global navigation satellite systems (GNSS).
Other	Other courses that do not make up the main course types. Includes the categories below.
Data Management (BoK)	Courses with a focus on spatial data management, such as storage, retrieval, format conversion, and sharing.
Design & Implementation of a GIS&T (BoK)	Topics include GIS&T project planning and management, GIS&T operations and infrastructure, and GIS design.
GIS&T & Society (BoK)	Courses with a focus on professionalism, ethics, community engagement, critical perspectives or policy within the realm of geospatial science.
Earth Geometry & Geodesy (GTCM)	Courses with a focus on the mathematics of the shape and area of the Earth.
GIS Internship/Work Placement	A course that provides placement in a workplace environment in order to apply geospatial knowledge.
Research methods	Courses that focus on the techniques and concepts of conducting research in the geospatial field.
Thesis/Research	Research that contributes to the geospatial discipline.
Capstone	Course that focuses on a final geospatial project in order to complete a qualification.

To compare the provision of geospatial offerings across the comparison countries, it is helpful to examine the relative size of the course offering in each category. In the tables and graphs that follow, the size of the category is measured by the total number of course offerings in that category for the country and the percentage of total courses offered for the country. The data show that the size of categories differs by country. Table 2 shows the number of courses in each category with the percentage of total course offerings for each of the 6 comparison countries. The largest percentage in each country is highlighted in red. Figure 5 shows the comparative distribution across all categories.

Table 2: Size of geospatial category by country.

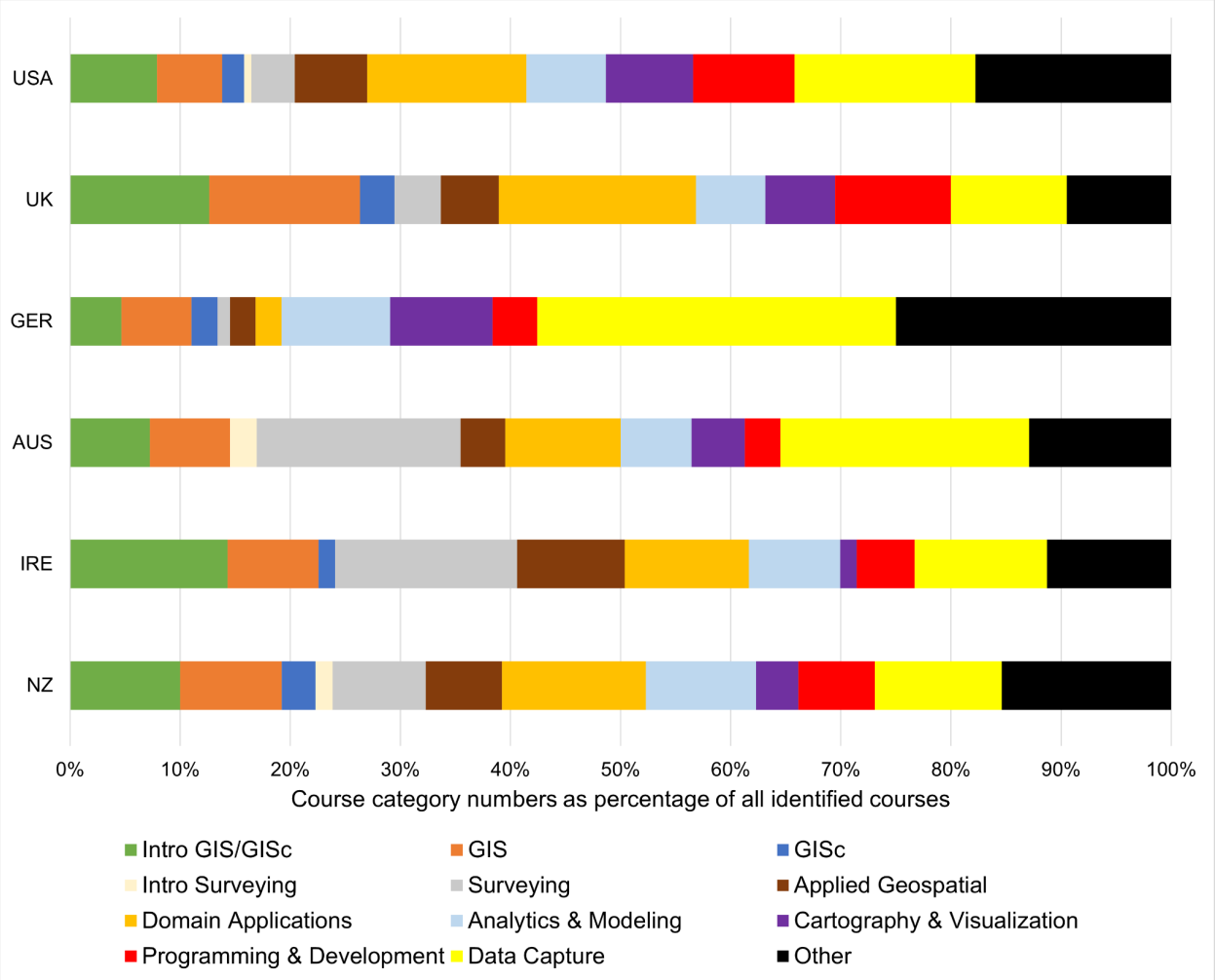
The number and percentage of courses identified for each category by country, including the main categories and the 'other' categories. The category with the largest percentage of courses offered for each country is represented in red.

	Category	NZ	IRE	AUS	GER	UK	USA
Main	Intro GIS/GISc	13 (10%)	19 (14.3%)	9 (7.3%)	8 (4.7%)	12 (12.6%)	12 (7.9%)
	GIS	12 (9.2%)	11 (8.3%)	9 (7.3%)	11 (6.4%)	13 (13.7%)	9 (5.9%)

	GISc	4 (3.1%)	2 (1.5%)	0	4 (2.3%)	3 (3.2%)	3 (2%)
	Intro Surveying	2 (1.5%)	0	3 (2.4%)	0	0	1 (0.7%)
	Surveying	11 (8.5%)	22 (16.5%)	23 (18.5%)	2 (1.2%)	4 (4.2%)	6 (3.9%)
	Applied Geospatial	9 (6.9%)	9 (9.8%)	5 (4%)	4 (2.3%)	5 (5.3%)	10 (6.6%)
	Domain Applications	17 (13.1%)	15 (11.3%)	13 (10.5%)	4 (2.3%)	17 (17.9%)	22 (14.5%)
	Analytics & Modeling	13 (10%)	11 (8.3%)	8 (6.5%)	17 (9.9%)	6 (6.3%)	11 (7.2%)
	Cartography & Visualization	5 (3.8%)	2 (1.5%)	6 (4.8%)	16 (9.3%)	6 (6.3%)	12 (7.9%)
	Programming & Development	9 (6.9%)	7 (5.3%)	4 (3.2%)	7 (4.1%)	10 (10.5%)	14 (9.2%)
	Data Capture	15 (11.5%)	16 (12%)	28 (22.6%)	56 (32.6%)	10 (10.5%)	25 (16.4%)
	Other	20 (15.4%)	15 (11.3%)	16 (12.9%)	43 (25%)	9 (9.5%)	27 (17.8%)
Other	Data Management	1 (0.8%)	5 (3.8%)	5 (4%)	11 (6.4%)	2 (2.1%)	4 (2.6%)
	Design & Implementation of a GIS&T	0	2 (1.5%)	2 (1.6%)	0	0	8 (5.3%)
	GIS&T & Society	3 (2.3%)	1 (0.8%)	2 (1.6%)	3 (1.7%)	0	7 (4.6%)
	Earth Geometry	4 (3.1%)	0	3 (2.4%)	18 (10.5%)	2 (2.1%)	3 (2%)
	GIS Internship/Work placement	4 (3.1%)	2 (1.5%)	2 (1.6%)	0	0	1 (0.7%)
	Research Methods	1 (0.8%)	2 (1.5%)	0	0	1 (1.1%)	0
	Thesis/Research	3 (2.3%)	2 (1.5%)	0	2 (1.2%)	2 (2.1%)	0
	Capstone	4 (3.1%)	1 (0.8%)	2 (1.6%)	9 (5.2%)	2 (2.1%)	4 (2.6%)
	Total	130	133	124	172	95	152

Figure 5: Distribution of categories as a percentage of total number of courses offered by country

Comparing the proportions of courses offered per main category out of all the identified geospatial courses for each country



Introductory GIS/GISc courses are well represented in both Ireland and Aotearoa New Zealand. Introductory GIS/GISc is the second largest category (by proportion of total course offerings) for Ireland at 14.3%, and third equal in Aotearoa New Zealand at 10%. We would also expect introductory courses to account for a lesser proportion as the compartison was only targetted at 5 institutions in these countries: UK (12.6%), about a quarter to less than NZ provision in Australia (7.3%) and USA (7.9%) and only significantly less in Germany (4.7%).

In all countries, GIS rather than GISc courses were more prevalent (Table 2). The UK had the highest proportion of GISc courses (3.2%) followed by Aotearoa NZ (3.1%). The comparison method used is relatively crude and may not account for actual course delivery. However, a strong focus on software over concepts can mean graduates are less prepared to meet the changing needs of the geospatial industry as they mature in their role and the software changes.

Aotearoa New Zealand's second most provided category is data capture (11.5%). Data capture is the most prominent category in Australia (22.6%) and Germany (32.6%). The provision of data capture courses in Aotearoa New Zealand is similar to that of Ireland (12%) but substantially less than both Germany and Australia. Some of this difference will be accounted in the more complete review in Aotearoa New Zealand and Ireland rather than the selected specialist institutions in the other courses as this specialist course.

Aotearoa New Zealand had the highest percentage proportions of Analytics and Modelling courses (10%) out of all the countries. However, proportions were not out of place with the other countries (from 6.3% to 9.9% excluding NZ).

Cartography and Visualization is more common has a comparatively greater emphasis in Germany (9.3%) and the USA (7.9%), while Aotearoa New Zealand has the second lowest provision (3.8%). Irish provision of Cartography and Visualization (1.5%) is substantially lower than other countries. The relative under provision of courses may be related to the whole country comparison but may also be an area of concern. Cartography and geovisualization relate to the visual communication and understanding of spatial information. This skill set is unique to spatial data but draws on graphic design and data science to gain insights from spatial datasets as well as create visually appealing spatially informed stories. It is a key skill in promoting the use of spatial data in decision making within organisations, particularly when communicating with those outside of spatial disciplines and in public engagement through communicating complex information in an easily understood format.

The importance of programming varies. Both the UK (10.5%) and the USA (9.2%) place strong emphasis on this skill area while Germany and Australia offer only 4.1 and 3.2%. Introductory Surveying courses were not identified in 3 of the 6 countries assessed. Surveying is a more specialised programme of study. It is likely that outside of Aotearoa New Zealand, Ireland, and Australia, the universities specialising in this area may not have been included in the analysis. Within this smaller number, Ireland did not record any introductory surveying courses. Consequently, we have combined introductory and general surveying courses together

as a more appropriate comparison in Table 3. Earth Geometry[16] is primarily delivered in surveying programmes and it has also been added to Table 3 for comparison.

The size of surveying and surveying related categories ranges between 23.4% and 6.3% of courses in the selected countries (Table 3). Aotearoa New Zealand, at 13.1%, is in the middle of these extremes and has a similar percentage to Ireland (16.5%). For Earth Geometry, Aotearoa New Zealand at 3.1% is again near the average provision (3.4%). The relative emphasis of surveying courses within the 'Surveying' category was not explored and a more detailed breakdown of content would be beneficial to understand current emphasis in surveying teaching in Aotearoa New Zealand and to identify any key gaps.

Table 3: Size of categories for Surveying (and related) courses by country

The size of the category is indicated by the number of courses and percentage of total number of courses for each country.

Category	NZ	IRE	AUS	GER	UK	USA
Intro Surveying	2 (1.5%)	0	3 (2.4%)	0	0	1 (0.7%)
Surveying	11 (8.5%)	22 (16.5%)	23 (18.5%)	2 (1.2%)	4 (4.2%)	6 (3.9%)
Earth Geometry	4 (3.1%)	0	3 (2.4%)	18 (10.5%)	2 (2.1%)	3 (2%)
Total	17 (13.1%)	22 (16.5%)	29 (23.4%)	20 (11.6%)	6 (6.3%)	10 (6.6%)

Domain application courses were the most provided category in Aotearoa New Zealand and the UK (by percentage of total offerings). These courses focus primarily on incorporating GIS or GISc into a single, specified domain such as forestry, archaeology, or ecology. Whereas, applied geospatial courses are primarily focused on applying geospatial methods to solve problems that are not restricted to a specified domain. Understanding the relative focus in each country is revealing (Table 4). All countries except Germany had a higher proportion of domain applications relative to applied geospatial courses. Germany had the same number of courses in both categories.

Table 4: Size of Applied Geospatial and Domain Application categories by country

The size of the category is indicated by the number of courses and percentage of total number of courses for each country.

Category	**NZ**	**IRE**	**AUS**	**GER**	**UK**	**USA**
Applied Geospatial	9 (6.9%)	9 (9.8%)	5 (4%)	4 (2.3%)	5 (5.3%)	10 (6.6%)

[16] Earth Geometry courses focus on the mathematics of the shape and area of the Earth including distance calculations and projections.

Domain Applications	17 (13.1%)	15 (11.3%)	13 (10.5%)	4 (2.3%)	17 (17.9%)	22 (14.5%)
Difference	8 (6.2%)	6 (4.5%)	8 (6.5%)	0 (0%)	12 (12.6%)	12 (7.9%)

Within the Main category (Table 2, Figure 5), Aotearoa New Zealand is neither the largest nor smallest provider of courses and provision is in keeping with other countries. It is in the Other category that the differences between countries become more apparent. Germany's course offerings were less standardised compared with the rest of the countries with the highest proportion of 'other' courses that did not fit into the main course categories (25%), followed by the USA (17.8%). The German 'other' courses are primarily Data Management and Earth Geometry & Geodesy courses. Both of which are not well provided in Aotearoa New Zealand. Of all countries surveyed, Aotearoa New Zealand has the lowest number of data management courses. Aotearoa New Zealand, Germany, and the UK did not have any Design and Implementation courses. The USA provides these courses in all 5 surveyed institutions.

Aotearoa New Zealand had the highest proportion of GIS Internship/Work Placement courses (3.1%), followed by Australia (1.6%). Germany and the UK did not have any of these courses. These pathway courses are appreciated by both employers and new spatial professionals in Aotearoa New Zealand (de Róiste 2016).

There is a low level of provision of Research Methods courses in all of the institutions surveyed. Approximately 1% of courses in Ireland, the UK and Aotearoa New Zealand were Research Methods courses, while Australia, Germany and the USA did not provide courses in this category. Aotearoa New Zealand had the highest proportion of thesis/research courses (2.3%), followed by the UK (2.1%). Australia and the USA did not have any of these courses. It is likely, however, that these courses are available but are not explicitly labelled as geospatial research courses.

4.2 A focused comparison between Aotearoa New Zealand and Ireland

In the previous section, the primary method of comparative analysis involved an interpretation of course titles supported by information provided by course descriptions. This section describes a focused comparison between Ireland and Aotearoa New Zealand by analysing the course content of courses using online course descriptions and learning outcomes. The analysis focuses on courses that we consider 'general' geospatial courses as opposed to specialty geospatial courses. Speciality geospatial courses would include courses such as GIS programming or GIS development courses.

For our analysis, we examined the online course descriptions and learning outcomes of geospatial courses and compared their objectives to a framework based on the technical knowledge areas and units of the GIS&T Body of Knowledge (BoK), and tiers and soft skill

(personal effectiveness, workplace and academic) competencies of the GTCM (see Table 5). The GTCM tiers are included as knowledge areas, and the associated competencies as units. Fourteen knowledge areas were identified; 10 from the BoK, 3 from the GTCM and an additional Te Ao Māori knowledge area was added to quantify course objectives in Aotearoa New Zealand that incorporate Matauranga Māori. Further information about the units/competencies and their descriptions can be found within the GIS&T BoK[17] and the GTCM[18] by DoLETA. There are some limitations with this approach. Prager and Plewe (2009) highlight inconsistent granularity of the BoK where some "advanced, narrow subjects are categorised into many separate topics, while some fundamental concepts and skills (e.g. vector editing, choropleth maps) are buried below the topic level." Some important topics within the BoK are therefore less evident. DiBiase et al. (2010) conclude in the results of their survey that 12 technical competencies in the GTCM were considered inadequate by 62% of participants. By combining both frameworks, we make space for important soft skills valued by employers (Succi & Canovi 2020) and use the more robust BoK for technical subjects. Further details about these models are provided in Appendix 5.

Table 5: Geospatial Knowledge Areas Comparison Framework

Based on the GIS&T Body of Knowledge (BoK) and the Geospatial Technical Competencies Model (GTCM) with one additional category (Te Ao Māori)

Knowledge Areas (source)	**Units**
Foundational Concepts (BoK)	Origins
	Cognitive
	Domains of Geographic Information
	Philosophical
	Basic Measures
	Interrogating Geographic Information
	Uncertainty
	General
Knowledge Economy (BoK)	GIS&T Workforce
	Coordinating Organisations
	GIS Operations
	Design & Implementation of GIS&T
	General
Computing Platforms (BoK)	Computing Infrastructures
	Computing Approaches
	Social Media and Location-based Services
	Software Systems
	Examples and Applications
	General
Programming and Development (BoK)	Algorithm Design/Algorithmic Approaches

[17] http://gistbok.ucgis.org/

[18] https://www.careeronestop.org/competencymodel/competency-models/geospatial-technology.aspx

	Development Tools
	Platform Specific Programming
	Programming Languages & Libraries
	Application Development
	General
Data Capture (BoK)	History & Trends
	Digital Data Source & Capture Methods
	Remote Sensing Platforms & Sensors
	Processing Remotely-Sensed Data
	GIS and Surveying
	Field Data Collection
	Data Coordinating Organisations
	General
Data Management (BoK)	Spatial Databases
	Representations of Spatial Objects
	Spatial Access Methods
	Query Processing
	Spatial Data Infrastructures
	Georeferencing Systems
	Data Manipulation
	General
Analytics and Modeling (BoK)	Methodological Context
	Building Blocks
	Data Exploration & Spatial Statistics
	Surface & Field Analyses
	Network & Location Analysis
	Space-Time Analysis & Modelling
	Geocomputational Methods & Models
	Big Data & Geospatial Analysis
	Analysis of Errors & Uncertainty
	General
Cartography and Visualization (BoK)	History & Trends
	Data Considerations
	Map Design Fundamentals
	Map Design Techniques
	Map Use
	Interactive Design Techniques
	General
Domain Applications (BoK)[19]	
GIS&T and Society (BoK)	Law, Regulation, and Policy
	Critical Perspectives

[19] All ‘Domain Application’ units were treated as a single topic due to wide variety

	Governance and Agency
	General
Personal Effectiveness Competencies (GTCM)	Interpersonal Skills
	Integrity
	Professionalism
	Initiative
	Dependability and Reliability
	Lifelong Learning
Academic Competencies (GTCM)	Reading
	Writing
	Mathematics
	Geography
	Science & Engineering
	Communication, Listening & Speaking
	Critical & Analytical Thinking
	Basic Computer Skills
Workplace Competencies (GTCM)	Teamwork
	Creative Thinking
	Planning & Organising
	Problem Solving/Decision Making
	Working with Tools & Technology
	Checking, Examining, & Recording
	Business Fundamentals
Te Ao Māori	

Our method of analysis involved carefully examining course descriptions, and when a course description or learning outcome mentioned an objective that corresponded to that knowledge area in the framework (Table 5), a point was recorded against that unit. For example, a course learning outcome that mentions map design techniques resulted in a point being awarded to the Map Design Techniques unit which in turn contributed to the total number of points for the Cartography and Visualization knowledge area. The total number of points per knowledge area per course was summed and used to determine the proportion of course objectives that fall into each knowledge area.

Only course learning outcomes and descriptions available online were analysed. Additional information such as a complete syllabus were not used as they were not uniformly available. Learning outcomes for courses were analysed first, followed by course descriptions, to limit accidental ‘doubling’ of points for a single objective. To be included in our analysis, a course needed 3 or more points. This approach meant courses with little or vague course information were excluded, however courses with informative descriptions but without learning objectives were included. Only unique objectives were awarded points. In other words, if a course mentioned the same objective more than once it only received 1 point for that objective. Courses were awarded multiple points for specific units so long as those points come from

unique objectives. Where an objective corresponds to a general knowledge area and another objective corresponds to a specific unit within that same knowledge area, the two objectives are considered unique and are both awarded a point. A single objective could be assigned to multiple knowledge areas/units provided the objective covered these areas. For example, an objective about professional ethics of a GIS&T can be assigned to both GIS&T and society and personal effectiveness competencies knowledge areas. Finally, the knowledge area ‘domain applications’ was excluded when analysing applied geospatial courses and domain applications courses to identify more nuanced areas of focus. Courses were divided into either undergraduate or postgraduate. If a course is offered in both undergraduate and postgraduate programmes, it would be classified as an undergraduate course.

We recognise online course descriptions and learning outcomes are often short and can be vague. Online details may not best represent course content which can be more fluid and responsive to learner’s needs. Interpretation of course objectives can also be subject to human error, and therefore can reduce the accuracy of the results. To limit this, courses were checked over again after all the courses had been analysed to ensure courses analysed at the start and end were consistently reviewed.

Aotearoa New Zealand has 130 geospatial courses while Ireland has a similar number with 133 courses. Figure 6 presents the total number of courses by category for each country, and Figure 7 presents the percentage of total courses in each category. Category sizes are similar in both countries. Ireland has substantially more surveying courses. In both Aotearoa New Zealand and Ireland, data capture courses are primarily remote sensing courses.

Figure 6: Total number of geospatial courses per category in Ireland and Aotearoa New Zealand

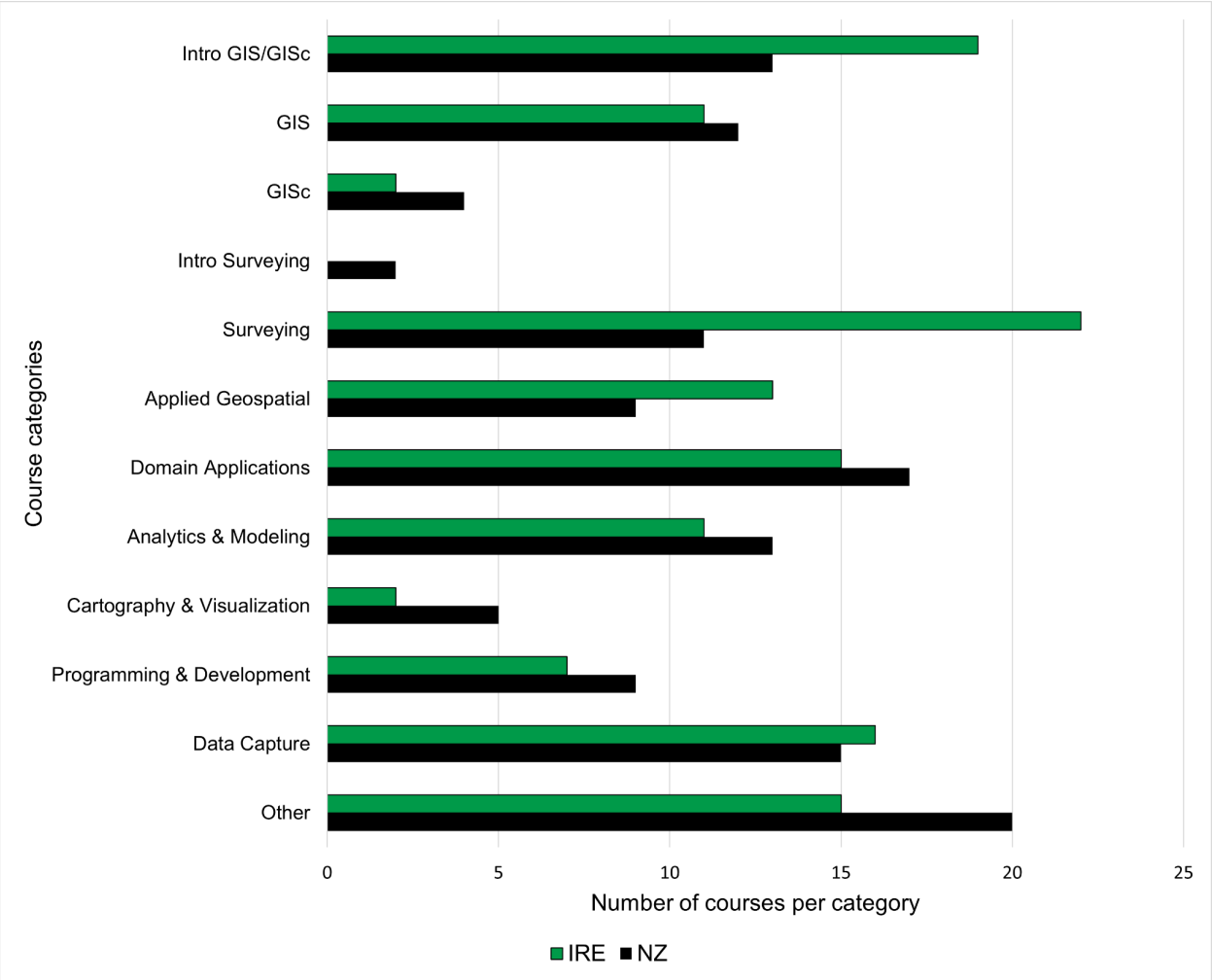
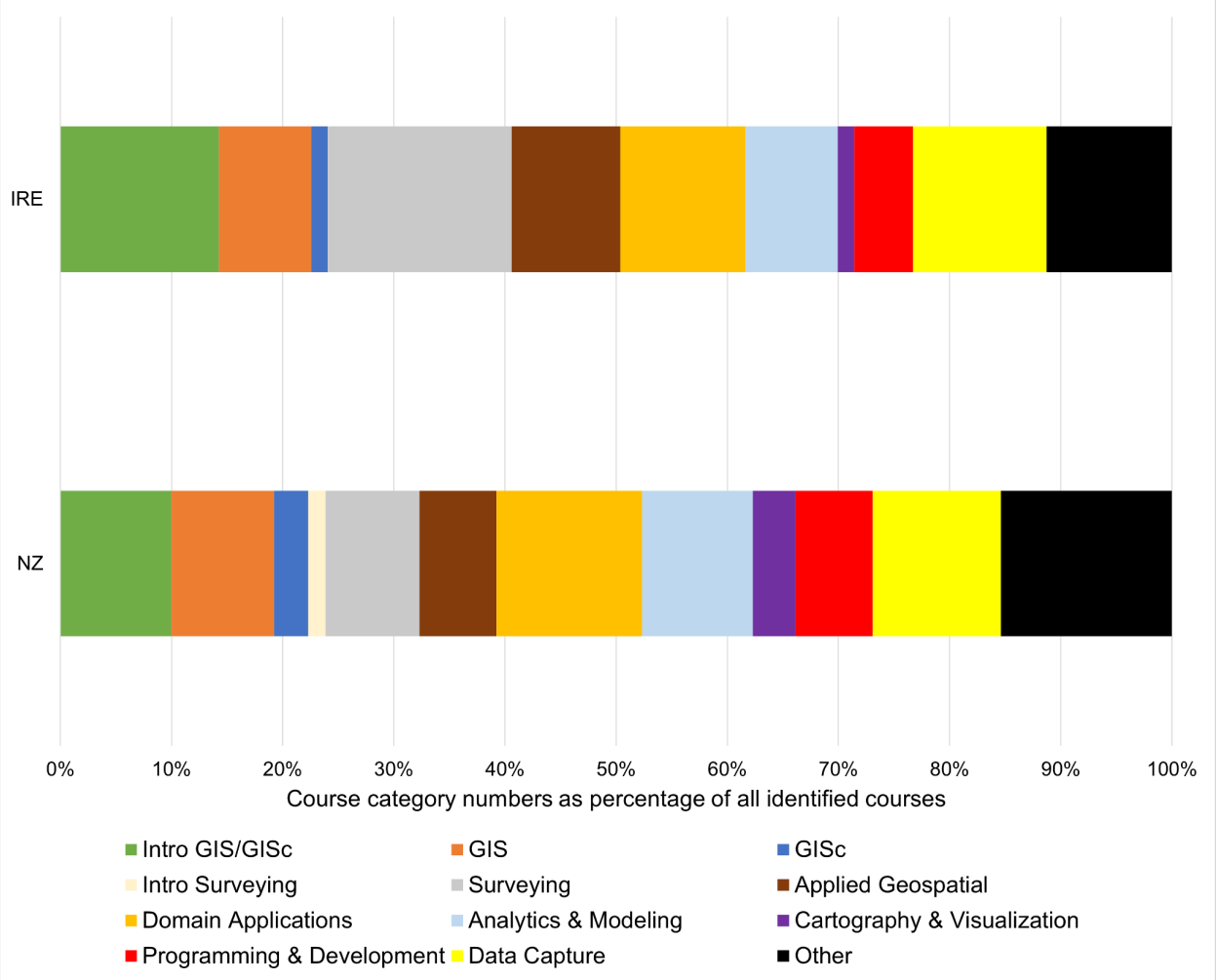


Figure 7: Percentage of courses offered main category in Ireland and Aotearoa New Zealand



It is within the 'Other' category that differences are more obvious but still not substantial. Course numbers are low and different course categories are proportionally larger or not provided at all. Ireland does not provide Earth Geometry (3.1% NZ, 0% IRE) courses and Aotearoa New Zealand does not provide 'design & implementation of a GIS&T' courses (0% NZ, 1.5% IRE). Ireland has a larger number of data management (0.8% NZ, 3.8% IRE) and research methods courses (0.8% NZ, 1.5% IRE). Aotearoa New Zealand has more GIS internship/work placement (3.1% NZ, 1.5% IRE), GIS&T and society (2.3% NZ, 0.8% IRE), and capstone courses (3.1% NZ, 0.8% IRE) than Ireland.

The second part of this analysis involved analysing knowledge area units (from Table 5) for four areas, or groups, of general courses:

- GIS/GISc–general, non-introductory GIS or GISc courses
- GIS/GISc Introductory–GIS or GISc courses at the introductory level
- Applied Geospatial–courses that apply geospatial methods for multiple domain areas

- Domain Applications–courses that apply geospatial method for a specific domain area (e.g, forestry).

Table 6 presents the proportion of points awarded to each knowledge area for each group.

Table 6: Knowledge area focus within courses in Ireland and Aotearoa New Zealand

Percentages are calculated within course categories (rather than across all courses). Aotearoa New Zealand values are given first followed by Irish values in Green. **Differences of 5% and over are bolded. Differences of 10% and over are bolded and underlined.**

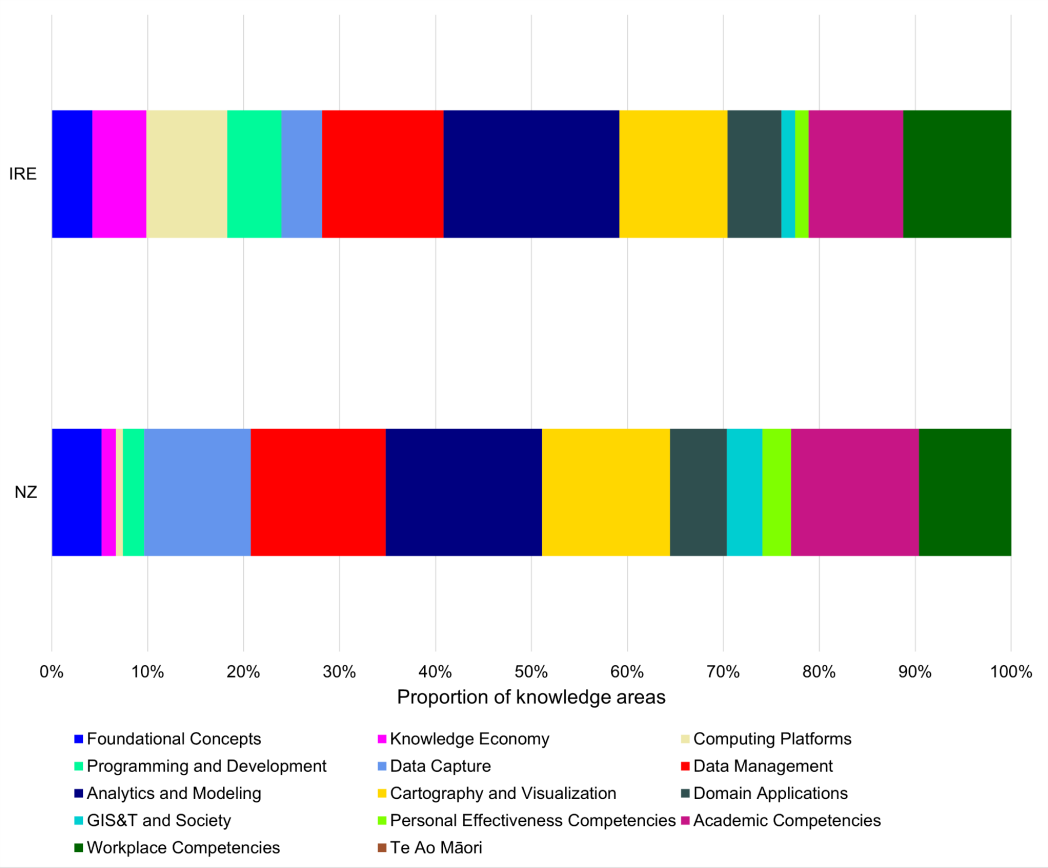
Knowledge Area	GIS/ GISc	Intro GIS/GISc	Applied Geospatial	Domain Application
Foundational concepts	5.2% 4.2%	12.2% 13.1%	11.9% 8.3%	**2.2%** **18.7%**
Knowledge economy	1.5% 5.6%	0.0% 1.6%	3.0% 0.0%	4.4% 0.0%
Computing platforms	**0.7%** **8.5%**	3.6% 3.3%	3.0% 0.0%	2.2% 2.2%
Programming and development	2.2% 5.6%	1.4% 0.6%	0.0% 0.0%	0.0% 1.1%
Data capture	**11.1%** **4.2%**	12.2% 10.9%	9.0% 8.3%	**37.0%** **16.5%**
Data management	14.1% 12.7%	**15.8%** **25.7%**	**14.9%** **25.0%**	**4.4%** **14.3%**
Analytics and modeling	16.3% 18.3%	15.8% 14.2%	**26.9%** **16.7%**	10.9% 7.7%
Cartography and visualization	13.3% 11.3%	10.1% 9.3%	16.4% 12.5%	**10.9%** **17.6%**
Domain applications	5.9% 5.6%	4.3% 1.6%	-	-
GIS&T and society	3.7% 1.4%	4.3% 1.6%	0.0% 0.0%	2.2% 0.0%
Personal effectiveness	3.0% 1.4%	2.9% 0.0%	0.0% 2.1%	0.0% 0.0%
Academic competencies	13.3% 9.9%	7.9% 7.7%	6.0% 10.4%	4.4% 4.4%
Workplace competencies	9.6% 11.3%	9.4% 10.4%	**9.0%** **16.7%**	17.4% 17.6%
Te Ao Māori	0.0% -	0.0% -	0.0% -	4.4% -

GIS/GISc

As Ireland only has two GISc courses, general GIS and GISc were combined in this analysis (Figure 8, Table 6). Overall Table 6 suggests that knowledge areas in general GIS/GISc courses in Aotearoa New Zealand and Ireland were similar. General GIS/GISc courses in both countries covered the same top three categories: Analytics and modelling (16.3% NZ, 18.3% IRE), data management (14.1% NZ, 12.7% IRE), and cartography and visualization (13.3% NZ, 11.3% IRE). Both countries had a joint third focus but these differed: Ireland prioritised workplace competencies (9.6% NZ, 11.3% IRE) while Aotearoa New Zealand placed a higher emphasis on academic competencies (13.3% NZ, 9.9% IRE). These were not substantially different.

The largest differences between the two countries are the knowledge areas of computing platforms (0.7% NZ, 8.5% IRE) and data capture (11.1% NZ, 4.2% IRE). Computing platforms include computing infrastructure and approaches, social media use, and Location Based Services (LBS). Although most courses mentioned use and proficiency of ArcGIS software, QGIS software, and other software packages, these were not applicable to the computing platforms knowledge area as defined by the GIS&T BoK.

Figure 8: Knowledge areas covered in GIS & GISc courses in Ireland and Aotearoa New Zealand



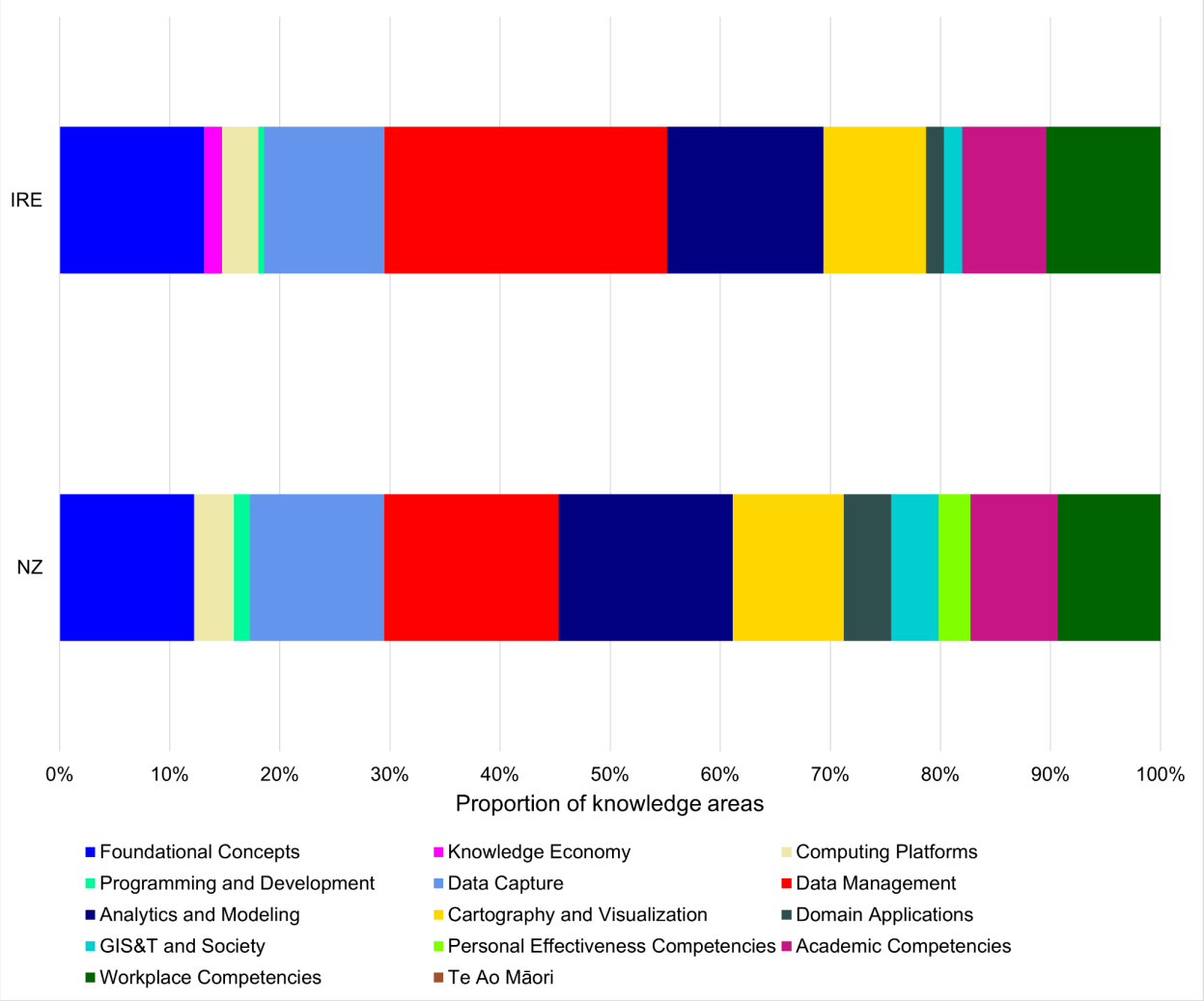
Introductory GIS/GISc

Ireland and Aotearoa New Zealand have similar provisions of undergraduate and postgraduate geospatial courses (54.6% NZ, 51.9% IRL). However, Ireland (20.3%) has a higher proportion of introductory courses compared with Aotearoa New Zealand (14.1%). In Ireland, nine universities offer an introductory GIS/GISc course while eight universities in Aotearoa New Zealand offer an introductory course. Ireland does not provide introductory surveying courses and Aotearoa New Zealand provides two.

When we break down these courses into knowledge areas (Figure 9, Table 6), the relative order is the same for both countries. Data management and analytics and modelling are first and second or joint first, while foundational concepts and data capture are third and fourth or joint third. However, the largest difference in provision is for data management; a difference of 9.9% greater focus in Ireland. Many public Irish datasets need to be standardised across Europe due to INSPIRE (https://inspire.ec.europa.eu/) and related initiatives. Aotearoa New Zealand does not have a spatial data framework and has lower compliance requirements. However, such a difference points to a potential gap in provision.

Both workplace (9.4% NZ, 10.4% IRE) and academic (7.9% NZ, 7.7% IRE) competencies (e.g. teamwork, problem solving, speaking, and critical analysis) play a relatively significant role of between 8-10% each. Personal competencies (e.g. interpersonal skills, integrity, and professionalism) were not covered in Ireland and Te Ao Māori and the knowledge economy was not mentioned in introductory courses in Aotearoa New Zealand.

Figure 9: Knowledge areas covered in introductory GIS/GISc courses in Ireland and Aotearoa New Zealand



Applied Geospatial

Applied geospatial courses employ geospatial approaches and methods to problems in multiple domain areas. Figure 10 and Table 6 detail the breakdown of knowledge areas. Within applied geospatial courses in Aotearoa New Zealand, the largest focus is on analytics & modelling (27.0%), followed by cartography and visualization (16.4%), and data management (14.9%). Within the areas covered, the least focus is on knowledge economy and computing platforms (3.0% each). There is no focus on programming and development, GIS&T and society, personal effectiveness competencies, and Te Ao Māori.

In Ireland, the largest focus in applied geospatial courses is on data management (25.0%), followed by analytics and modelling (16.7%) and workplace competencies (16.7%), and

academic competencies (10.4%). There is no focus on knowledge economy, computing platforms, programming and development, and GIS&T and society.

The strong focus on analysis and modelling in both countries (26.9% (NZ), 16.7% (IRE)) is appropriate for the type of courses. However, the difference in proportion may be important. Analysis and modelling is high in Aotearoa New Zealand and may be higher than needed for graduates entering the geospatial industry. It is worth noting however, that these skills are likely to be highly valued outside of the geospatial industry. Spatial analysis and modelling can be a key skill set for data science and business analytics.

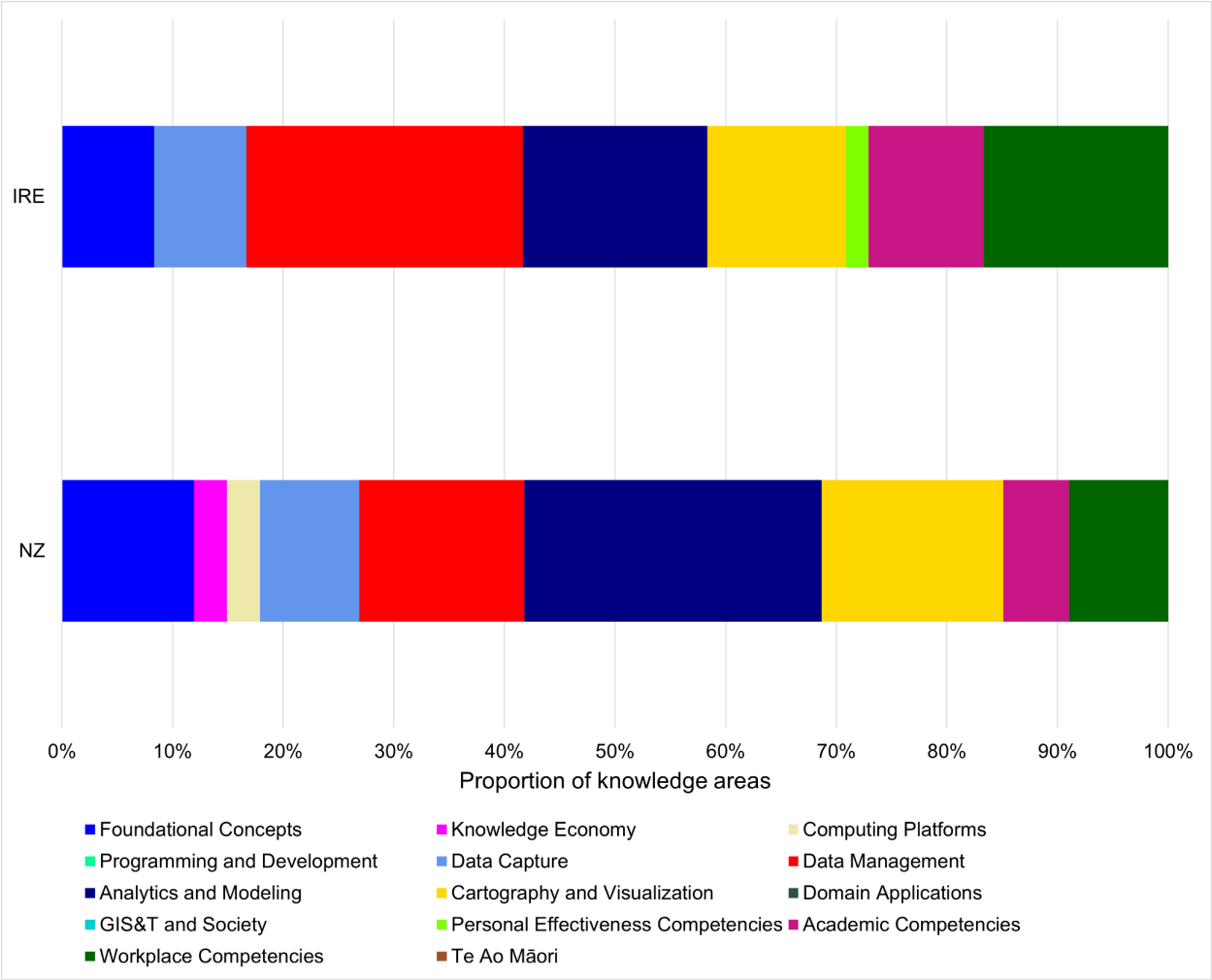
The difference in focus on data management is also worth considering (14.9% (NZ), 25.0% (IRE)). Again we see a much higher focus on data management in Ireland.

Both countries place a similar emphasis on cartography and geovisualization within these applied geospatial courses (16.4% (NZ), 12.5% (IRE)), highlighting the role of communication within the applied areas.

Soft and transferable skills have a higher focus within Ireland than Aotearoa New Zealand: academic competencies, including speaking and critical analysis (6.0% (NZ), 10.4% (IRE)) workplace competencies, including teamwork and problem solving (9.0% (NZ), 16.7% (IRE)) and personal effectiveness, including interpersonal skills and integrity (0% (NZ), 2.1% (IRE)).

Programming and development and GIS&T and Society are not well covered within the more general applied geospatial courses. This omission is not concerning given the course category. Applied geospatial courses are expected to follow a methods based approach and not explore wider societal issues. Equally, programming is a specialist skillset and therefore more appropriately taught in other dedicated courses on wider geospatial programmes.

Figure 10: Knowledge areas covered in applied geospatial courses in Ireland and Aotearoa New Zealand



Domain Applications

Ireland and Aotearoa New Zealand offer similar numbers of domain application courses (17 NZ, 15 IRE). Figure 11 and Table 6 provide the breakdown of knowledge areas. Aotearoa New Zealand has a greater focus on data capture with 37% of courses covering data capture compared to 16.5% in Ireland. Ireland has a greater focus on foundational concepts with 18.7% of courses covering foundational concepts compared to 2.2% of courses in Aotearoa New Zealand. Data capture includes remote sensing and field data collection. As Aotearoa New Zealand does not have the imposition of European regulations and expectations around the capture and processing of data, this increased emphasis may be appropriate. The higher emphasis on foundational concepts in Ireland points to the possibility that these courses are more targeted towards students new to GIS coming from that domain or with an interest in the relevant domain, e.g. a health GIS course may be taken by a student interested in public health

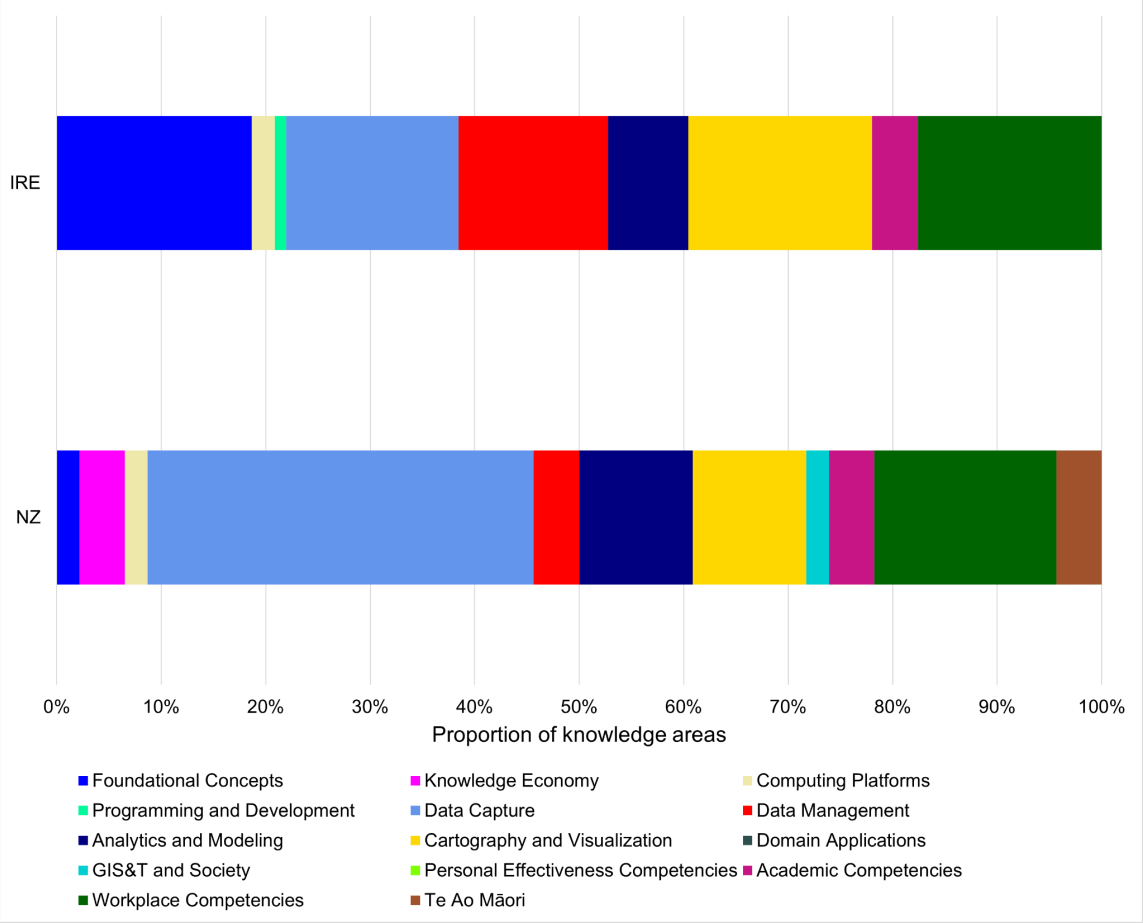
looking to upskill in GIS as a skillset in their wider domain rather than specialise in GIS or other geospatial areas.

Data management (4.4% NZ, 14.3% IRE) and cartography and visualization (10.9% NZ, 17.6% IRE) are also out of alignment with Ireland focusing more on data management by a difference of 9.9% and on cartography and visualization by a difference of 6.7%.

Neither country covers personal effectiveness competencies as part of this group of courses. Aotearoa New Zealand does not cover programming and development and the focus is similarly light in Ireland (1.1%). Ireland does not cover knowledge economy and GIS&T and society and both areas are also lightly covered in Aotearoa New Zealand (4.4% and 2.2% respectively).

Domain applications are the only general area where Te Ao Māori (4.4%) was covered. The lack of coverage in other general courses is a concern.

Figure 11: Knowledge areas covered in Domain application courses in Ireland and Aotearoa New Zealand



All General Geospatial Groups

The final analysis compares the two countries for the four groups of general geospatial courses combined (Figure 12, Table 7). The largest difference in content is within data management (13.7% NZ, 20.6% IRE). This difference points to a possible gap in provision in NZ within the less specialised geospatial courses. As mentioned, the gap could result from the greater emphasis on national standards as dictated by INSPIRE, however, these skills are also likely to be highly valuable in Aotearoa New Zealand and may limit graduates' mobility to move to other employment markets.

The top 5 knowledge areas in Aotearoa New Zealand are all similarly high proportions compared with Ireland: Analytics and Modelling (17.3% NZ, 13.7% IRE), Data Capture (14.2% NZ, 10.7% IRE), Data Management (13.7% NZ, 20.6% IRE), Cartography and Visualization (12.4% NZ, 12.0% IRE), and Workplace Competencies (10.3% NZ, 13.0% IRE).

Transferable or soft skills were treated similarly in both countries (21.4% NZ, 21.1% IRE) with the greatest emphasis on workplace competencies (10.3% NZ, 13.0% IRE), e.g. teamwork, creative thinking, and problem solving/decision making.

The focus on computing platforms was low in both countries (2.3% NZ, 3.6% IRE). Although most courses mentioned use and proficiency of ArcGIS software, QGIS software, and other software packages, these were not applicable to the computing platforms knowledge area as defined by the GIS&T BoK. This resulted in few computing platforms objectives across courses. A lack of focus in this area may also indicate a lower emphasis on elements that have gained industry popularity, such as dashboards and online provision.

The lack of focus on programming and development is reflected in both countries (1.3% NZ, 1.8% IRE) and for these more general geospatial courses, should not be a concern as these skills are usually taught in specialised courses as part of a wider geospatial programme of study (e.g. GISCI 343 at the University of Auckland, GISC 405 at the University of Canterbury, GISC 420 at Victoria University of Wellington, and SURV319 at Otago University).

The proportion of Te Ao Māori is low in Aotearoa New Zealand (0.5% - from a single course). The capture, communication and storage of spatial features relating to the sustainable management of Aotearoa New Zealand's natural and cultural resources, particularly when working with and supporting Māori communities, requires an understanding of Te Ao Māori and the importance of Tikanga and associated protocols. This knowledge area is specific to Aotearoa New Zealand, and is currently underserved by current education provision.

Figure 12: Knowledge areas covered in all general geospatial courses in Ireland and Aotearoa New Zealand

Includes introductory GIS/GISc courses, GIS courses, GISc courses, applied geospatial courses, and domain application courses

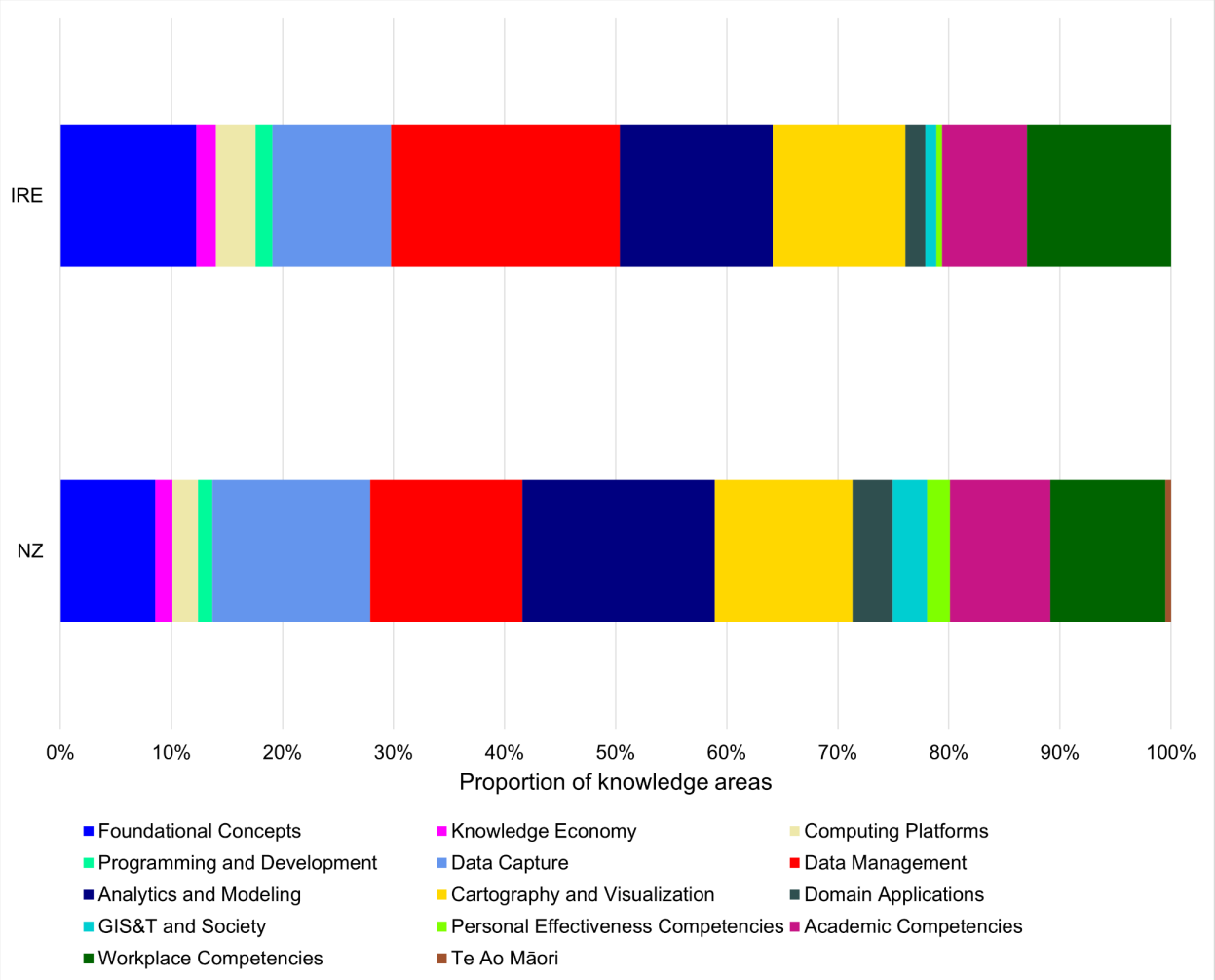


Table 7: Knowledge area focus for general geospatial courses (combined) in Aotearoa New Zealand and Ireland

Percentages are calculated across all general geospatial courses and will differ from the values provided in Table 3 above.
Differences over 5% are bolded.

Knowledge area	Aotearoa New Zealand	Ireland
Foundational Concepts	8.5%	12.2%
Knowledge Economy	1.6%	1.8%
Computing Platforms	2.3%	3.6%
Programming and Development	1.3%	1.5%
Data Capture	14.2%	10.7%
Data Management	**13.7%**	**20.6%**
Analytics and Modelling	17.3%	13.7%
Cartography and Visualization	12.4%	12.0%
Domain Applications	3.6%	1.8%
GIS&T and Society	3.1%	1.0%
Personal Effectiveness	2.1%	0.5%
Academic Competencies	9.0%	7.6%
Workplace Competencies	10.3%	13.0%
Te Ao Māori	0.5%	-

5. Geospatial Education Workshop Summary

A 2-hour geospatial education workshop was held on the 30th of August at the New Zealand Geospatial Research Conference (NZGRC). The workshop was attended by 28 participants from local and central government, Crown Research Institutes (CRIs), private industry, and academia. The workshop was facilitated by Mairéad de Róiste, Scott Pool (Te Herenga Waka Victoria University of Wellington), John Lowry (Massey University), and Geoff O'Malley (Toitū Te Whenua Land Information New Zealand). Ethics approval was granted by Te Herenga Waka Victoria University of Wellington #30588.

Each participant was given a printed list of 11 possible questions and asked to vote on the 3 they would most like to discuss at the workshop. Table 1 shows the questions and the number of votes received for each. All participants could see the votes so vote counts may not be fully representative as participants may have decided not to vote if their choice would not have impacted the final result.

As Q4 and Q11 were similar and the workshop was time constrained, it was suggested that Q11 be removed as Q4 was the more encompassing of the two.

Table 8: Questions presented to the workshop participants for potential discussion with the number of votes for each question

Question	Votes	%
1. Where is geospatial education thriving and where is it struggling? ○ What are the factors behind these states?	2	4%
2. Where do expectations of undergraduate and postgraduate education differ for geospatial science?	1	2%
3. What are the differences between industry and academic expectations for geospatial science education and how can or should these be overcome?	13	23%
4. What does the geospatial industry expect/hope for from graduates learning geospatial science in tertiary education? ○ Are there specific hard and/or soft skills, theoretical concepts, technologies, or software? ○ Are there areas where tertiary education in NZ is doing well? Are there areas of deficiency? ○ How do expectations differ between undergrads and postgrads?	11	20%

5. If geospatial science tertiary educators were to write a ‘mission statement’ what would it be?	1	2%
6. Introductory geospatial science courses are often service courses (i.e., students from a variety of majors (from data science through geology to economics) take the courses). How can we design these courses to meet industry needs while meeting the needs of students with a broad range of interests and academic backgrounds?	1	2%
7. What is the difference between geospatial science technical training courses (short courses) and geospatial science courses at a university? What roles do each play in the development of learning and progression in geospatial science careers? Assuming both are important to the geospatial industry, how does their importance differ?	5	9%
8. Should geospatial science education be taught in universities or polytechnics? If both, how do their roles differ?	1	2%
9. How important is it for graduates to complete a named qualification (e.g., minor, major, BA/BSc, PGDip) in geospatial science? Or is it the courses they take that are important?	4	7%
10. What role do other courses play in a university education for someone going into a geospatial science career? In other words, is it important to be ‘well rounded’ or is the geospatial industry looking for a specific skill set/knowledgebase?	2	4%
11. What are the skills (hard and/or soft), knowledge of theoretical concepts, or technologies that will be needed of graduates interested in geospatial science careers in the coming decade?	15	27%

The two questions (Q3 and Q4) were presented sequentially to 4 groups split across tables. Each group nominated a spokesperson, and the summary of their discussion was recorded. Common themes were identified by one of the workshop leaders at the time. The discussion is summarised under the relevant question, and certain points are repeated. As the points presented below summarise each of the different groups some points raised may be contradictory.

Q3: What are the differences between industry and academic expectations for geospatial science education and how can or should these be overcome?

There was general agreement that tertiary geospatial education should teach general geospatial theory, knowledge, and practice rather than just particular tools. The geospatial industry is fast-paced with changing technologies. Specialised skills can become redundant quickly. Focusing on learning how to learn is important as well as understanding good practice, documentation, and metadata. Collaboration is a key concern for industry and collaborative tools such as GitHub are important.

A concern was expressed that universities focus too much on theory and not enough on practical skills. This was tempered however by the recognition that there is a lack of knowledge of what education can actually offer.

Education is likely to focus more on cartography as communication, UX, ethics, and privacy. These foci were broadly grouped under critical thinking and may not be clearly valued by employers who may view geospatial information and processes purely technically. However, these skills can be valuable for professionals to understand the implications of their work.

A significant difference is the importance of data engineering for industry. Learning how to deal with and improve real data is critical, and students should not just work with good quality, clean datasets.

Other specific skills were mentioned as important: programming, spatial analysis, SQL, technical knowledge of databases, and understanding of enterprise systems (including their complexity and supporting a large number of users). It was recognised that many of these are covered in some university programmes.

Different employers have different needs, in some organisations, there's a greater awareness of operational needs, whereas others are more policy rather than practical focused.

The students coming through university are also likely to develop different skill sets. There is space in the geospatial industry for different types of graduates. The geospatial industry can benefit from software developers who are GIS aware as well as GIS professionals who have an understanding of software and good practices.

A distinction was made between training and education. There was recognition that employers will have to train new graduates and will bear the associated cost. The idea of an industry training organisation was raised wherein both industry and educators have input into curriculum and resource development. Other possibilities include consideration of lifelong learning, short university-based courses, and micro credentials (assessed short courses that could be amalgamated to count towards a qualification).

Q4: What does the geospatial industry expect/hope for from graduates learning geospatial science in tertiary education?

a. Are there specific hard and/or soft skills, theoretical concepts, technologies, or software?

A range of hard skills were identified. Programming and automation were mentioned by several participant groups. Data skills are particularly important: the finding, managing, manipulating, and processing of data as well as database processing skills. Relatedly, security and authenticity in enterprise environments are also important. Spatial statistics and web delivery were raised. Familiarity with high-performance computing was also identified with the disclaimer that this may be more suited to CRIs and other research-focused organisations in the participant group.

Within soft skills, transferable skills such as teamwork, collaboration, and communication are highly regarded. Communication skills comprise map and other visual communication, science communication and particularly communicating with non-experts, such as stakeholders, managers outside of geospatial, and the general public. Stakeholder engagement and requirement gathering, problem-solving and learning how to learn were also identified. Cultural awareness and the impact of the Treaty of Waitangi on data sovereignty and other issues is a valuable area.

More specific to the geospatial industry, the scientific approach and associated processes as well as spatial literacy were highlighted. Awareness of the impact of space on equity was also raised.

In terms of technologies, it is expected that universities provide students with exposure to a range of software and are platform agnostic.

Two additional concepts were identified, both having to do with how employers in the geospatial industry view what students should learn about geospatial data and technologies. With regard to data, it was identified that spatial data are unique compared with other types of data. For example, a good understanding of not just coordinate systems, but spatial data accuracy is required for working with spatial data competently. This suggests some employers understand that learning GIS is more than learning how to use a software and there is a knowledge base upon which technical skills must be developed. Despite this, some employers tend to be unable to differentiate GIS as a tool versus a body of knowledge and professional skills.

b. Are there areas where tertiary education in NZ is doing well? Are there areas of deficiency?

Tertiary education is doing well in providing the ‘basic stuff’. Cartography and map making were specifically mentioned. Tertiary education is also doing well at wider awareness raising of GIS and more ‘people tacking it on to their geography degree or their hydrology’.

Areas for improvement focused on communication skills (including presenting), collaboration, information on standards and best practice, and time management particularly within time-constrained projects (e.g., doesn’t have to be perfect).

Opinions were mixed as to whether spatial statistics were appropriately covered as the impression was that there was a stronger focus on theory rather than applied problem solving.

Participants raised the potential for industry to be more involved in assessment.

c. How do expectations differ between undergrads and postgrads?

Participants had higher expectations of graduates with postgraduate qualifications. It is expected undergraduates and postgraduates differ based on their depth of understanding, experience, and awareness of methods, concepts, and tools. Postgraduates should be able to

work independently and can lead the projects. Undergrads require more support and are likely to be assigned specific tasks.

Perceived importance of questions

This summary primarily focuses on what was learnt from the discussions for the two questions chosen for discussion in the workshop. There is also value in examining which questions were less valued by the participants within the workshop time constraints and these other questions are addressed briefly here. Table 1 above also presents the percentages of votes for each question, and these can be viewed as a ranking of importance.

The majority of votes were for questions 3 (23%), 4 (20%) and 11 (27%). Question 3 focused on perceived differences in how educators and employers view the role of tertiary education in producing graduates for the geospatial industry. Questions 4 and 11 were similar and due to the lack of time, only question 4 was discussed in the breakout sessions. The aim of question 4 was to seek answers about what the geospatial industry expects from students graduating in the geospatial industry presently, while question 11 was meant to seek understanding of future needs (the next decade). Given the quickly evolving nature of geospatial technologies, insight into perceived future needs is valuable. Although the questions could have been worded to differentiate their aims more clearly, it is fair to assume that the difference in what the questions were asking was not lost to the participants. This suggests that many participants felt it was important to discuss what the geospatial industry expects from graduating students both now (Q4) and in the future (Q11).

Other than these three, questions that received more than 5% of the vote were questions 7 and 9. Question 7 (9%) aimed to understand participants' perception of differences (if any) between educational expectations at polytechnic institutions compared to universities, and question 9 (7%) sought understanding on the importance of named qualifications in geospatial science. Both questions can be thought of as addressing the qualifications of graduates whereas questions 3, 4 and 11 targeted a better understanding of perceived skills and knowledge presumably obtained through a university education. The lower emphasis on these may point to little perceived difference in importance between the two or in contrast may simply be less important compared to the other questions. Further discussion is needed.

Other questions received less than 5% of the vote. It is worth noting no questions received no votes. This could be that participants chose questions because they wanted to “even things out” or because all the questions were of interest to at least one participant. Q2 was partially covered by Q1 and 2 were partially covered by the questions discussed by the groups. Q6, 7 and 9 are likely to be highly relevant to educators and input from industry would be welcomed but it is likely to be of less importance to the selection of industry both at the conference and in the workshop. Q11 (other relevant courses outside of geospatial programme) was partially covered by the workshop discussion but is also likely to require some supporting information on what is already available within geospatial programmes throughout Aotearoa New Zealand.

6. Discussion

The geospatial industry in Aotearoa New Zealand, and internationally, continues to grow. Geospatial professionals remain on the long-term skills shortage list for Aotearoa New Zealand. de Róiste (2014) identifies the largest gap is for qualified and experienced geospatial professionals, while a smaller gap also exists for geospatial professionals without experience. To fill this gap from within Aotearoa New Zealand's workforce, geospatial graduates must enter the geospatial industry and gain experience.

Despite an overall decrease in students enrolling in tertiary education in Aotearoa New Zealand over time, enrolments have increased in both undergraduate and postgraduate geospatial courses and programmes. This movement is positive and may be partially attributed to growth in students taking spatial analysis standards as part of the geography curriculum in secondary school.

It should be noted however that an increase in the numbers of students taking geospatial courses in universities may not result in increasing numbers entering the geospatial industry as many students who take geospatial courses (especially at the introductory level) enter other careers. For example, students completing a conservation biology degree may be required to take one or more geospatial courses, but they will most likely pursue careers in conservation biology. Universities sometimes track graduates but this process is difficult and not necessarily comprehensive nor is it standardised across institutions.

Although the number of secondary school students taking NCEA Spatial Analysis standards has grown, the standards are taught as part of the Geography curriculum and a reduction in students taking Geography may affect student awareness of geospatial subjects at university. While the geography subject is the most likely secondary subject where geospatial skills are taught, there may be value in exploring other subjects in secondary school to identify areas where geospatial skills could be provided as part of that subject's curriculum. An NCEA refresh is currently underway with new achievement standards at Levels 1, 2 and 3 expected to be in place by January 2027[20].

As of the end of our survey of courses in 2021, Aotearoa New Zealand has well-established geospatial education provision, across various institutions and programmes. Geospatial education is offered at both undergraduate and postgraduate levels. The courses provided on different programmes provide theoretical knowledge as well as technical skills, and practical experience in geospatial fundamentals, spatial data analysis and modelling, remote sensing, and cartography. Postgraduate opportunities include research papers where students engage in original research and develop advanced geospatial skills in different domain applications and

[20] https://www.education.govt.nz/our-work/changes-in-education/curriculum-and-assessment-changes/#NCEA-change-programme

research methodologies. Industry collaboration is incorporated through guest lectures, research collaborations and work placements or internships.

Within this growing provision, gaps in the education provision should be identified and filled. This report reviewed course provision in Aotearoa New Zealand against 5 institutions in 4 countries and performed a more in depth comparison with the Republic of Ireland.

Aotearoa New Zealand's course provisions are in step with provision internationally. Ireland and Aotearoa New Zealand have similar provisions of undergraduate and postgraduate geospatial courses and introductory courses are provided at a high number of education institutions in both countries. Programming, spatial analysis and other geospatial skills are provided at a number of universities and in line with overseas provision. These areas were identified by participants in the geospatial industry and educators workshop.

Introductory courses explore a wide breadth of geospatial topics at the expense of an in-depth investigation into the topics (Prager & Plewe 2009). Ireland had the highest proportion of introductory GIS/GISc courses (19.6%) compared to the 5 comparison countries, followed by the UK (12.6%) and Aotearoa NZ (10%). Sinton (2009) argues that undergraduate offerings are important to attract students to a discipline, as students are less likely to come across a discipline if it is only taught at a graduate level. Ensuring visibility of geospatial education for students in subjects where GIS and other spatial technologies are learned and applied is likely to improve overall knowledge of the domain and ensure the geospatial industry is seen as an option for graduates. Meyer et al. (1999) point out that teaching GIS can be expensive, particularly due to the cost of hardware. Improvements in online provision of geospatial analysis tools (such as ArcGIS Online) and data (e.g. LINZ data service) means more powerful geospatial techniques can be applied on less expensive machines. However, at least in the medium term, a need for hardware access is likely to remain, as some students may have limited access to their own computers and transporting laptops can discourage student engagement. As students naturally take introductory courses before advanced courses, lower student numbers are expected in more advanced courses and may require additional software (e.g. remote sensing software) or equipment (e.g. UAV) and are comparatively more costly to run.

As detailed in Section 2, geospatial education, especially at undergraduate and introductory levels, does not simply target future geospatial professionals who go on to directly enter the geospatial industry. Geospatial education encompasses a wide variety of approaches and targets different learners, including diverse students from different majors who develop a geospatial skillset to complement their career outside of the geospatial industry, e.g. service courses for conservation biology, earth science, or landscape architecture. This broad interest base is positive as it improves spatial capability outside of the industry while also exposing different students to this potential career pathway.

While geospatial provision in tertiary education in Aotearoa New Zealand is aligned with the comparison countries of this study in general, some areas of course provision are worth

exploring further. First, we discuss three areas where Aotearoa New Zealand is broadly in step with other countries but further exploration is beneficial: internships, design and implementation of a GIS&T, domain application, and soft skills. Second, we examine two areas of under provision: Data management and Te Ao Māori.

Internships are provided at a higher proportion in Aotearora New Zealand compared with overseas. This provision can be an important pathway to industry for students (de Róiste 2016), can be an important step in gaining experience in addition to the qualifications in demand by industry (de Róiste 2014) and leads to benefits to both host firms and students (Franco et al. 2019). The continued focus on internships is likely to be of benefit to the geospatial industry.

Design & implementation of GIS&T courses are not offered in Aotearoa New Zealand. These courses include content such as managing GIS&T operations and infrastructure, GIS&T project planning and management, and GIS design (UCGIS n.d.). GIS project management skills are sought after by employers (Hong 2016) and Solem et al. (2008) highlight the importance of general management skills for all professional geographers. Ireland, Australia and the USA all have at least one design and implementation of a GIS&T course of all the identified geospatial courses. However, the numbers of these courses were typically low across case studies (Australia and Ireland: 2, USA: 8). Design and implementation may be covered in other courses as indicated through course descriptions and learning objectives in countries where we did not undertake a more comprehensive comparison. While it is likely design & implementation of GIS&T courses would be of benefit to some geospatial graduates and their employers in Aotearoa New Zealand, the case for inclusion is borderline.

A domain application course is a specialised course where the primary focus is incorporating GIS or GISc into a specific domain, for example, a forestry GIS course. Our definition of a domain application course is based on the knowledge area of the GIS&T BoK (UCGIS n.d.). Aotearoa New Zealand has the highest provision of domain application courses but this number is in line with Ireland and not out of step with the average of the other countries. Aotearoa New Zealand and Ireland have similar amounts of domain content in GIS/GISc courses and Aotearoa New Zealand has a slightly higher proportion of domain application content within introductory GIS/GISc courses. Interdisciplinary applications of geospatial tools and technology can deepen critical spatial thinking and engagement with course content, as students can identify the criteria for the spatial analysis themselves based on their own research and understanding of the problem (Bearman et al. 2016, Sinton 2009). Domain application courses can also increase the use of GIS in non-geography disciplines which can potentially benefit geography as a discipline overall (Sinton 2009). Such a focus on provision is unlikely to be of detriment to the industry or students. Our workshop identified a concern of over emphasis on theory. This concern was not reflected in our findings. There are few theory only courses and the emphasis on domain applications is a counterpoint to this concern. However, we acknowledge the importance of greater industry and education collaboration later in this section.

While technical knowledge is clearly important for geospatial roles, our use of elements of the GTCM framework identifies relevant soft skills, e.g. personal effectiveness. Ireland and

Aotearoa New Zealand had similar proportions of soft skills but for both countries, this proportion was relatively low and accounted for approximately 20% of the identified course contents. Only a small proportion of soft skills were made up of personal effectiveness competencies. Personal effectiveness competencies include interpersonal skills, integrity, professionalism, initiative, dependability and reliability, and lifelong learning. Wikle and Fagin (2015 p. 643) describe soft skills as “generic competencies such as effective communication or an ability to work within a collaborative environment” and explain that “most soft skills are transferable across job types and employment levels.” The inclusion of soft skills is supported by an increasing emphasis on soft skills by employers and universities (Succi & Canovi 2020). Communication, writing, presenting, and problem-solving skills are examples of important soft skills for geospatial professionals (Hong 2016). As the proliferation of geospatial data increases, students should be well-equipped with the required competencies for geospatial positions as well as the knowledge of increasing themes of data privacy and ethics (Walter 2020).

The low proportion of identified soft skills within Aotearoa New Zealand may only reflect a lack within the course outlines rather than the actual course content, as educators typically only incorporate the technical skills into the course outlines. However, it is likely that the lack of soft skills in the course outlines is indicative of a lack of recognition of the importance of soft skills and the purposeful embedment of these skills within course objectives by educators. Communication skills were identified in our industry and educators workshop. Wikle and Fagin (2015) suggest that problem-based learning is an effective way of incorporating soft skills into geospatial curricula. Problem-based learning involves students managing their own learning, working in teams, and working with fixed resources. Problem-based learning has been shown to improve soft skills and others have used this to simulate real work environments (Wikle & Fagin 2015). Critical thinking and other soft skills help with evaluating data quality, accuracy and relevance, in the design of different analytical steps of a project, recognising biases, assumptions, or limitations in analysis methods, as well as communicating to a variety of stakeholders. A focus on education is important here rather than simply training in the specifics of how to use software or tools.

Aotearoa New Zealand had the lowest proportion of data management courses across the 6 countries and had a lower proportion of data management content compared with Ireland. Our workshop identified the importance of finding, managing and processing data, assessing data quality, ensuring data security, and monitoring databases. The difference in dedicated data management courses and content between Ireland and Aotearoa New Zealand may be explained by the difference of spatial data availability in the two countries. Ireland is part of the European Union spatial data infrastructure created by the INSPIRE directive, which enables public access of European spatial data and the sharing of this data among public sector organisations (European Commission n.d.). This membership may facilitate a greater demand for data management rather than data capture in Ireland corresponding to our findings of a larger proportion of data capture content in Aotearoa New Zealand. Employers regard data management skills, such as database development and query skills as important for GIS positions (Hong 2016). Hong (2016) recommends trimester long database management courses to better prepare students, as the depth and breadth of the topic cannot be fully

covered by a component within a general GIS course. Geospatial data management education provision could be improved in Aotearoa New Zealand.

Te Ao Māori content was only identified in the domain applications course outlines (4.35%). Briggs et al. (2020) argue recognising indigenous knowledge in geospatial sciences is important. GIS has been critiqued as it tends to ignore concepts integral to Indigenous knowledge of place, such as relatedness, ambiguity, non-empirical experience, and the value placed on geographical knowledge and, therefore, a need to restrict its access (Briggs et al. 2020). Māori culture is integral to Aotearoa New Zealand's identity. By incorporating Te Ao Māori into geospatial courses, students gain an understanding of cultural diversity and inclusivity, a broader sense of place, the cultural significance of features and landscapes, as well as treaty implications for land ownership and mapping, resource management, and territorial boundaries. Te Ao Māori encompasses a rich body of indigenous knowledge, including traditional place names, resource management practices, navigation methods, and cultural connections to the land. Educators should, however, exercise caution when incorporating indigenous perspectives into course content. Integrating Māori content in current courses will likely require consultation with iwi, Te Kahui Manu Hokai - the Māori GIS organisation, and Māori educators working in this area. A focus on Te Ao Māori fosters a more inclusive and holistic approach to geospatial analysis, helping shape a geospatial workforce that is respectful, culturally sensitive, and equipped to address the unique geospatial context in this country.

While the growth in geospatial graduates is positive, some potential future issues face the continued growth or maintenance of these numbers. Both national and international student enrolments have reduced in Aotearoa New Zealand[21]. The decline in student numbers is also reflected in overseas institutions[22].

While the principles, concepts and underlying theory of GISc have been established over nearly half a century (Goodchild 2019) geospatial disciplines continue to evolve rapidly. Changes in the geospatial industry are driven by rapid advances in Big Data and data science (Goodchild 2019). Big Data refers to the volume, velocity, and variety of data now available through new sensors (remote and *in situ*) and “volunteered geographic information” or geographic information provided via the internet. Data science is a rapidly growing discipline involved with the extraction (mining) of information from these data using complex algorithms and high-powered computers. There is a need to consider an education and career in the geospatial industry (as with many careers) as requiring a commitment to lifelong learning. Students cannot expect the knowledge and skills learned through a university programme (undergraduate or postgraduate) to be sufficient, or even applicable, throughout their career in the industry. A distinction should be made between training for particular roles and education, which should provide a firm foundation against which lifelong learning can be achieved. As a cost borne by

[21] Overall tertiary student numbers declined by 5.1% from 2021 to 2022 and domestic enrolments declined by 4.1% from 2021 to 2022. International student numbers declined 13.7% between 2021 and 2022. https://www.educationcounts.govt.nz/statistics/tertiary-participation

[22] https://fortune.com/2023/03/09/american-skipping-college-huge-numbers-pandemic-turned-them-off-education/

students rather than their employers, education has a wider remit than training and has an appropriate focus on more robust skills. A singular focus on how to use particular software can mean graduates are ill-equipped to deal with the fast-paced changes in industry. Universities need to cater for a range of diverse learners both entering the geospatial industry and beyond. Added to this, the skills demanded by roles in the geospatial industry can vary substantially (de Róiste 2014). The more ready availability of learning materials (Veenendaal 2014), e.g. YouTube, user forums and websites, means the role of geospatial education has changed.

COVID-19 has had a significant impact on teaching and learning (Blanford et al. 2022). The tertiary sector is also experiencing a significant workforce contraction due to funding issues and provision of geospatial courses may be impacted in the short term. The availability of online resources and non-traditional university experience, coupled with an increase in cost of living[23] resulting in a greater need for students to find more paid work alongside study, means continued professional development or lifelong learning is more important.

Continued professional development is already ingrained in membership of some geospatial professional bodies (e.g. Survey + Spatial NZ[24]). In the future, universities may need to work more on the premise that a university education is the primer to a lifelong education and students and employers will need to recognise this expectation as well. The provision of short courses and other alternative providers was not included in this study, so the extent to which this currently happens and what gaps or provision are in this area is unknown. This type of formal upskilling may not be widely practised in industry. de Róiste (2016) noted that young geospatial professionals were most likely to be supported by internal mentoring, and opportunities for course attendance were limited. Access to more formal training may change with length of service within an organisation.

A gap in converting students taking undergraduate geospatial courses to postgraduate programmes is also a space for opportunity. Potential gains can be made here in providing further relevant education to future geospatial graduates to ensure the skills in demand by industry are being developed. However, the low conversion from undergraduate to postgraduate also speaks to a strong employment market and the expectation that students bear the full cost of their upskilling at postgraduate level rather than in concert with employers. Our industry workshop acknowledged a difference in expectations of graduates with postgraduate and undergraduate qualifications. The extent to which this difference is financially valued by industry is unclear. Graduates with a primary degree entering the geospatial industry may need greater access to lifelong learning opportunities and flexible postgraduate programmes, and universities may benefit from engaging with large geospatial employers to design appropriate study pathways, e.g. LINZ has scholarships for employees. Other more training-based approaches are also currently available, though outside the scope of this study (e.g. Eagle Technology's GALoP programme focussing on the ESRI GIS software suite).

[23] https://www.stats.govt.nz/news/cost-of-living-remains-high-for-all-household-groups
[24] https://www.surveyspatialnz.org/

Our workshop with the geospatial industry and educators identified a lack of knowledge in industry about what is covered at university. This report will address some of this knowledge gap and assure industry professionals of the wide range of geospatial skills covered across the country. A continued focus on internships as part of geospatial course provision will also facilitate knowledge transfer. However, additional interactions will likely benefit both educators and employers. For example, employer involvement in assessment is likely to be of interest to students and seen as a bridge between education and employment. A series of workshops at appropriate industry conferences could also be valuable in increasing both industry and educators' knowledge of geospatial education and in-demand skills. Such initiatives can bridge the lack of knowledge of educational provision as well as provide opportunities for educators to gain a better understanding of the needs and focus of industry.

7. Conclusion

Against a growing geospatial industry, geospatial student numbers at tertiary level have increased. The number of students taking spatial analysis standards at secondary school is also positive and has grown or been maintained for the last four years. Spatial analysis standards are covered under the Geography curriculum, which is under review. The continued presence of spatial analysis standards in the curriculum refresh is likely to remain important for the geospatial industry in attracting university students. It is worth considering the place of geospatial skills in other subjects as the curriculum is reviewed and potentially creating relevant resources for subjects such as History and Digital Technologies.

Geospatial education in Aotearoa New Zealand is in step with international provision at the course level with five other countries. A more in-depth comparison with Ireland also reflects this position. However, three potential gaps were identified: Data management, Te Ao Māori and soft skills. Data management is underrepresented nationally and was a concern identified by participants in our workshop with geospatial professionals and educators. Te Ao Māori is under-represented in courses, with only one course provided nationally and two course learning objectives in our more in-depth comparison. The contextual importance of Mātauranga Māori is valuable for geospatial graduates in understanding and adapting geospatial skills to the unique national setting in Aotearoa New Zealand. Soft skills are valued by industry, particularly communication skills, and a lack of emphasis on course learning objectives may not adequately prepare students for industry.

The university system has been substantially impacted by COVID-19 in how learning and teaching are conducted, coupled with declining student numbers and a strong employment market. The analysis conducted for this report is a snapshot and the university sector will likely experience a reduction in geospatial courses in the short term due to a workforce contraction. may mean geospatial provision is out of step with international provision.

This project ended with a geospatial industry and educators workshop. Such initiatives are likely to be important opportunities for employers and industry professionals to build knowledge of the education landscape as well as for educators to identify the relative importance of different skills. Other industry involvement (e.g., internships, guest lectures, and involvement in assessment) is also likely to be welcomed by both students and industry and is already being supported by some educators.

Universities are well placed, in consultation with industry and professional bodies, to provide lifelong learning opportunities. Short courses or micro-credentials may be well received by professionals.

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Appendix 1: Data format for Tertiary Education Commission (TEC) data

Data on the number of students who completed, did not complete and are still enrolled in a tertiary programme that contains at least 3 GIS courses for a given year was provided by the Tertiary Education Commission (TEC) on the 8th of December 2021 at the request of Toitū Te Whenua Land Information New Zealand (LINZ).

The numbers of students in the tertiary GIS course data was rounded down to the nearest multiple of 5 to protect privacy. Consequently, we used the median values between the possible maximum and minimum values to estimate the true value. For example, if less than 5 students completed a bachelor's degree programme in 2004 with 3 or more GIS courses, the true value can be anywhere between 1 and 4. So, the median value of 2.5 is used.

The requested data contains fields with the following information:

1. **Provider type**
   I.e. university or polytechnic.
2. **Provider name**
   For example, Auckland University of Technology.
3. **Award Level**
   The New Zealand Qualifications Framework (NZQF) level that applies to a qualification type. For example, a bachelor's degree has the NZQF level 7. In the dataset, this is written as "L07 Bachelors".
4. **Qualification completed flag**
   The completion status of a tertiary student's programme for that year. The possible values in the dataset are "Completed", "Not completed" or "Enrolled".
5. **Qualification end year**
   The year of the qualification completed flag value.
6. **GIS qualification selection type**
   The amount of GIS courses or course hours within a tertiary programme. The possible values are "More than 0.75 of course hours were in GIS courses", "More than 0.5 of course hours were in GIS courses", "More than 0.25 of course hours were in GIS courses", "3 or more GIS courses". These values are mutually exclusive.
7. **Average Survey EFTS studied**
   For example, 0.17.
8. **Number of students**
   The number of students within the tuple.
9. **Student status**
   Whether a student is a domestic or international student. The possible values are "New Zealand" and "International".

The list of courses categorised as geospatial courses for the purpose of these data are listed in Appendix 2.

Appendix 2: Tertiary Education Commission (TEC) course list

The tertiary geospatial education data provided by the TEC provided student number data from the following courses.

CourseCode	CourseTitle	CourseType	ProviderCode	ProviderName
ATBCNDS018	Geodesy & Referencing Systems	Survey	6003	Bay of Plenty Polytechnic
ATBCNDS018A	Geodesy and Referencing Systems: 23859	Survey	6003	Bay of Plenty Polytechnic
ATBCNDS018B	Geodesy and Referencing Systems: 23860	Survey	6003	Bay of Plenty Polytechnic
ATBCNDS018C	Geodesy and Referencing Systems: 26298	Survey	6003	Bay of Plenty Polytechnic
ATBCZZCOP05	Geodesy & Referencing Systems	Survey	6003	Bay of Plenty Polytechnic
ATBCZZCOP05A	GEODESY & REFERENCING SYSTEMS: 23859	Survey	6003	Bay of Plenty Polytechnic
ATBCZZCOP05B	GEODESY & REFERENCING SYSTEMS: 23860	Survey	6003	Bay of Plenty Polytechnic
ATBCZZCOP05C	GEODESY & REFERENCING SYSTEMS: 26298	Survey	6003	Bay of Plenty Polytechnic
001843	Geographic Information Systems	GIS	6004	Unitec New Zealand Ltd
001861	Land Surveying	Survey	6004	Unitec New Zealand Ltd
001866	Land Surveying-SemA	Survey	6004	Unitec New Zealand Ltd
001867	Land Surveying-SemB	Survey	6004	Unitec New Zealand Ltd
001871	Cadastral Surveying	Survey	6004	Unitec New Zealand Ltd
001873	Surveying	Survey	6004	Unitec New Zealand Ltd
001891	Geodetic Surveying	Survey	6004	Unitec New Zealand Ltd
001894	Remote Sensing	GIS	6004	Unitec New Zealand Ltd
001895	Geographic Information Systems	GIS	6004	Unitec New Zealand Ltd
002873	Land Surveying	Survey	6004	Unitec New Zealand Ltd
006042	Geographic Information Systems	GIS	6004	Unitec New Zealand Ltd

008164	Applied GIS	GIS	6004	Unitec New Zealand Ltd
008856	Geographic Information Systems	GIS	6004	Unitec New Zealand Ltd
008866	Applied Geographic Info System	Survey	6004	Unitec New Zealand Ltd
010199	Land Surveying	Survey	6004	Unitec New Zealand Ltd
010456	Land Surveying 1	Survey	6004	Unitec New Zealand Ltd
010472	Land Surveying 2	Survey	6004	Unitec New Zealand Ltd
010543	Surveying Mathematics	Survey	6004	Unitec New Zealand Ltd
010546	Land Surveying 1	Survey	6004	Unitec New Zealand Ltd
010547	Surveying Studies 1	Survey	6004	Unitec New Zealand Ltd
010548	Survey Computations 1	Survey	6004	Unitec New Zealand Ltd
010604	GIS - Applications in Design	GIS	6004	Unitec New Zealand Ltd
010704	Land Surveying 2	Survey	6004	Unitec New Zealand Ltd
010705	Surveying Project 1	Survey	6004	Unitec New Zealand Ltd
010706	Geodetic Surveying	Survey	6004	Unitec New Zealand Ltd
010707	Cadastral Surveying	Survey	6004	Unitec New Zealand Ltd
011038	Advcd Field Surveying NZ Biota	Survey	6004	Unitec New Zealand Ltd
011484	Surveying Software	Survey	6004	Unitec New Zealand Ltd
012156	Site Survey Preparatn Analysis	Survey	6004	Unitec New Zealand Ltd
012388	Surveying Computations A	Survey	6004	Unitec New Zealand Ltd
012389	Surveying Studies	Survey	6004	Unitec New Zealand Ltd
012391	Surveying Software	Survey	6004	Unitec New Zealand Ltd
012392	Surveying Computations B	Survey	6004	Unitec New Zealand Ltd
012393	Surveying Drawing Skills	Survey	6004	Unitec New Zealand Ltd
012446	Geodetic Surveying	Survey	6004	Unitec New Zealand Ltd
012449	Surveying Project	Survey	6004	Unitec New Zealand Ltd
3EN 18.301	Survey Software	Survey	6004	Unitec New Zealand Ltd

3EN 18.455	Land Surveying	Survey	6004	Unitec New Zealand Ltd
3EN 18.462	Introductory Surveying	Survey	6004	Unitec New Zealand Ltd
3EN 18.510	Cadastral Surveying	Survey	6004	Unitec New Zealand Ltd
3EN 18.512	Surveying	Survey	6004	Unitec New Zealand Ltd
3EN 18.608	Geodetic Surveying	Survey	6004	Unitec New Zealand Ltd
3EN 18.623	Remote Sensing	GIS	6004	Unitec New Zealand Ltd
3EN 18.627	Geographic Information Systems	GIS	6004	Unitec New Zealand Ltd
4CO 03.304	Land Surveyers	Survey	6004	Unitec New Zealand Ltd
4CO 03.452	Comm 2:Dip Quant Surv & Construct Mgmt	Survey	6004	Unitec New Zealand Ltd
DCVP700	CAD Visualisation and Presentation	GIS	6006	Ara Institute of Canterbury Ltd
ENV6.900	Geographical Information Systems	GIS	6007	Eastern Institute of Technology
ITGA7.100	GIS Analytics	GIS	6007	Eastern Institute of Technology
104 BI3CD312	Spatial Information Systems	GIS	6009	Universal College of Learning
BI3CD312	Spatial Information Systems	GIS	6009	Universal College of Learning
604.6743	Geographic Information Systems	GIS	6012	NorthTec
6641.6007	Geographic Information Systems	GIS	6012	NorthTec
CHH162.01	Introduction to GIS	GIS	6015	Southern Institute of Technology Ltd
DE4202.01	Land Surveying 1	Survey	6015	Southern Institute of Technology Ltd
DE6207.01	Land Surveying 2	Survey	6015	Southern Institute of Technology Ltd
EM202.01	Earth Science and Environmental Management	Survey	6015	Southern Institute of Technology Ltd
EM209.01	Geographic Information Systems	GIS	6015	Southern Institute of Technology Ltd

EM209.v10	Geographic Information Systems	GIS	6015	Southern Institute of Technology Ltd
ST5218 EM209	Geographic Information Systems	GIS	6015	Southern Institute of Technology Ltd
BIS5.131	Introduction to Geographic Information Systems	GIS	6017	Western Institute of Technology at Taranaki
BIS6.231	Geographical Information Systems Techniques	GIS	6017	Western Institute of Technology at Taranaki
GIS600	GIS & REMOTE SENSING	GIS	6017	Western Institute of Technology at Taranaki
GIS610	ADVANCED GIS TOPICS	GIS	6017	Western Institute of Technology at Taranaki
GIS700	GIS PROJECT	GIS	6017	Western Institute of Technology at Taranaki
FMAN.4001	Introduction to GIS and GPS	GIS	6018	Waiariki Institute of Technology
SVY1101	Geology and Surveying	Survey	6022	Open Polytechnic of New Zealand Ltd
SVY1103	Surveying B	Survey	6022	Open Polytechnic of New Zealand Ltd
SVY1104	Surveying Computations A	Survey	6022	Open Polytechnic of New Zealand Ltd
SVY1110	Introduction to GPS	Survey	6022	Open Polytechnic of New Zealand Ltd
SVY1500V1	Spatial Science for Engineers	GIS	6022	Open Polytechnic of New Zealand Ltd
SVY2905	Geology & Surveying Practice	Survey	6022	Open Polytechnic of New Zealand Ltd
ATBCNDS006	Survey Instruments: 23875	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS007A	Survey Measurement Practices: 23876	Survey	6025	Toi Ohomai Institute of Technology Ltd

ATBCNDS007B	Survey Measurement Practices: 23877	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS008	Survey Instruments and Measurement: 23880	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS009A	Survey Computations: 8799	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS009B	Survey Computations: 8801	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS010A	Maths in Surveying: 5268	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS010B	Maths in Surveying: 8800	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS015A	Cadastral Surveying: 23874	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS015B	Cadastral Surveying: 23885	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS016A	Survey Measurement Techniques: 8766	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS016B	Survey Measurement Techniques: 23873	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS018	Geodesy & Referencing Systems	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS018A	Geodesy and Referencing Systems: 23859	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS018B	Geodesy and Referencing Systems: 23860	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCNDS018C	Geodesy and Referencing Systems: 26298	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCZZCOP05	Geodesy & Referencing Systems	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCZZCOP05A	GEODESY & REFERENCING SYSTEMS: 23859	Survey	6025	Toi Ohomai Institute of Technology Ltd

ATBCZZCOP05B	GEODESY & REFERENCING SYSTEMS: 23860	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATBCZZCOP05C	GEODESY & REFERENCING SYSTEMS: 26298	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATDEDE4202	Land Surveying 1	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATDEDE5205	Engineering Surveying	Survey	6025	Toi Ohomai Institute of Technology Ltd
ATDEDE6207	Land Surveying 2	Survey	6025	Toi Ohomai Institute of Technology Ltd
BIOL3013	Marine Surveying	Survey	6025	Toi Ohomai Institute of Technology Ltd
BIOL5015	Marine Biology Surveying Techniques	Survey	6025	Toi Ohomai Institute of Technology Ltd
BIOL5020	Introductory Biological Surveying	Survey	6025	Toi Ohomai Institute of Technology Ltd
FMAN.4001	Introduction to GIS and GPS	GIS	6025	Toi Ohomai Institute of Technology Ltd
FMAN.5208	Forestry Statistics and Remote Sensing	GIS	6025	Toi Ohomai Institute of Technology Ltd
FMAN.5308	Remote Sensing and Statistics	GIS	6025	Toi Ohomai Institute of Technology Ltd
FORS5001	Remote Sensing	GIS	6025	Toi Ohomai Institute of Technology Ltd
GEOM5021	Cadastral Surveying	Survey	6025	Toi Ohomai Institute of Technology Ltd
GEOM5023	Survey Mathematics	Survey	6025	Toi Ohomai Institute of Technology Ltd
GEOM5024	Geographic Information Systems	GIS	6025	Toi Ohomai Institute of Technology Ltd
GEOM6017	Global Navigation Satellite System (GNSS)	Survey	6025	Toi Ohomai Institute of Technology Ltd

GEOM6018	Geodesy	Survey	6025	Toi Ohomai Institute of Technology Ltd
GEOM6019	Advanced Survey Mathematics	Survey	6025	Toi Ohomai Institute of Technology Ltd
MATH6002	Remote Sensing and Multivariate Statistics	GIS	6025	Toi Ohomai Institute of Technology Ltd
MATH7001	Remote Sensing	GIS	6025	Toi Ohomai Institute of Technology Ltd
580.09	Geographic Information Systems (GIS) - Special Topics Workshop	GIS	6506	Dunedin College of Education
430204	Geographic Data Analysis	GIS	7001	The University of Auckland
430317	Remote Sensing of the Environment	GIS	7001	The University of Auckland
430318	Geographic Information Analysis	GIS	7001	The University of Auckland
430319	Adapting GIS for Analysis	GIS	7001	The University of Auckland
430771	Spatial Analysis	GIS	7001	The University of Auckland
430772	Remote Sensing	GIS	7001	The University of Auckland
430773	GIS: Advanced Query & Display Systems	GIS	7001	The University of Auckland
430774	GIS and Modelling	GIS	7001	The University of Auckland
760338	Spec Topic:Geographic Information Systems	GIS	7001	The University of Auckland
COMPSCI716	Visualization	GIS	7001	The University of Auckland
EARTHSCI210	Introduction to GIS and Spatia	GIS	7001	The University of Auckland
GEOG 208	GIS and Human Environments	GIS	7001	The University of Auckland
GEOG103	Mapping Our World	GIS	7001	The University of Auckland
GEOG140	Geo Info and Spatial Thinking	GIS	7001	University of Auckland
GEOG204	Geographic Data Analysis	GIS	7001	The University of Auckland
GEOG204A	Geographic Data Analysis	GIS	7001	The University of Auckland
GEOG204B	Geographic Data Analysis	GIS	7001	The University of Auckland
GEOG208	GIS and Human Environments	GIS	7001	The University of Auckland

GEOG210	Intro to GIS & Spatial Thinking	GIS	7001	The University of Auckland
GEOG317	Remote Sensing and GIS	GIS	7001	The University of Auckland
GEOG318	GIS Principles and Practice	GIS	7001	The University of Auckland
GEOG319	GIS Project	GIS	7001	The University of Auckland
GEOG342	Tech, Society & Environment	GIS	7001	University of Auckland
GEOG770	GIS and Spatial Data Handling	GIS	7001	The University of Auckland
GEOG771	Spatial Analysis & Geocomputat	GIS	7001	The University of Auckland
GEOG772	Advanced Raster Data Analysis	GIS	7001	The University of Auckland
GEOG773	Visualisation and Cartography	GIS	7001	The University of Auckland
GEOG774	Advanced Spatial Data Handling	GIS	7001	The University of Auckland
GEOG779	Programming, GIS Customisation	GIS	7001	The University of Auckland
GISCI140	Geographic Info & Spatial Think	GIS	7001	University of Auckland
GISCI241	Principles of Remote Sensing	GIS	7001	University of Auckland
GISCI242	Principles of GIScience	GIS	7001	University of Auckland
GISCI243	Special Topic	GIS	7001	University of Auckland
GISCI341	Advanced Remote Sensing	GIS	7001	University of Auckland
GISCI343	GIScience Programming & Develop	GIS	7001	University of Auckland
GISCI344	Special Topic	GIS	7001	University of Auckland
GISCI390	Directed Study	GIS	7001	The University of Auckland
GISCI399	GIScience Capstone	GIS	7001	University of Auckland
PROPERTY773	GIS and Property Analysis	GIS	7001	The University of Auckland
516218	Remote Sensing	GIS	7002	University of Waikato
516328	Geographic Information Systems	GIS	7002	University of Waikato
516517	Advanced Geographic Information Systems	GIS	7002	University of Waikato
COMP532	Information Visualisation	GIS	7002	University of Waikato
EARTH251	Spatial Analysis in Geosciences	GIS	7002	University of Waikato

ENVP207	Spatial Analysis	GIS	7002	University of Waikato
ENVPL202	Cartography and Spatial Analysis	GIS	7002	University of Waikato
GEOG328	Geographic Information Systems	GIS	7002	University of Waikato
GEOG517	Advanced Geographic Information Systems	GIS	7002	University of Waikato
GEOG518	Advanced Cartographic Theory and Practice	GIS	7002	University of Waikato
GEOG528	Applied Geographic Information Systems for Research and Planning	GIS	7002	University of Waikato
GEOG538	Automated Spatial Analysis using Geographic Information Systems	GIS	7002	University of Waikato
GEOG548	Advanced Geographic Information Systems Modelling	GIS	7002	University of Waikato
GEOG558	Applied Geographic Information Systems for Research and Planning	GIS	7002	University of Waikato
GEOG568	Applications of Geographic Information Systems	GIS	7002	University of Waikato
GEOG590	Directed Study	GIS	7002	University of Waikato
GEOG591	Dissertation	GIS	7002	University of Waikato
GEOGY328	Geographical Information Systems	GIS	7002	University of Waikato
GEOGY538	Automated Spatial Analysis using Geographic Information Systems	GIS	7002	University of Waikato
GEOGY548	Advanced Geographic Information Systems Modelling	GIS	7002	University of Waikato
POPS591	Dissertation	GIS	7002	University of Waikato
32307	Advanced GIS	GIS	7003	Massey University
89761	Applied Remote Sensing	GIS	7003	Massey University
132106	Introduction to Geographic Information Systems	GIS	7003	Massey University
132206	Spatial Analysis using GIS	GIS	7003	Massey University
132207	Principles of GIS	GIS	7003	Massey University
132306	GIS in Practice	GIS	7003	Massey University

132307	Structured Programming for GIS	GIS	7003	Massey University
132322	GIS Practicum	GIS	7003	Massey University
132738	GIS Principles and Applications	GIS	7003	Massey University
132740	Geographic Information Systems Programming and Practice	GIS	7003	Massey University
145201	Quantitative Methods in Geo	GIS	7003	Massey University
145202	Working with Geographic Data	GIS	7003	Massey University
145739	GIS Principles and Applications	GIS	7003	Massey University
145740	GIS Programming and Practice	GIS	7003	Massey University
158740	Geoinformatics	GIS	7003	Massey University
158741	Location Data: Mapping, Analysis and Visualisation	GIS	7003	Massey University
189271	Remote Sensing	GIS	7003	Massey University
189274	Geographic Information Systems	GIS	7003	Massey University
189364	Land Eval & Geog Info Sys	GIS	7003	Massey University
189371	Advanced Remote Sensing	GIS	7003	Massey University
189374	Geographic Information Systems	GIS	7003	Massey University
189707	Env Remote Sensing	GIS	7003	Massey University
189761	Applied Remote Sensing	GIS	7003	Massey University
230705	Interpretation in Geospatial Analytics	GIS	7003	Massey University
233201	Remote Sensing	GIS	7003	Massey University
233204	Geographic Information Systems	GIS	7003	Massey University
233214	GIS and Spatial Statistics	GIS	7003	Massey University
233251	GIS and Remote Sensing	GIS	7003	Massey University
233301	Advanced Remote Sensing	GIS	7003	Massey University
233304	Geographic Information Systems	GIS	7003	Massey University
233314	Remote Sensing and Earth Observation	GIS	7003	Massey University

233706	Environmental Geographical Information Systems	GIS	7003	Massey University
233707	Environmental Remote Sensing	GIS	7003	Massey University
233712	Environmental Geographic Information Systems	GIS	7003	Massey University
CE09SCI051	Steven Mills The Geospatial Research Centre	GIS	7004	Victoria University of Wellington
GEOG115	Geog Interp:Design Cartography	Survey	7004	Victoria University of Wellington
GEOG215	Introduction to Geographic Information Systems (GIS) and Science	GIS	7004	Victoria University of Wellington
GEOG315	Advanced Geographic Information Systems (GIS)	GIS	7004	Victoria University of Wellington
GEOG415	Introduction to Geographic Information Science and its Applications	GIS	7004	Victoria University of Wellington
GEOG591	Thesis	GIS	7004	Victoria University of Wellington
GISC401	Foundations of Geographic Information Science	GIS	7004	Victoria University of Wellington
GISC402	GIScience Research	GIS	7004	Victoria University of Wellington
GISC403	Cartography and Geovisualisation	GIS	7004	Victoria University of Wellington
GISC404	Geospatial Analysis	GIS	7004	Victoria University of Wellington
GISC405	GIS Programming and Databases	GIS	7004	Victoria University of Wellington
GISC406	Remote Sensing for Earth Observation	GIS	7004	Victoria University of Wellington
GISC410	Special Topic	GIS	7004	Victoria University of Wellington
GISC411	Geographic Information Science in Health	GIS	7004	Victoria University of Wellington
GISC412	Spatial Algorithms and Programming	GIS	7004	Victoria University of Wellington

GISC413	Special Topic: Geomatic Data Acquisition Techniques	GIS	7004	Victoria University of Wellington
GISC415	Internship	GIS	7004	Victoria University of Wellington
GISC416	Special Topic:Conservation GIS	GIS	7004	Victoria University of Wellington
GISC420	Geographic Computing	GIS	7004	Victoria University of Wellington
GISC421	Geographic Information Science: Applications and Impact	GIS	7004	Victoria University of Wellington
GISC422	Spatial Analysis and Modelling	GIS	7004	Victoria University of Wellington
GISC423	Cartography and Geovisualisation	GIS	7004	Victoria University of Wellington
GISC424	Remote Sensing	GIS	7004	Victoria University of Wellington
GISC425	Special Topic: Geographical Computing	GIS	7004	Victoria University of Wellington
GISC426	Special Topic:	GIS	7004	Victoria University of Wellington
GISC427	Emerging Topics in GIS	GIS	7004	Victoria University of Wellington
GISC428	Directed Individual Study	GIS	7004	Victoria University of Wellington
GISC429	Internship	GIS	7004	Victoria University of Wellington
GISC511	Research Project	GIS	7004	Victoria University of Wellington
GISC512	Placement and Applied Research Project	GIS	7004	Victoria University of Wellington
GISC591	Thesis	GIS	7004	Victoria University of Wellington

GISC690	Thesis	GIS	7004	Victoria University of Wellington
MAOR203	Te Taunaha Whenua/Mapping Whenua	Survey	7004	Victoria University of Wellington
PHYG415	Special Topic A:	GIS	7004	Victoria University of Wellington
DIGI205	Introduction to Geographic Information Systems	GIS	7005	University of Canterbury
DRRE408	GIS for Disaster Risk and Resilience	GIS	7005	University of Canterbury
ENCI261	Surveying	GIS	7005	University of Canterbury
ENCI262	Survey, Transport and GIS	GIS	7005	University of Canterbury
ENCI462	Geographic Information Systems	GIS	7005	University of Canterbury
ENCN261	Transport and Surveying	GIS	7005	University of Canterbury
ENME651	Independent Course of Study: Geographic information systems for freight log	GIS	7005	University of Canterbury
ENNR202	Land Information Survey	GIS	7005	University of Canterbury
ENNR262	Resource Information and Surveying	GIS	7005	University of Canterbury
FORE216	Surveying and Information Technology in Forestry	GIS	7005	University of Canterbury
FORE342	Geospatial Science in Forest Monitoring and Management	GIS	7005	University of Canterbury
FORE601	Special Topic: GIS in Forestry	GIS	7005	University of Canterbury
GEOG205	Introduction to Geographic Information Systems	GIS	7005	University of Canterbury
GEOG208	Remote sensing for geospatial analysis	GIS	7005	University of Canterbury
GEOG313	Remote Sensing Data for Geographic Analysis	GIS	7005	University of Canterbury
GEOG323	Geospatial Analysis in the Social and Environmental Sciences	GIS	7005	University of Canterbury
GEOG324	Advanced GIS	GIS	7005	University of Canterbury
GEOG362	Special Topic Remote sensing and GIS	GIS	7005	University of Canterbury
GEOG405	Geomatics Project	GIS	7005	University of Canterbury

GEOG406	GeoVisualisation	GIS	7005	University of Canterbury
GEOG415	Geography Internship	GIS	7005	University of Canterbury
GEOG416	Special Topic: Spatial Data Analysis Techniques	GIS	7005	University of Canterbury
GEOG417	Special Topic: Customising GIS Techniques	GIS	7005	University of Canterbury
GEOG431	Geographical Information Systems: Concepts	GIS	7005	University of Canterbury
GEOG432	Applications of Geographical Information Systems	GIS	7005	University of Canterbury
GEOG433	Environmental Remote Sensing: Skills and Concepts	GIS	7005	University of Canterbury
GEOG434	Environmental Remote Sensing: Applications	GIS	7005	University of Canterbury
GEOG693	Geospatial Science and Technology Project	GIS	7005	University of Canterbury
GISC101	Introduction to Spatial Data Science	GIS	7005	University of Canterbury
GISC401	Foundations of Geographic Information Science	GIS	7005	University of Canterbury
GISC402	GI Science Research	GIS	7005	University of Canterbury
GISC403	Cartography and Geovisualisation	GIS	7005	University of Canterbury
GISC404	Spatial Analysis	GIS	7005	University of Canterbury
GISC405	GIS Programming and Databases	GIS	7005	University of Canterbury
GISC406	Remote Sensing for Earth Observation	GIS	7005	University of Canterbury
GISC411	Geographic Information Systems (GIS) in Health	GIS	7005	University of Canterbury
GISC412	Spatial Algorithms and Programming	GIS	7005	University of Canterbury
GISC413	Geomatic Data Acquisition Techniques	GIS	7005	University of Canterbury
GISC415	Geographic Information Systems (GIS) Internship	GIS	7005	University of Canterbury
GISC416	Conservation GIS	GIS	7005	University of Canterbury
GISC417	GIS Special Topic	GIS	7005	University of Canterbury
GISC422	Foundations of Geographic Information Systems	GIS	7005	University of Canterbury
GISC690	GISC Thesis	GIS	7005	University of Canterbury
PDIG17	Introduction to Geographic Inf	GIS	7005	University of Canterbury

000550	Env Anal w Geog Info Systems	GIS	7006	Lincoln University
000557	GIS and Applications in Natura	GIS	7006	Lincoln University
000927	ST: GIS Apps in NZ Biogeo	GIS	7006	Lincoln University
001187	Spatial Statistical Methods	GIS	7006	Lincoln University
002690	Special Topic:Intro. to GIS	GIS	7006	Lincoln University
002691	Special Topic:Adv Applics GIS	GIS	7006	Lincoln University
005351	Sp Top:Intro GIS - Nat Res Ass	GIS	7006	Lincoln University
005726	Adv Geographic Info Systems A	GIS	7006	Lincoln University
005727	Adv Geographic Info Systems B	GIS	7006	Lincoln University
006171	Prog & Customisation with GIS	GIS	7006	Lincoln University
EDUN065	GIS INTRODUCTION	GIS	7006	Lincoln University
ENGN075	SURVEYING AND STRUCTURES	GIS	7006	Lincoln University
ENNR202	Land Info Survey	GIS	7006	Lincoln University
ERST202	RES ANALYSIS GEOG INF SY	GIS	7006	Lincoln University
ERST310	ADV GIS & APPL NAT RES A	GIS	7006	Lincoln University
GIS	GIS Systems	GIS	7006	Lincoln University
QMET603	SPATIAL STATISTICAL METH	GIS	7006	Lincoln University
580.07	Geography - Geographic Information Systems - Through Investigations	GIS	7007	University of Otago
580.09	Geographic Information Systems (GIS) - Special Topics Workshop	GIS	7007	University of Otago
APPS597	Supervised Independent Study	GIS	7007	University of Otago
APPS598	Workplace-based Project	GIS	7007	University of Otago
GEOG290	Field Research Methods (Science)	Survey	7007	University of Otago
GEOG380	Field Research Studies	Survey	7007	University of Otago
GEOG495	Master's Thesis Preparation	GIS	7007	University of Otago

GISS5F	Geographic Information Systems MAppSc Full-time, Full-year	GIS	7007	University of Otago
GISS5FH	Geographic Information Systems MAppSc Full-time, Part-year	GIS	7007	University of Otago
GISS5H	Geographic Information Systems MAppSc Part-time, Full-year	GIS	7007	University of Otago
GISS5HQ	Geographic Information Systems MAppSc Part-time, Part-year	GIS	7007	University of Otago
INFO251	Spatial Data Structures	GIS	7007	University of Otago
INFO252	Spatial Knowledge Discovery	GIS	7007	University of Otago
INFO332	Spatial Information Systems	GIS	7007	University of Otago
SPIN201	Spatial Information Systems 1	GIS	7007	University of Otago
SPIN301	Spatial Information Systems 2	GIS	7007	University of Otago
SPIN401	Spatial Information Systems 3	GIS	7007	University of Otago
SPIN402	Geocomputational Methods	GIS	7007	University of Otago
SPIN5F	Geographic Information Systems Masters Full-time, Full-year	GIS	7007	University of Otago
SPIN5FH	Geographic Information Systems Masters Full-time, Part-year	GIS	7007	University of Otago
SPIN5FZ	Spatial Information Studies Thesis	GIS	7007	University of Otago
SPIN5H	Geographic Information Systems Masters Part-time, Full-year	GIS	7007	University of Otago
SPIN5HQ	Geographic Information Systems Masters Part-time, Part-year	GIS	7007	University of Otago
SPIN5HZ	Spatial Information Studies Thesis	GIS	7007	University of Otago
SURV101	Introductory Surveying	GIS	7007	University of Otago
SURV102	Geospatial Science	GIS	7007	University of Otago
SURV103	Communication	Survey	7007	University of Otago
SURV111	Introductory Surveying	Survey	7007	University of Otago

SURV112	Computational Methods for Surveyors	Survey	7007	University of Otago
SURV113	Communication	Survey	7007	University of Otago
SURV114	Introduction to Land Administration and Planning	Survey	7007	University of Otago
SURV169	Special Topic	Survey	7007	University of Otago
SURV201	Surveying Methods 1	Survey	7007	University of Otago
SURV202	Surveying Mathematics	Survey	7007	University of Otago
SURV203	Land Development Engineering 1	Survey	7007	University of Otago
SURV204	Land Development Engineering 2	Survey	7007	University of Otago
SURV205	Statutory Planning A	Survey	7007	University of Otago
SURV206	Land Tenure 1	Survey	7007	University of Otago
SURV207	Cadastral Surveying 1	Survey	7007	University of Otago
SURV208	Introduction to Geographic Information Systems	GIS	7007	University of Otago
SURV209	Research Methods in Surveying	Survey	7007	University of Otago
SURV211	Surveying Methods 1	Survey	7007	University of Otago
SURV212	Surveying Mathematics	Survey	7007	University of Otago
SURV213	Land Development 1A	Survey	7007	University of Otago
SURV214	Land Development 1B	Survey	7007	University of Otago
SURV215	Statutory Planning	Survey	7007	University of Otago
SURV216	Land Tenure Studies 1	Survey	7007	University of Otago
SURV217	Cadastral Surveying 1	Survey	7007	University of Otago
SURV218	Spatial Data in Surveying	Survey	7007	University of Otago
SURV298	Introductory Field Camp	Survey	7007	University of Otago
SURV299	Second Year Field Course	Survey	7007	University of Otago
SURV301	Surveying Methods 2	Survey	7007	University of Otago
SURV302	Geodetic Reference Systems and Network Analysis	Survey	7007	University of Otago

SURV303	Urban Design 1	Survey	7007	University of Otago
SURV304	Land Development Engineering 3	Survey	7007	University of Otago
SURV305	Statutory Planning 2	Survey	7007	University of Otago
SURV306	Land Tenure 2	Survey	7007	University of Otago
SURV307	Cadastral Surveying 2	Survey	7007	University of Otago
SURV309	Introduction to Remote Sensing Technologies	GIS	7007	University of Otago
SURV310	Spatial Databases	GIS	7007	University of Otago
SURV311	Surveying Methods 2	Survey	7007	University of Otago
SURV312	Geodetic Reference Systems and Network Analysis	Survey	7007	University of Otago
SURV315	Land Development 2	Survey	7007	University of Otago
SURV316	Land Tenure Studies 2	Survey	7007	University of Otago
SURV317	Cadastral Surveying 2	Survey	7007	University of Otago
SURV318	Introduction to Remote Sensing Technologies	GIS	7007	University of Otago
SURV319	Spatial Algorithms and Programming	GIS	7007	University of Otago
SURV321	Engineering Surveying	Survey	7007	University of Otago
SURV322	Hydrographic Surveying	Survey	7007	University of Otago
SURV323	Photogrammetry 1	GIS	7007	University of Otago
SURV324	Land Development Engineering 3	Survey	7007	University of Otago
SURV325	Financial Aspects of Land Development	Survey	7007	University of Otago
SURV326	Special Topics 1	Survey	7007	University of Otago
SURV329	Special Topic	Survey	7007	University of Otago
SURV330	Special Topic	Survey	7007	University of Otago
SURV331	Spatial Data in Environmental Science	GIS	7007	University of Otago
SURV332	Spatial Information Systems	GIS	7007	University of Otago
SURV335	Resource Consent Practice	Survey	7007	University of Otago

SURV380	Project	Survey	7007	University of Otago
SURV399	Third Year Field Course	Survey	7007	University of Otago
SURV401	Surveying Methods 3	Survey	7007	University of Otago
SURV403	Project Management	Survey	7007	University of Otago
SURV404	Subdivisional Design 2	Survey	7007	University of Otago
SURV405	Land Planning and the Environment	Survey	7007	University of Otago
SURV407	Cadastral Surveying 3	Survey	7007	University of Otago
SURV408	Professional Studies	Survey	7007	University of Otago
SURV410	Management Issues in Geographic Information Systems	GIS	7007	University of Otago
SURV411	Spatial Analysis and Modelling	GIS	7007	University of Otago
SURV412	Geovisualisation and Cartography	GIS	7007	University of Otago
SURV413	Resource Mapping and Image Processing	GIS	7007	University of Otago
SURV414	Advanced Photogrammetry	GIS	7007	University of Otago
SURV418	Professional Studies	Survey	7007	University of Otago
SURV421	Advanced Surveying Methods	Survey	7007	University of Otago
SURV422	Advanced Hydrographic Surveying	Survey	7007	University of Otago
SURV423	Advanced Photogrammetry	GIS	7007	University of Otago
SURV424	Resource Mapping and Image Processing	GIS	7007	University of Otago
SURV425	Advanced Urban Design	Survey	7007	University of Otago
SURV426	Advanced Land Tenure Studies	Survey	7007	University of Otago
SURV427	Advanced Cadastral Surveying	Survey	7007	University of Otago
SURV428	Environmental Engineering	Survey	7007	University of Otago
SURV429	Marine Law and the Environment	Survey	7007	University of Otago
SURV430	Special Topic	Survey	7007	University of Otago
SURV431	Advanced Engineering Surveying	Survey	7007	University of Otago

SURV432	Construction Management	Survey	7007	University of Otago
SURV450	Professional Practice	Survey	7007	University of Otago
SURV451	Surveying Methods 3	Survey	7007	University of Otago
SURV452	Hydrographic Surveying 2	Survey	7007	University of Otago
SURV453	Urban Design 2	Survey	7007	University of Otago
SURV454	Environmental Engineering	Survey	7007	University of Otago
SURV455	Statutory Planning B	Survey	7007	University of Otago
SURV456	Land Tenure 3	Survey	7007	University of Otago
SURV457	Cadastral Surveying 3	Survey	7007	University of Otago
SURV458	Marine Law and the Environment	Survey	7007	University of Otago
SURV459	Engineering Surveying	Survey	7007	University of Otago
SURV460	Construction Management	Survey	7007	University of Otago
SURV462	Hydrographic Field Design and Voyage	Survey	7007	University of Otago
SURV463	Advanced Practical Techniques in Hydrography	Survey	7007	University of Otago
SURV469	Special Topic:	Survey	7007	University of Otago
SURV470	Professional Project	Survey	7007	University of Otago
SURV472	GIS Management and Operations	GIS	7007	University of Otago
SURV473	Special Topic	Survey	7007	University of Otago
SURV474	Special Topic	Survey	7007	University of Otago
SURV475	Special Topic	Survey	7007	University of Otago
SURV476	Special Topic	Survey	7007	University of Otago
SURV477	Special Topic	Survey	7007	University of Otago
SURV478	Special Topic	Survey	7007	University of Otago
SURV480	Research Project	Survey	7007	University of Otago
SURV481	Research Project	Survey	7007	University of Otago
SURV482	Research Report	Survey	7007	University of Otago

SURV483	Research Project (for BAppSc)	Survey	7007	University of Otago
SURV490	Dissertation	Survey	7007	University of Otago
SURV495	Masters Thesis Preparation	GIS	7007	University of Otago
SURV498	Work Experience	Survey	7007	University of Otago
SURV499	Vacation Employment	Survey	7007	University of Otago
SURV508	Spatial Databases	GIS	7007	University of Otago
SURV509	Introduction to Remote Sensing Technologies	GIS	7007	University of Otago
SURV510	Management Issues in Geographic Information Systems	GIS	7007	University of Otago
SURV511	Spatial Analysis and Modelling	GIS	7007	University of Otago
SURV512	Geovisualisation and Cartography	GIS	7007	University of Otago
SURV513	Resource Mapping and Image Processing	GIS	7007	University of Otago
SURV514	Advanced Photogrammetry	GIS	7007	University of Otago
SURV515	GIS Programming in Python	GIS	7007	University of Otago
SURV519	Spatial Algorithms and Programming	GIS	7007	University of Otago
SURV551	Advanced Surveying Methods	Survey	7007	University of Otago
SURV552	Advanced Hydrographic Surveying	Survey	7007	University of Otago
SURV553	Advanced Urban Design	Survey	7007	University of Otago
SURV554	Advanced Environmental Engineering	Survey	7007	University of Otago
SURV555	Advanced Statutory Planning	Survey	7007	University of Otago
SURV556	Advanced Land Tenure	Survey	7007	University of Otago
SURV557	Advanced Cadastral Surveying	Survey	7007	University of Otago
SURV558	Advanced Marine Law and the Environment	Survey	7007	University of Otago
SURV559	Advanced Engineering Surveying	Survey	7007	University of Otago
SURV562	Hydrographic Field Design and Voyage	Survey	7007	University of Otago
SURV563	Advanced Practical Techniques in Hydrography	Survey	7007	University of Otago

SURV569	Special Topic	GIS	7007	University of Otago
SURV573	Special Topic	GIS	7007	University of Otago
SURV574	Special Topic	Survey	7007	University of Otago
SURV575	Special Topic	Survey	7007	University of Otago
SURV576	Advanced Special Topic	Survey	7007	University of Otago
SURV577	Advanced Special Topic	Survey	7007	University of Otago
SURV578	Advanced Special Topic	Survey	7007	University of Otago
SURV580	Research project	Survey	7007	University of Otago
SURV590	Dissertation	GIS	7007	University of Otago
SURV591	Dissertation	Survey	7007	University of Otago
SURV5AF	Master of Surveying Thesis Full-time, Full-year	Survey	7007	University of Otago
SURV5AH	Master of Surveying Thesis Part-time, Full-year	Survey	7007	University of Otago
SURV5AP	Master of Surveying Thesis Full-time, Part-year	Survey	7007	University of Otago
SURV5AQ	Master of Surveying Thesis Part-time, Part-year	Survey	7007	University of Otago
SURV5F	Surveying MSc Thesis Full-time, Full-year	Survey	7007	University of Otago
SURV5FH	Surveying MSc Thesis Full-time, Part-year	Survey	7007	University of Otago
SURV5H	Surveying MSc Thesis Part-time, Full-year	Survey	7007	University of Otago
SURV5HQ	Surveying MSc Thesis Part-time, Part-year	Survey	7007	University of Otago
SURV5HZ	Surveying Masters thesis	Survey	7007	University of Otago
SURV9F	Surveying PhD Thesis Full-time, Full-year	GIS	7007	University of Otago
SURV9FH	Surveying PhD Thesis Full-time, Part-year	GIS	7007	University of Otago
SURV9H	Surveying PhD Thesis Part-time, Full-year	GIS	7007	University of Otago
SURV9HQ	Surveying PhD Thesis Part-time, Part-year	GIS	7007	University of Otago
115002	Introduction to Spatial Computing	GIS	7008	Auckland University of Technology (AUT)
409226	Geocomputation	GIS	7008	Auckland University of Technology (AUT)

777315	GIS - Geographical Information Systems	GIS	7008	Auckland University of Technology (AUT)
778040	Applications of Geographical Information Systems	GIS	7008	Auckland University of Technology (AUT)
779005	Advanced Applications in Geographic Information Systems	GIS	7008	Auckland University of Technology (AUT)
ARDN630	Spatial Systems	GIS	7008	Auckland University of Technology (AUT)
COMP817	Geocomputation	GIS	7008	Auckland University of Technology (AUT)
ENVS621	Geographic Information Systems	GIS	7008	Auckland University of Technology (AUT)
ENVS721	Geo-spatial analysis	GIS	7008	Auckland University of Technology (AUT)
ENVS723	Remote Sensing	GIS	7008	Auckland University of Technology (AUT)
ENVS801	Applications of Geographical Information Systems	GIS	7008	Auckland University of Technology (AUT)
ENVS802	Advanced Applications in Geographic Information Systems	GIS	7008	Auckland University of Technology (AUT)
ENVS803	GIS and Programming	GIS	7008	Auckland University of Technology (AUT)
ENVS804	Geospatial Science for Conservation	GIS	7008	Auckland University of Technology (AUT)
ENVS808	Geospatial Internship	GIS	7008	Auckland University of Technology (AUT)
GISC401	Foundations of Geographic Information Science	GIS	7008	Auckland University of Technology (AUT)
GISC402	GIS Research	GIS	7008	Auckland University of Technology (AUT)
GISC403	Cartography and Geovisualisation	GIS	7008	Auckland University of Technology (AUT)

GISC404	Geospatial Analysis	GIS	7008	Auckland University of Technology (AUT)
GISC405	GIS Programming and Databases	GIS	7008	Auckland University of Technology (AUT)
GISC406	Remote Sensing for Earth Observation	GIS	7008	Auckland University of Technology (AUT)
GISC411	Geographic Information Science (GIS) in Health	GIS	7008	Auckland University of Technology (AUT)
GISC412	Spatial Algorithms and Programming	GIS	7008	Auckland University of Technology (AUT)
GISC413	Special Topic: Geomatic Data Acquisition Techniques	GIS	7008	Auckland University of Technology (AUT)
GISC415	Internship	GIS	7008	Auckland University of Technology (AUT)
GISC416	Special Topic in Conservation GIS	GIS	7008	Auckland University of Technology (AUT)
GISC592	MGIS Thesis Sub-paper (F/T)	GIS	7008	Auckland University of Technology (AUT)
GISC593	MGIS Thesis Sub-paper (P/T)	GIS	7008	Auckland University of Technology (AUT)
GISC594	MGIS Thesis Extension 0.25 EFTS	GIS	7008	Auckland University of Technology (AUT)
GISC595	MGIS Thesis Extension 0.167 EFTS	GIS	7008	Auckland University of Technology (AUT)
GISC801	Specialist Readings: Conservation GIS	GIS	7008	Auckland University of Technology (AUT)
GIS	GIS Systems	GIS	8505	Telford Rural Polytechnic
TAI244	Tai244 Introduction to Geographic Information Systems	GIS	9386	Te Whare Wananga o Awanuiarangi

Appendix 3: National Certificate of Educational Achievement (NCEA)

National Certificate of Educational Achievement (NCEA) is administered by the New Zealand Qualifications Authority (NZQA). Secondary school students normally obtain three levels of NCEA during secondary school: Level 1, level 2, and level 3. Generally, secondary school students in year 11 will study for NCEA level 1 and obtain their qualification that same year and year 12 and 13 (final year) students normally study and achieve levels 2 and 3 respectively. However, students may leave secondary school before completing year 11 or year 12. NCEA qualifications are not required to leave school. In Aotearoa New Zealand, a school year begins in either January or February and ends in December of any given year.

NCEA qualifications are gained through credits in Aotearoa New Zealand. A student needs 80 credits to achieve each NCEA level, alongside additional literacy and numeracy requirements. Level 1 requires 80 credits at any NCEA level. Level 2 requires 60 credits at level 2 or above, and 20 credits from any level. Level 3 requires 60 credits at level 3 or above and 20 credits from level 2 or above. Credits are gained by completing standards. For example, NCEA level 2 Geography includes standard 91240 worth 4 credits at NCEA level 2. Between 18 and 25 credits in different subjects (e.g. Maths or Geography) are needed to pass that subject.

A merit (M) endorsement for a standard signifies the student not only achieved the standard but did very well, whereas an excellence (E) endorses outstanding work. For example, if a student performs outstandingly in standard 91240, they will be awarded 4 “achieved with excellence” level 2 credits. When a student does not achieve a standard, they are not awarded any credits. Merit or excellence endorsed credits can contribute to a subject endorsement and an overall qualification endorsement. For a merit or excellence subject endorsement, students need to achieve 14 or more merit or excellence credits in that subject within a year. For an overall qualification endorsement (NCEA level 1, 2, and 3), students need 50 merit or excellence endorsed credits across all subjects within that particular level. For example, NCEA level 2 with merit requires 50 or more level 2 merit or excellence credit.

To attend a university in Aotearoa New Zealand, students also need the University Entrance (UE) qualification, which is also administered by NZQA. UE requires an NCEA level 3 qualification, 10 literacy credits at NCEA level 2 or above, 10 numeracy credits, and three approved NCEA level 3 subjects. The credits needed for UE are usually gained at the same time a student is studying for their NCEA level 3 qualification without additional study. For certain tertiary programmes, a student may require NCEA achievement or endorsements in certain subjects and standards, as well as UE. Those aged 20 or over can apply for special admission to university without UE.

Students typically complete a particular NCEA qualification within one school year. However, credits for an NCEA qualification can be obtained over any number of years and all credits gained remain valid. Since studying for an NCEA qualification level is not restricted by time or year level, analysing the secondary school student data within this document requires certain assumptions.

Appendix 4: Data assumptions for NCEA and Tertiary Comparisons

To make effective comparisons, we made the following assumptions regarding tertiary and NCEA data.

1. A bachelor's degree programme takes 3 years to complete.
2. A postgraduate programme takes 4 years to complete after leaving secondary school (3 years for a bachelor's degree programme then 1 year for postgraduate programme).
3. A postgraduate programme takes 1 year to complete after a bachelor's degree programme.
4. Postgraduate students went into their postgraduate programme the year after their final year of their bachelor's degree programme.
5. A postgraduate programme with GIS specialisation takes 1 year to complete after a bachelor's degree programme.
6. A postgraduate student with 75% or more total course hours in GIS are specialising in GIS.
7. Secondary school students go directly to university the year after completing NCEA level 3.
8. Students enrolled in spatial analysis standards completed all three NCEA level qualifications consecutively.
9. Students take 1 year to complete each NCEA qualification excluding University Entrance (UE).
10. Students gain their UE qualification in the same year they gain their NCEA level 3 qualification and finish year 13.
11. Students only take standards that correspond with their year level.

Appendix 5: Competency Models

Competency gaps exist between the demands of the geospatial industry and the geospatial workforce (Doyle, 2020). Competency models provide a list of competencies for employers to use to identify competencies a candidate needs for a certain role (Doyle, 2020). This section describes the geospatial competency models used throughout the report including why and how they are used. The background information provided by this section on these competency models will aid to better understand the methods and limitations of analysing course provisions and course contents throughout the report.

Two major geospatial science and technology competency models have been created to address these gaps:
1. The Geospatial Technology Competency Model (GTCM) by the U.S. Department of Labor (DoLETA), Employment and Training Administration (https://www.careeronestop.org/competencymodel/competency-models/geospatial-technology.aspx).
2. The Geographic Information Science & Technology Body of Knowledge (GIS&T BoK) by the University Consortium for Geographic Information Science (UCGIS) (http://gistbok.ucgis.org/).

Khan et al. (2016) cites the GTCM by DoLETA and the GIS&T BoK by UCGIS as the two foundations of best practice. Du Plessis & Niekerk (2014) describes the GIS&T BoK as the most effective. There is a general lack of consensus of what competencies are most important (Gaudet et al., 2003), however it is agreed that soft skills are just as important as geospatial specific skills (de Róiste, 2014; Hong, 2016; Solem et al., 2008). The GTCM by DoLETA includes soft skills within its competency list, whereas the GIS&T BoK does not. In this report, we will use both the GTCM by DoLETA and the GIS&T BoK as they both have different strengths and weaknesses and each can be applied better depending on the situation. There is an emphasis on the technical competencies of the GIS&T BoK and the soft skills of the GTCM in this report.

The GTCM by DoLETA was first created in 2003 due to a growing demand for geospatial workers (Doyle, 2020). The GTCM consists of tiers, which are then made up of competencies. The GTCM is still similar to its original form at its conception, despite minor changes in 2018 (Doyle, 2020). The GIS&T BoK was originally created in 2006, with an updated digital version launching in 2016 (University Consortium for Geographic Information Science [UCGIS], n.d.). The BoK consists of knowledge areas made up of units which are made up of topics. Some consider all these units as essential knowledge to be competent in geospatial science (Du Plessis & Niekerk, 2014). The BoK is continually updated with new units (UCGIS, n.d.). Both of these models have their caveats. The GIS&T BoK focus is considered to have a particular emphasis on the requirements of the USA's geospatial industry, and should be modified to meet international requirements (Prager & Plewe, 2009; Du Plessis & Niekerk, 2014). A survey concluded that 12 technical competencies in the GTCM were considered inadequate by 62% of participants (DiBiase et al., 2010).

Studies by de Róiste (2014), Hong (2016) and Solem et al. (2008) concluded that although technical competencies such as database development, query skills, and programming skills were considered important by employers, soft skills such as communication, writing, problem solving, presenting, and foundational knowledge in Geography were considered just as desirable amongst employers. Therefore, we used the GIS&T BoK to address the technical competencies desired in geospatial workers and the GTCM by DoLETA to address the general competencies desired in geospatial workers throughout this report.

Appendix 6: Geospatial Courses in Aotearoa New Zealand

Institution	Code	Title	Category
Auckland University of Technology	ENVS 805	Advances in Remote Sensing	Analytics & Modeling
Auckland University of Technology	COMP 817	Geocomputation	Analytics & Modeling
Auckland University of Technology	ENVS 806	Advances in Geospatial Analysis	Analytics & Modeling
Auckland University of Technology	ENVS 721	Geo-spatial analysis	Analytics & Modeling
Eastern Institute of Technology	ITGA7 .100	GIS Analytics	Analytics & Modeling
University of Canterbury	GISC4 04	Spatial Analysis	Analytics & Modeling
University of Canterbury	GEOG 323	Geospatial Analysis in the Social and Environmental Sciences	Analytics & Modeling
University of Auckland	GEOG 771	Spatial Analysis and Geocomputation	Analytics & Modeling
University of Auckland	GEOG 772	Advanced Raster Data Analysis	Analytics & Modeling
University of Otago	SURV 411	Advanced Spatial Analysis and Modelling	Analytics & Modeling
University of Otago	SURV 511	Advanced Spatial Analysis and Modelling	Analytics & Modeling
University of Waikato	GEOG Y548	Advanced Geographic Information Systems Modelling	Analytics & Modeling
Victoria University of Wellington	GISC4 22	Spatial Analysis and Modelling	Analytics & Modeling
Auckland University of Technology	ENVS 801	Applications of Geographical Information Systems	Applied GIS/GISc

Auckland University of Technology	ENVS 802	Advanced Applications in Geographic Information Systems	Applied GIS/GISc
Lincoln University	ERST 310	GIS and Applications in Natural Resource Analysis	Applied GIS/GISc
Lincoln University	ERST 202	Environmental Analysis with Geographic Information Systems	Applied GIS/GISc
Massey University of New Zealand	233712	Environmental Geographic Information Systems	Applied GIS/GISc
NorthTec: Tai Tokerau Wānanga	NSCI7736	Applied Geographic Information Systems	Applied GIS/GISc
University of Canterbury	GISC411	Spatial Analytics for Health, Society and Environment	Applied GIS/GISc
Unitec Institute of Technology	NSCI7736	Applied Geographic Information Systems	Applied GIS/GISc
University of Waikato	GEOGY558	Applied Geographic Information Systems for Research and Planning	Applied GIS/GISc
University of Canterbury	GEOG693	Geospatial Science and Technology Project	Capstone
Unitec Institute of Technology	ENCE6212	Surveying Project	Capstone
University of Auckland	GISCI399	Capstone: GIScience	Capstone
University of Otago	SURV470	Professional Project	Capstone
Massey University of New Zealand	145300	Cartography and Data Visualisation	Cartography & Visualization
Unitec Institute of Technology	ENCE5206	Surveying Drawing Skills	Cartography & Visualization
University of Otago	SURV512	Geovisualisation and Cartography	Cartography & Visualization
University of Otago	SURV412	Geovisualisation and Cartography	Cartography & Visualization
Victoria University of Wellington	GISC423	Cartography and Geovisualisation	Cartography & Visualization
Auckland University of Technology	ENVS 723	Remote Sensing	Data Capture

Massey University of New Zealand	189761	Applied Remote Sensing	Data Capture
Massey University of New Zealand	233713	Environmental Remote Sensing	Data Capture
Massey University of New Zealand	233301	Advanced Remote Sensing	Data Capture
Massey University of New Zealand	233314	Remote Sensing and Earth Observation	Data Capture
University of Canterbury	GISC413	Geomatic Data Acquisition Techniques	Data Capture
University of Canterbury	GISC406	Remote Sensing for Earth Observation	Data Capture
University of Canterbury	GEOG208	Remote sensing for geospatial analysis	Data Capture
University of Auckland	GISCI241	Principles of Remote Sensing	Data Capture
University of Auckland	GISCI341	Remote Sensing of Surface Processes	Data Capture
University of Otago	SURV509	Introduction to Remote Sensing Technologies	Data Capture
University of Otago	SURV513	Resource Mapping and Image Processing	Data Capture
University of Otago	SURV309	Introduction to Remote Sensing Technologies	Data Capture
University of Otago	SURV413	Resource Mapping and Image Processing	Data Capture
Victoria University of Wellington	GISC424	Remote Sensing	Data Capture
University of Auckland	GEOG774	Advanced Spatial Data Handling	Data Management
Auckland University of Technology	ENVS804	Geospatial Science for Conservation	Domain Applications
University of Canterbury	FORE642	Advanced IT Applications in Forestry and Natural Resource Management	Domain Applications
University of Canterbury	ENME651	Independent Course of Study: Geographic information systems for freight logistics	Domain Applications

University of Canterbury	DRRE 408	GIS for Disaster Risk and Resilience	Domain Applications
University of Canterbury	ENTR 616	Transport Planning and Modelling	Domain Applications
University of Canterbury	FORE 141	Forest Growth and Measurements	Domain Applications
University of Canterbury	FORE 342	Geospatial Science in Forest Monitoring and Management	Domain Applications
University of Canterbury	ENNR 320	Integrated Catchment Analysis	Domain Applications
Unitec Institute of Technology	ENGG DE52 05	Engineering Surveying	Domain Applications
Unitec Institute of Technology	ENCE 6208	Land Development 2	Domain Applications
Unitec Institute of Technology	ENCE 6213	Land Development 1	Domain Applications
University of Otago	SURV 552	Advanced Hydrographic Surveying	Domain Applications
University of Otago	SURV 559	Advanced Engineering Surveying	Domain Applications
University of Otago	SURV 459	Engineering Surveying	Domain Applications
University of Waikato	ENVP L309	Urban Spatial Analysis	Domain Applications
University of Waikato	EART H251	Applied Earth Sciences	Domain Applications
Victoria University of Wellington	MAOR 203	Te Taunaha Whenua/Mapping Whenua	Domain Applications
Unitec Institute of Technology	ENCE 4201	Surveying Computations A	Earth Geometry & Geodesy
Unitec Institute of Technology	ENCE 5210	Surveying Computations B	Earth Geometry & Geodesy
University of Otago	SURV 202	Surveying Mathematics	Earth Geometry & Geodesy
University of Otago	SURV 302	Geodetic Reference Systems and Network Analysis	Earth Geometry & Geodesy

Auckland University of Technology	ENVS 702	GIS - Geographical Information Systems	GIS
Eastern Institute of Technology	ENV6.900	Geographic Information Systems	GIS
Lincoln University	ERST 606	Advanced Geographic Information Systems A	GIS
Lincoln University	ERST 607	Advanced Geographic Information Systems B	GIS
Massey University of New Zealand	145739	GIS Principles and Applications	GIS
Massey University of New Zealand	145202	Working With Geographic Data	GIS
NorthTec: Tai Tokerau Wānanga	6007	Geographic Information Systems	GIS
University of Canterbury	GEOG 324	Web GIS and Geoinformatics	GIS
Unitec Institute of Technology	NSCI6743	Geographic Information Systems	GIS
University of Auckland	GEOG 770	GIS and Spatial Data Handling	GIS
University of Waikato	GEOGY328	Geographical Information Systems	GIS
Victoria University of Wellington	GEOG 315	Advanced Geographic Information Systems (GIS)	GIS
Auckland University of Technology	ENVS 808	Geospatial Internship	GIS Internship/Work Placement
University of Canterbury	GISC415	Geographic Information Systems (GIS) Internship	GIS Internship/Work Placement
Victoria University of Wellington	GISC429	Internship	GIS Internship/Work Placement
Victoria University of Wellington	GISC512	Placement and Applied Research Project	GIS Internship/Work Placement
Unitec Institute of Technology	ENCE 5203	Land Administration 1	GIS&T & Society

University of Otago	SURV 450	Professional Practice	GIS&T & Society
Victoria University of Wellington	GISC4 21	Geographic Information Science: Applications and Impact	GIS&T & Society
Auckland University of Technology	ENVS 807	Geospatial Customisation and Visualisation	GISc
Massey University of New Zealand	15874 0	Location Systems: Spatial Databases, Tools and Applications	GISc
Massey University of New Zealand	15874 1	Location Data: Mapping, Analysis and Visualisation	GISc
University of Auckland	GISCI 242	Principles of GIScience	GISc
Auckland University of Technology	ENVS 621	Geographic Information Systems	Intro GIS/GISc
Massey University of New Zealand	23321 4	GIS and Spatial Statistics	Intro GIS/GISc
Southern Institute of Technology	EM20 9	Geographic Information Systems (Offered under Bachelor of Environmental Management or Graduate Diploma in Environmental Management)	Intro GIS/GISc
University of Canterbury	GISC1 01	Introduction to Spatial Data Science	Intro GIS/GISc
University of Canterbury	GISC4 22	Foundations of Geographic Information Systems	Intro GIS/GISc
University of Canterbury	GEOG 205	Introduction to Geographic Information Systems and Science	Intro GIS/GISc
University of Auckland	GEOG 103G	Mapping Our World	Intro GIS/GISc
University of Auckland	GISCI 140	Geographic Information and Spatial Thinking	Intro GIS/GISc
University of Otago	SURV 102	Geospatial Science	Intro GIS/GISc
University of Otago	SURV 208	Introduction to Geographic Information Systems	Intro GIS/GISc
University of Waikato	GEOG Y228	Introduction to Geographical Information Systems and Big Data	Intro GIS/GISc
Victoria University of Wellington	GEOG 415	Introduction to Geographic Information Science and its Applications	Intro GIS/GISc

Victoria University of Wellington	GEOG 215	Introduction to Geographic Information Systems (GIS) and Science	Intro GIS/GISc
Unitec Institute of Technology	ENCE 5202	Surveying Studies	Intro Surveying
University of Otago	SURV 101	Introductory Surveying	Intro Surveying
Auckland University of Technology	ENVS 803	GIS and Programming	Programming & Development
Massey University of New Zealand	145740	GIS Programming and Practice	Programming & Development
University of Canterbury	GISC405	GIS Programming and Databases	Programming & Development
University of Canterbury	GISC412	Spatial Data Science	Programming & Development
University of Auckland	GISCI 343	GIScience Programming and Development	Programming & Development
University of Otago	SURV 519	Spatial Algorithms and Programming	Programming & Development
University of Otago	SURV 319	Spatial Algorithms and Programming	Programming & Development
University of Waikato	GEOG Y538	Auckland University of Technologyomated Spatial Analysis using Geographic Information Systems	Programming & Development
Victoria University of Wellington	GISC420	Geographic Computing	Programming & Development
University of Canterbury	GISC402	GI Science Research	Research Methods
Unitec Institute of Technology	ENCE 5204	Surveying Software	Surveying
Unitec Institute of Technology	ENGGDE4202	Land Surveying 1	Surveying
Unitec Institute of Technology	ENGGDE620	Land Surveying 2	Surveying
University of Otago	SURV 551	Advanced Surveying Methods	Surveying
University of Otago	SURV 557	Advanced Cadastral Surveying	Surveying

University of Otago	SURV 201	Surveying Methods 1	Surveying
University of Otago	SURV 207	Cadastral Surveying 1	Surveying
University of Otago	SURV 301	Surveying Methods 2	Surveying
University of Otago	SURV 307	Cadastral Surveying 2	Surveying
University of Otago	SURV 451	Surveying Methods 3	Surveying
University of Otago	SURV 457	Cadastral Surveying 3	Surveying
University of Otago	SURV 480	Research Project	Thesis/Research
Victoria University of Wellington	GISC511	Research Project	Thesis/Research
Victoria University of Wellington	GISC591	Thesis	Thesis/Research

Appendix 7: Overseas Geospatial Courses

Country	Institution	Code	Title	Category
AUS	Flinders University	STEM3003/STEM8004	Modelling in Space and Time, Geostatistics and GIS GE	Analytics & Modeling
AUS	RMIT University	GEOM2152	GIS Analytics	Analytics & Modeling
AUS	RMIT University	GEOM1057	Spatial Information Science Analytics	Analytics & Modeling
AUS	University of Southern Queensland	GIS3405	Spatial Analysis and Modelling	Analytics & Modeling
AUS	University of Tasmania	KGG370	Analysis of Observations	Analytics & Modeling
AUS	University of Tasmania	KGG375	GIS: Advanced Spatial Analysis	Analytics & Modeling
AUS	University of Tasmania	KGG212	GIS: Spatial Analysis	Analytics & Modeling
AUS	The University of Western Australia	ENVT5566	Advanced Spatial and Environmental Modelling	Analytics & Modeling
AUS	RMIT University	GEOM2083	Applied Geospatial Techniques	Applied GIS/GISc
AUS	RMIT University	GEOM5188C	Apply GIS software to spatial problems	Applied GIS/GISc
AUS	University of Southern Queensland	GIS3008	Applications of GIS and Remote Sensing	Applied GIS/GISc
AUS	University of Tasmania	KGG540	Environmental Geographic Information Science B	Applied GIS/GISc
AUS	University of Tasmania	KGG541	Environmental Geographic Information Science C	Applied GIS/GISc

AUS	RMIT University	GEOM2114	Geospatial Science Major Project A	Capstone
AUS	RMIT University	GEOM2121	Survey Network Design and Analysis	Capstone
AUS	RMIT University	GEOM2077	Cartography 1	Cartography & Visualization
AUS	RMIT University	GEOM2079/ GEOM2080	Cartography 2	Cartography & Visualization
AUS	RMIT University	GEOM5191C	Design and produce maps	Cartography & Visualization
AUS	RMIT University	COSC6249C	Develop 2-D and 3-D terrain visualisations	Cartography & Visualization
AUS	RMIT University	GEOM5147C	Prepare and present GIS data	Cartography & Visualization
AUS	University of Southern Queensland	GIS1401	Geographic Data Presentation	Cartography & Visualization
AUS	Flinders University	STEM2003/S TEM8006	Airborne Remote Sensing and Photogrammetry GE	Data Capture
AUS	Flinders University	STEM1003/S TEM8008	GIS Airborne and Ground Data Capture for all Disciplines GE	Data Capture
AUS	Flinders University	STEM2001/S TEM8003	Remote Sensing for all Disciplines GE	Data Capture
AUS	RMIT University	GEOM5186C	Collect spatial data using a total station	Data Capture
AUS	RMIT University	GEOM5140C	Collect spatial data using GNSS	Data Capture
AUS	RMIT University	COSC6207C	Collect spatial data using terrestrial technologies	Data Capture
AUS	RMIT University	GEOM5193C	Conduct advanced GNSS control surveys	Data Capture

AUS	RMIT University	GEOM5194C	Conduct advanced remote sensing analysis	Data Capture
AUS	RMIT University	GEOM5149C	Conduct GNSS surveys	Data Capture
AUS	RMIT University	GEOM5192C	Digitally enhance and process image data	Data Capture
AUS	RMIT University	GEOM2139	GPS Mapping	Data Capture
AUS	RMIT University	PHYS2088	Physics of Satellite Measurement	Data Capture
AUS	RMIT University	GEOM1009/ GEOM2128	Remote Sensing	Data Capture
AUS	RMIT University	GEOM2066	Satellite Positioning	Data Capture
AUS	RMIT University	GEOM5148C	Plan spatial data collection	Data Capture
AUS	University of Southern Queensland	SVY1110	Introduction to Global Positioning System	Data Capture
AUS	University of Southern Queensland	SVY3202	Photogrammetry and Remote Sensing	Data Capture
AUS	University of Southern Queensland	GIS3406	Remote Sensing and Image Processing	Data Capture
AUS	University of Tasmania	KGG543	Advanced Earth Observation	Data Capture
AUS	University of Tasmania	KGG542	Environmental Remote Sensing A	Data Capture
AUS	University of Tasmania	KGG306	Global Navigation Satellite Systems	Data Capture
AUS	University of Tasmania	KGG546	Global Navigation Satellite Systems	Data Capture

AUS	University of Tasmania	KGG330	Remote Sensing: Drone Photogrammetry	Data Capture
AUS	University of Tasmania	KGG544	Remote Sensing: Drone Photogrammetry	Data Capture
AUS	University of Tasmania	KGG213	Remote Sensing: Image Analysis	Data Capture
AUS	University of Tasmania	KGG103	Remote Sensing: Introduction	Data Capture
AUS	The University of Western Australia	GEOG3301	Advanced GIS and Remote Sensing	Data Capture
AUS	The University of Western Australia	ENVT4409	Remote Sensing of the Environment	Data Capture
AUS	RMIT University	GEOM5189C	Create spatial data	Data Management
AUS	RMIT University	ISYS1055/IS YS1057	Database Concepts	Data Management
AUS	RMIT University	COSC6209C	Develop spreadsheets for spatial data	Data Management
AUS	RMIT University	GEOM5190C	Maintain spatial data	Data Management
AUS	RMIT University	GEOM5144C	Store and retrieve spatial data	Data Management
AUS	RMIT University	GEOM5158C	Plan and implement spatial projects	Design & Implementation of a GIS&T
AUS	University of Southern Queensland	SVY4309	Practice Management for Spatial Scientists	Design & Implementation of a GIS&T
AUS	RMIT University	GEOM5195C	Conduct complex engineering set-out surveys	Domain Applications
AUS	RMIT University	GEOM1060/ GEOM2063	Engineering Surveying	Domain Applications

AUS	RMIT University	GEOM5155C	Produce maps for land management purposes	Domain Applications
AUS	University of Southern Queensland	SVY2303	Construction Surveying	Domain Applications
AUS	University of Southern Queensland	SVY2302	Mine Surveying	Domain Applications
AUS	University of Southern Queensland	SVY1500	Spatial Science for Engineers	Domain Applications
AUS	University of Tasmania	KLA534/KLA381	Agricultural Landscape systems	Domain Applications
AUS	The University of Western Australia	EART3353	Geological Mapping	Domain Applications
AUS	The University of Western Australia	ENVT5562	GIS and Spatial Analysis: Coastal Resilience	Domain Applications
AUS	The University of Western Australia	ENVT5564	GIS and Spatial Analysis: Contaminated Sites	Domain Applications
AUS	The University of Western Australia	ENVT5561	GIS and Spatial Analysis: Multifunctional Landscapes	Domain Applications
AUS	The University of Western Australia	ENVT5565	GIS and Spatial Analysis: Sensor Networks	Domain Applications
AUS	The University of Western Australia	ENVT5563	GIS and Spatial Analysis: Waterway Restoration	Domain Applications
AUS	RMIT University	GEOM5153C	Conduct geodetic surveys	Earth Geometry & Geodesy
AUS	RMIT University	GEOM2119/GEOM2120	Geodesy	Earth Geometry & Geodesy
AUS	RMIT University	GEOM5152C	Perform geodetic surveying computations	Earth Geometry & Geodesy

AUS	Flinders University	STEM2004/STEM8007	Advanced Geographical Information Systems GE	GIS
AUS	RMIT University	GEOM2151	Advanced GIS	GIS
AUS	RMIT University	GEOM2138	Advanced Spatial Information Science	GIS
AUS	RMIT University	GEOM5157C	Coordinate GIS data manipulation and analysis	GIS
AUS	RMIT University	GEOM1163	GIS Principles	GIS
AUS	RMIT University	OFFC5350C	Operate spatial software applications	GIS
AUS	RMIT University	GEOM1044	Spatial Information Science Principles	GIS
AUS	University of Southern Queensland	GPL2901	GIS and Planning Practice 1	GIS
AUS	University of Southern Queensland	GPL3902	GIS and Planning Practice 2	GIS
AUS	RMIT University	GEOM2163	Geospatial Science Work Experience 1	GIS Internship/Work Placement
AUS	RMIT University	GEOM2164	Geospatial Science Work Experience 2	GIS Internship/Work Placement
AUS	RMIT University	GEOM2116	Professional Practice	GIS&T & Society
AUS	University of Tasmania	KGG505	Surveying Practice	GIS&T & Society
AUS	Flinders University	STEM1002/STEM8002	Introduction to Geographical Information Systems GE	Intro GIS/GISc
AUS	RMIT University	GEOM1159	GIS Fundamentals	Intro GIS/GISc
AUS	RMIT University	GEOM1033	Spatial Information Science Fundamentals	Intro GIS/GISc

AUS	University of Southern Queensland	GIS1402	Geographic Information Systems	Intro GIS/GISc
AUS	University of Tasmania	KGG102	GIS: Introduction	Intro GIS/GISc
AUS	University of Tasmania	KGG539	Introduction to Geographic Information Systems	Intro GIS/GISc
AUS	University of Tasmania	KGG315	Introduction to Surveying and Spatial Sciences	Intro GIS/GISc
AUS	The University of Western Australia	GEOG2201	Geographic Information Systems	Intro GIS/GISc
AUS	The University of Western Australia	ENVT4411	Geographic Information Systems Applications	Intro GIS/GISc
AUS	RMIT University	GEOM2088	Introduction to Surveying	Intro Surveying
AUS	University of Southern Queensland	SVY1102	Surveying A	Intro Surveying
AUS	University of Tasmania	KGG255	Surveying 1	Intro Surveying
AUS	RMIT University	PHYS1080	Surveying Programming	Programming & Development
AUS	University of Southern Queensland	GIS3407	GIS Programming and Visualisation	Programming & Development
AUS	University of Southern Queensland	GIS4407	Web Based Geographic Information System	Programming & Development
AUS	The University of Western Australia	ENVT4408	GIS Programming	Programming & Development
AUS	RMIT University	BUIL6451C	Plan and conduct field surveying operations	Surveying

AUS	RMIT University	GEOM2101	Cadastral Surveying 1	Surveying
AUS	RMIT University	?	Cadastral Surveying 2	Surveying
AUS	RMIT University	GEOM5197C	Conduct precision surveys	Surveying
AUS	RMIT University	GEOM2093	GNSS Surveying	Surveying
AUS	RMIT University	GEOM5184C	Operate surveying equipment	Surveying
AUS	RMIT University	GEOM5151C	Perform advanced surveying computations	Surveying
AUS	RMIT University	GEOM5181C	Perform simple surveying and spatial computations	Surveying
AUS	RMIT University	?	Plane Surveying and Computations	Surveying
AUS	RMIT University	GEOM5185C	Produce basic plans of surveys	Surveying
AUS	RMIT University	GEOM2091	Terrestrial Surveying	Surveying
AUS	University of Southern Queensland	SVY3400	Advanced Surveying	Surveying
AUS	University of Southern Queensland	SVY2301	Automated Surveying Systems	Surveying
AUS	University of Southern Queensland	SVY3304	Cadastral Surveying	Surveying
AUS	University of Southern Queensland	SVY2106	Geodetic Surveying A	Surveying
AUS	University of Southern Queensland	SVY3107	Geodetic Surveying B	Surveying
AUS	University of Southern Queensland	SVY1104	Survey Computations A	Surveying

AUS	University of Southern Queensland	SVY2105	Survey Computations B	Surveying
AUS	University of Southern Queensland	SVY1901	Surveying and Spatial Science Practice 1	Surveying
AUS	University of Southern Queensland	SVY2902	Surveying and Spatial Science Practice 2	Surveying
AUS	University of Southern Queensland	SVY2903	Surveying and Spatial Science Practice 3	Surveying
AUS	University of Southern Queensland	SVY3904	Surveying and Spatial Science Practice 4	Surveying
AUS	University of Tasmania	KGG220	Surveying 2	Surveying
AUS	University of Tasmania	KGG320	Surveying 3	Surveying
GER	Friedrich Schiller Universität Jena	GEO 408A	Advanced Statistics for Geospatial Modelling	Analytics & Modeling
GER	Friedrich Schiller Universität Jena	GEOG 311	Geographic Information Science Projekt	Analytics & Modeling
GER	Friedrich Schiller Universität Jena	MUGM005	Geoststatistics and Geoinformation Systems	Analytics & Modeling
GER	Friedrich Schiller Universität Jena	GEOG 211	Introduction to Spatial Analysis Using GIS	Analytics & Modeling
GER	Friedrich Schiller Universität Jena	GEO 408B	Machine Learning for Geospatial Modelling	Analytics & Modeling
GER	Friedrich Schiller Universität Jena	GEO 403	Spatial Analysis Using GIS	Analytics & Modeling
GER	Jade Hochschule	?	GIS (Analyse)	Analytics & Modeling

GER	Jade Hochschule	?	Vertiefung räumliche Datenanalyse und Statistik	Analytics & Modeling
GER	Jade Hochschule	?	Vertiefung räumliche Datenanalyse und Statistik	Analytics & Modeling
GER	Technische Universität Berlin	60299	Adjustment Theory and Transformation of Geodetic Networks	Analytics & Modeling
GER	Technische Universität Berlin	61438	Advanced Methods for Geospatial Analysis	Analytics & Modeling
GER	Technische Universität Berlin	61433	Geo Data Science	Analytics & Modeling
GER	Technische Universität Berlin	61048	GIS Geoinformatics 2	Analytics & Modeling
GER	Technische Universität Berlin	61439	Selected Sections of Geoinformatics	Analytics & Modeling
GER	Technische Universität Berlin	61437	Semantic 3D/4D City Models	Analytics & Modeling
GER	Universität Trier	MA6ES047	GEOSPATIAL DATA ANALYSIS: ADVANCED GIS	Analytics & Modeling
GER	Universität Trier	MA6ES046	GEOSPATIAL DATA ANALYSIS: ADVANCED GIS & TIME SERIES ANALYSIS	Analytics & Modeling
GER	Jade Hochschule	?	GIS-Anwendungen	Applied GIS/GISc
GER	Jade Hochschule	?	Mobilitätsanalysen mit GIS	Applied GIS/GISc
GER	Technische Universität Dresden	13-F0-M012	Umweltinformationssysteme	Applied GIS/GISc
GER	Universität Trier	BA3GAR2019	ANWENDUNGEN DER GEOINFORMATIK	Applied GIS/GISc
GER	Jade Hochschule	?	Einführungsprojekt GIS	Capstone

GER	Jade Hochschule	?	Projekt (Hauptvermessungsübung)	Capstone
GER	Jade Hochschule	?	Projekt Geoinformatik	Capstone
GER	Jade Hochschule	?	Projekt Photogrammetrie	Capstone
GER	Jade Hochschule	?	Projekt Visualisierung	Capstone
GER	Technische Universität Berlin	61436	Project Geoinformatics	Capstone
GER	Technische Universität Dresden	13-H0-M043	Projekt Erdmessung	Capstone
GER	Technische Universität Dresden	13-G0-M019	Projekt Fernerkundung und Bildanalyse	Capstone
GER	Universität Trier	BA6AGI2015	STUDIENPROJEKT GEOINFORMATIK	Capstone
GER	Friedrich Schiller Universität Jena	GEOG 143	Cartography	Cartography & Visualization
GER	Jade Hochschule	?	CAD und Visualisierung	Cartography & Visualization
GER	Jade Hochschule	?	Kartographie	Cartography & Visualization
GER	Jade Hochschule	?	Kartographische Informationsverarbeitung	Cartography & Visualization
GER	Jade Hochschule	?	Seminar Kartographie	Cartography & Visualization
GER	Technische Universität Berlin	61283	Kartierung	Cartography & Visualization
GER	Technische Universität Berlin	60356	Visualisierungstechniken für Umweltwissenschaften und Entwicklung des städtischen Freiraums	Cartography & Visualization

GER	Universität Trier	MA6GIC1022	CARTOGRAPHICAL COMMUNICATION	Cartography & Visualization
GER	Universität Trier	BA6FWB4306	GEOVISUALISIERUNG	Cartography & Visualization
GER	Universität Trier	BA6AGI2028	GEOVISUALISIERUNG I	Cartography & Visualization
GER	Universität Trier	MA6ANG2023	GEOVISUALISIERUNG II	Cartography & Visualization
GER	Universität Trier	MA6GIC1024	GEOVISUALIZATION	Cartography & Visualization
GER	Universität Trier	BA6AGI2006	GRUNDLAGEN DER KARTOGRAPHIE	Cartography & Visualization
GER	Universität Trier	MA6GIC1007	INTRODUCTION TO 3D VISUALIZATION	Cartography & Visualization
GER	Universität Trier	BA3GAR2011	KARTOGRAPHIE	Cartography & Visualization
GER	Universität Trier	MA3GARC2012	KARTOGRAPHISCHES PROJEKTSTUDIUM 1	Cartography & Visualization
GER	Friedrich Schiller Universität Jena	GEOG 214	Advanced Methods in Remote Sensing	Data Capture
GER	Friedrich Schiller Universität Jena	GEO 420	Atmospheric Remote Sensing	Data Capture
GER	Friedrich Schiller Universität Jena	GEO 418	Hyperspectral Remote Sensing	Data Capture
GER	Friedrich Schiller Universität Jena	GEOG 112	Introduction to Applied Remote Sensing	Data Capture
GER	Friedrich Schiller Universität Jena	GEOG 312	Introduction to Radar Remote Sensing	Data Capture

GER	Friedrich Schiller Universität Jena	GEO 436	Introduction to Radar Remote Sensing	Data Capture
GER	Friedrich Schiller Universität Jena	GEO 402	Land Surface Parameters	Data Capture
GER	Friedrich Schiller Universität Jena	GEO 409	Remote Sensing Data Exploration Techniques	Data Capture
GER	Friedrich Schiller Universität Jena	GEO 411	Surfacemanagement and remote sensing	Data Capture
GER	Jade Hochschule	?	Einführung in die Fernerkundung	Data Capture
GER	Jade Hochschule	?	Fernerkundung I	Data Capture
GER	Jade Hochschule	?	Fernerkundung II	Data Capture
GER	Jade Hochschule	?	Geodatenerfassung I	Data Capture
GER	Jade Hochschule	?	Geodatenerfassung II	Data Capture
GER	Jade Hochschule	?	Nahbereichsphotogrammetrie	Data Capture
GER	Jade Hochschule	?	Photogrammetrie	Data Capture
GER	Jade Hochschule	?	Photogrammetrie und Fernerkundung	Data Capture
GER	Jade Hochschule	?	Photogrammetrische Informationsverarbeitung	Data Capture
GER	Jade Hochschule	?	Raumbeobachtung	Data Capture
GER	Jade Hochschule	?	Seminar Photogrammetrie	Data Capture
GER	Jade Hochschule	?	Sensorik	Data Capture
GER	Jade Hochschule	?	Topographie	Data Capture

GER	Jade Hochschule	?	Vermessungskunde	Data Capture
GER	Technische Universität Berlin	60285	Engineering Geodesy	Data Capture
GER	Technische Universität Berlin	60358	Fernerkundung	Data Capture
GER	Technische Universität Berlin	61442	GNSS Remote Sensing	Data Capture
GER	Technische Universität Berlin	61450	GNSS Signal Processing and Data Communication	Data Capture
GER	Technische Universität Berlin	61449	Methodology of Positioning and Navigation with GNSS	Data Capture
GER	Technische Universität Berlin	40566	Microwave and Radar Remote Sensing	Data Capture
GER	Technische Universität Berlin	40628	Photogrammetric Computer Vision	Data Capture
GER	Technische Universität Dresden	13-G0-M010	Fernerkundung I	Data Capture
GER	Technische Universität Dresden	13-G0-M018	Fusion in Photogrammetry and Remote Sensing	Data Capture
GER	Technische Universität Dresden	13-H0-M020	GNSS und Bahnbestimmung	Data Capture
GER	Technische Universität Dresden	13-G0-M012	Image Analysis	Data Capture
GER	Technische Universität Dresden	13-H0-M041	Integrierte Navigation	Data Capture
GER	Technische Universität Dresden	13-B1-M049	Messtechnik - Datenerfassung und Geoinformationssysteme (BIG)	Data Capture

GER	Technische Universität Dresden	13-G0-M006	Photogrammetric Computer Vision	Data Capture
GER	Technische Universität Dresden	13-G0-M013	Remote Sensing II	Data Capture
GER	Technische Universität Dresden	13-H0-M044	Satellitengeodäsie	Data Capture
GER	Technische Universität Dresden	13-H0-M038	Satellitennavigation (GNSS)	Data Capture
GER	Universität Trier	MA3GARC2009	3D-GEODATENERFASSUNG UND DIGITALE PHOTOGRAMMETRIE	Data Capture
GER	Universität Trier	MA6ES016	ADVANCED REMOTE SENSING DATA PROCESSING AND ANALYSIS	Data Capture
GER	Universität Trier	MA6GIC1011	ADVANCED REMOTE SENSING DATA PROCESSING AND INTERPRETATION	Data Capture
GER	Universität Trier	BA6FWB4305	AUSWERTUNG VON SATELLITENBILDDATEN ZUR UMWELTBEWERTUNG	Data Capture
GER	Universität Trier	MA6GIC1012	ECOSYSTEM REMOTE SENSING AND MODELLING	Data Capture
GER	Universität Trier	MA6ES006	FUNDAMENTALS OF ENVIRONMENTAL REMOTE SENSING	Data Capture
GER	Universität Trier	BA6FWB4303	GRUNDLAGEN DER FERNERKUNDUNG	Data Capture
GER	Universität Trier	MA6GIC1023	LIDAR REMOTE SENSING FOR ENVIRONMENTAL OBSERVATION AND MONITORING	Data Capture
GER	Universität Trier	MA3GARC2015	LIDAR-FERNERKUNDUNG ZUR UMWELTBEOBACHTUNG	Data Capture

GER	Universität Trier	BA6FWB4304	METHODEN DER SATELLITENGESTÜTZTEN ERDBEOBACHTUNG	Data Capture
GER	Universität Trier	MA6ES021	MONITORING AND REMOTE SENSING IN METEOROLOGY	Data Capture
GER	Universität Trier	MA6GIC1025	RASTER DATA PROCESSING AND IMAGE ENHANCEMENT TECHNIQUES	Data Capture
GER	Universität Trier	MA6GIC1021	REMOTE SENSING OF GLOBAL CHANGE PROCESSES	Data Capture
GER	Universität Trier	MA6ES023	SVAT MODELS AND INTEGRATION OF REMOTE SENSING DATA	Data Capture
GER	Universität Trier	MA6ES018	ECOSYSTEM REMOTE SENSING AND MODELLING CONCEPTS	Data Capture
GER	Friedrich Schiller Universität Jena	GEO 450	Earth Observation data processing using the open source software GRASS GIS	Data Capture
GER	Friedrich Schiller Universität Jena	GEO 417	Geo Data Infrastructure (GDI) Concepts in Earth Observation and Earth System Science	Data Management
GER	Friedrich Schiller Universität Jena	GEO 413	Geodatabases	Data Management
GER	Friedrich Schiller Universität Jena	GEOG 213	Spatial Data and Databases	Data Management
GER	Jade Hochschule	?	Datenbanken	Data Management
GER	Jade Hochschule	?	Geodatenmanagement	Data Management
GER	Jade Hochschule	?	GIS (Standards und Dienste)	Data Management
GER	Technische Universität Berlin	61432	Geodatabases and Infrastructures	Data Management

GER	Technische Universität Dresden	13-B1-M010	Geodatenbanken I	Data Management
GER	Technische Universität Dresden	13-B1-M020	Geodatenbanken II	Data Management
GER	Universität Trier	BA6AGI2007	DATENBANKSYSTEME	Data Management
GER	Universität Trier	BA6AGI2029	GEODATENBANKEN	Data Management
GER	Friedrich Schiller Universität Jena	GEOG 433	GIS-based Environmental Change Analysis	Domain Applications
GER	Technische Universität Dresden	13-B2-J003	GIS and Applications to Urban Development	Domain Applications
GER	Technische Universität Dresden	13-B2-M012	Projekt Landmanagement und Geoinformation	Domain Applications
GER	Technische Universität Dresden	13-02-M014	Wasserbauliche und Geodätische Exkursion	Domain Applications
GER	Jade Hochschule	?	Geodäsie im System Erde	Earth Geometry & Geodesy
GER	Jade Hochschule	?	Geodätische Beiträge zur Klima- und Erdsystemforschung	Earth Geometry & Geodesy
GER	Jade Hochschule	?	Ingenieurgeodäsie und Industrielle Messtechnik I	Earth Geometry & Geodesy
GER	Jade Hochschule	?	Physikalische Geodäsie	Earth Geometry & Geodesy
GER	Jade Hochschule	?	Referenzsysteme und Transformationen	Earth Geometry & Geodesy
GER	Jade Hochschule	?	Seminar Geodäsie	Earth Geometry & Geodesy

GER	Technische Universität Berlin	60199	FOU Introduction to Satellite Geodesy	Earth Geometry & Geodesy
GER	Technische Universität Berlin	50120	Introduction to Satellite Geodesy	Earth Geometry & Geodesy
GER	Technische Universität Berlin	61440	Introduction to Space Geodesy	Earth Geometry & Geodesy
GER	Technische Universität Dresden	13-B1-M050	Einführung in die Geodätische Messtechnik	Earth Geometry & Geodesy
GER	Technische Universität Dresden	13-H0-M036	Erdmessung und Bezugssysteme	Earth Geometry & Geodesy
GER	Technische Universität Dresden	13-H0-M039	Geodätische Bezugssysteme	Earth Geometry & Geodesy
GER	Technische Universität Dresden	13-H0-M040	Geodätische Erdsystembeobachtung	Earth Geometry & Geodesy
GER	Technische Universität Dresden	13-B1-M051	Geodätische Messtechnik I	Earth Geometry & Geodesy
GER	Technische Universität Dresden	13-B1-M052	Geodätische Messtechnik II	Earth Geometry & Geodesy
GER	Technische Universität Dresden	13-H0-M042	Physikalische Geodäsie	Earth Geometry & Geodesy
GER	Technische Universität Dresden	13-H0-M037	Positionierung und Navigation	Earth Geometry & Geodesy
GER	Universität Trier	BA6AGI2008	GEODÄTISCHE METHODEN	Earth Geometry & Geodesy
GER	Technische Universität Berlin	60672	Datenanalyse, Kartographie & Geoinformationssysteme	GIS
GER	Technische Universität Berlin	61277	Geodaten	GIS

GER	Technische Universität Berlin	60023	Geodaten und GIS	GIS
GER	Technische Universität Berlin	61435	Geographical Information Systems	GIS
GER	Technische Universität Berlin	61431	Geoinformatics	GIS
GER	Technische Universität Berlin	60331	Geoinformation Systems	GIS
GER	Technische Universität Berlin	61055	GIS Geographical Information Systems B	GIS
GER	Technische Universität Dresden	?	Geoinformationssysteme I	GIS
GER	Technische Universität Dresden	11-.02-.2248	Geoinformationssysteme II	GIS
GER	Technische Universität Dresden	13-B2-M009	Geoinformationssysteme II	GIS
GER	Technische Universität Dresden	11-.02-.2212	Geoinformationssysteme III	GIS
GER	Jade Hochschule	?	Grundlagen räumlichen Denkens: Ansätze, Theorien, Methodologien	GIS&T & Society
GER	Technische Universität Dresden	13-B1-M056	Geoinformationsrecht I	GIS&T & Society
GER	Technische Universität Dresden	13-B1-M057	Geoinformationsrecht II	GIS&T & Society
GER	Jade Hochschule	?	Geobasisdaten	GISc
GER	Jade Hochschule	?	Grundkonzepte von räumlichen Informationen	GISc

GER	Technische Universität Dresden	13-B1-M017	Geodätisches Seminar	GISc
GER	Universität Trier	BA3GAR2013	GEOINFORMATIK I	GISc
GER	Friedrich Schiller Universität Jena	GEOG 146	Geoinformationsystems	Intro GIS/GISc
GER	Friedrich Schiller Universität Jena	GEOG 111	Introduction to Geographic Information Science	Intro GIS/GISc
GER	Jade Hochschule	?	GIS (Einführung)	Intro GIS/GISc
GER	Technische Universität Berlin	60224/61184	Einführung in die Geoinformationsverarbeitung	Intro GIS/GISc
GER	Universität Trier	MA3GARC2014	ADVANCED METHODS IN GIS AND APPLICATIONS	Intro GIS/GISc
GER	Universität Trier	BA6FWB4301	EINFÜHRUNG IN DIE GEOINFORMATIK	Intro GIS/GISc
GER	Universität Trier	BA6AGI2001	GRUNDLAGEN DER GEOINFORMATIK	Intro GIS/GISc
GER	Universität Trier	MA6ES013	INTRODUCTION TO GEOINFORMATICS	Intro GIS/GISc
GER	Friedrich Schiller Universität Jena	GEO 404	Applied Geographic Information Science	Programming & Development
GER	Friedrich Schiller Universität Jena	GEO 401	Geospatial Software Development	Programming & Development
GER	Friedrich Schiller Universität Jena	GEO 406	Web-based Information Systems	Programming & Development
GER	Jade Hochschule	?	GIS-Programmierung	Programming & Development
GER	Jade Hochschule	?	Programmieren geodätischer Aufgaben	Programming & Development

GER	Technische Universität Berlin	61434	Deep Learning for Geographical Data	Programming & Development
GER	Universität Trier	MA6GIC1001	COMPUTER PROGRAMMING FOR GIS	Programming & Development
GER	Jade Hochschule	?	Landesvermessung	Surveying
GER	Technische Universität Berlin	60984	Vermessungskunde für die Beruflichen Fachrichtungen	Surveying
GER	Technische Universität Berlin	60945	Masterarbeit Geodesy and Geoinformation Science	Thesis/Research
GER	Technische Universität Dresden	13-00-MTGG	Masterthesis Geodäsie und Geoinformation	Thesis/Research
IRE	National Centre for Geocomputation	NCG603A	ADVANCED TOPICS IN GEOCOMPUTATION	Analytics & Modeling
IRE	National Centre for Geocomputation	GY672	ANALYSING SPATIAL AND TEMPORAL DATA USING R	Analytics & Modeling
IRE	National Centre for Geocomputation	NCG602A	METHODS & TECHNIQUES IN GEOCOMPUTATION	Analytics & Modeling
IRE	National University of Ireland, Galway	PAB5127	Geospatial Analysis and Remote Sensing	Analytics & Modeling
IRE	Trinity College Dublin	?	Spatial Analysis using GIS	Analytics & Modeling
IRE	Technological University Dublin	?	GIS Modelling	Analytics & Modeling
IRE	Technological University Dublin	?	Spatial Analysis	Analytics & Modeling
IRE	Technological University Dublin	?	Spatial Data Analytics	Analytics & Modeling

IRE	Technological University Dublin	?	Statistics for Geo Surveying	Analytics & Modeling
IRE	University College Cork	GG6536	Geospatial Data Analysis	Analytics & Modeling
IRE	University College Dublin	GEOL40570	Geocomputation	Analytics & Modeling
IRE	Dublin City University	GY331	Environmental GIS	Applied GIS/GISc
IRE	Dundalk Institute of Technology	ENVR S8007	Environmental Field Studies and GIS	Applied GIS/GISc
IRE	Dundalk Institute of Technology	ENVR S8019	Environmental Monitoring and GIS	Applied GIS/GISc
IRE	Galway-Mayo Institute of Technology	?	Applied Geographic Information Systems	Applied GIS/GISc
IRE	Galway-Mayo Institute of Technology	?	Geographic Information Systems 2	Applied GIS/GISc
IRE	Technological University Dublin	?	Applied Geographical Information Systems	Applied GIS/GISc
IRE	Technological University Dublin	?	Case Studies in GI Applications	Applied GIS/GISc
IRE	University College Cork	GG6505	Applications of Geoinformatics	Applied GIS/GISc
IRE	University College Dublin	AESC40420	Geographic Information Systems	Applied GIS/GISc
IRE	University College Dublin	GEOG40770	GIS for Environmental Assessment	Applied GIS/GISc

IRE	University College Dublin	GEOG40850	GIS for Environmental Investigations	Applied GIS/GISc
IRE	University of Limerick	ER4002	ENVIRONMENTAL MODELLING & GIS 1	Applied GIS/GISc
IRE	University of Limerick	ER4003	ENVIRONMENTAL MODELLING & GIS 2	Applied GIS/GISc
IRE	National Centre for Geocomputation	NCG607	GEOGRAPHIC INFORMATION SCIENCE IN PRACTISE	Capstone
IRE	Technological University Dublin	?	Map Design & Map Production	Cartography & Visualization
IRE	University College Cork	GG6535	Data Visualisation	Cartography & Visualization
IRE	Munster Technological University - Kerry	INFO81006	GIS Field Data Capture & Project Generation with QFIELD	Data Capture
IRE	National Centre for Geocomputation	GY641	AERIAL SURVEYS AND DRONE OPERATIONS	Data Capture
IRE	National Centre for Geocomputation	GY314	ENVIRONMENTAL REMOTE SENSING	Data Capture
IRE	National Centre for Geocomputation	GY643	MARINE REMOTE SENSING- INFOMAR	Data Capture
IRE	National Centre for Geocomputation	GY642	SATELLITE REMOTE SENSING AND EARTH OBSERVATION	Data Capture
IRE	Technological University Dublin	?	Earth Observation (EO)	Data Capture
IRE	Technological University Dublin	?	Photogrammetry	Data Capture
IRE	Technological University Dublin	?	Satellite Surveying (GNSS)	Data Capture

IRE	Technological University Dublin	?	Spatial Data Acquisition	Data Capture
IRE	Technological University Dublin	?	Spatial Data Acquisition 1 (GNSS & Coordinate Reference Systems)	Data Capture
IRE	Technological University Dublin	?	Spatial Data Acquisition 2 (Remote Sensing Technologies)	Data Capture
IRE	University College Cork	?	Digital image Processing	Data Capture
IRE	University College Cork	GG3041	Environmental Remote Sensing	Data Capture
IRE	University College Cork	GG6502	Introduction to Remote Sensing	Data Capture
IRE	University College Dublin	GEOG10140	Remote Sensing	Data Capture
IRE	University College Dublin	GEOL40580	Remote Sensing	Data Capture
IRE	Dundalk Institute of Technology	ENVR S8012	Data Handling and GIS	Data Management
IRE	National Centre for Geocomputation	CS621C	SPATIAL DATABASES	Data Management
IRE	Technological University Dublin	?	Advanced Spatial Data Management	Data Management
IRE	Technological University Dublin	?	Spatial Data Infrastructures	Data Management
IRE	Technological University Dublin	?	Spatial Databases	Data Management
IRE	Technological University Dublin	?	Geographic Information Management 1 (Organisational GI Strategies & FME)	Design & Implementation of a GIS&T

IRE	Technological University Dublin	?	GI Project Management	Design & Implementation of a GIS&T
IRE	Dundalk Institute of Technology	AGRI S9Z09	GIS, Data Management and Statistics	Domain Applications
IRE	Galway-Mayo Institute of Technology	?	Geographic Information Systems 1	Domain Applications
IRE	Institute of Technology Sligo	ARCH07033	Introduction to Geographic Information Systems for Archaeolo	Domain Applications
IRE	Munster Technological University - Kerry	INFO81004	GIS for Civil Engineers	Domain Applications
IRE	Munster Technological University - Kerry	AGRI81005	Precision Farming	Domain Applications
IRE	National University of Ireland, Galway	EOS3102	Environmental & Marine Geophysical Remote Sensing	Domain Applications
IRE	University College Cork	GG6533	Spatial Ecology and GIS	Domain Applications
IRE	University College Dublin	GEOL30400	Digital Geology and GIS	Domain Applications
IRE	University College Dublin	FOR30430	Geographic Information Systems	Domain Applications
IRE	University College Dublin	PLAN40220	Geographical Information Systems for Policy and Planning	Domain Applications
IRE	University College Dublin	PLAN2002W	GIS & Planning	Domain Applications
IRE	University College Dublin	ARCH41340	GIS, Cultural Heritage and Spatial Thinking	Domain Applications

IRE	University College Dublin	ENVB40540	Introduction to Ecological Mapping with open source software (QGIS)	Domain Applications
IRE	The Waterford Institute of Technology	A07605	Applied GIS	Domain Applications
IRE	The Waterford Institute of Technology	A06215	Forest Surveying and Mapping	Domain Applications
IRE	Trinity College Dublin	?	Geographical Information: Data & Tools	GIS
IRE	Technological University Dublin	GEOM2151	Advanced GIS	GIS
IRE	Technological University Dublin	SSPL4001	Geographic Information Management	GIS
IRE	Technological University Dublin	?	Geographic Information Science 1	GIS
IRE	Technological University Dublin	?	Geographic Information Science 2	GIS
IRE	Technological University Dublin	TU5405	Geographic Information Systems (Short Course)	GIS
IRE	Technological University Dublin	SSPL1002	Geo-Spatial Awareness	GIS
IRE	University College Cork	GG3012	Advanced Geographical Information Systems	GIS
IRE	University College Dublin	GEOG40870	Advanced GIS	GIS
IRE	University College Dublin	PLAN40350	Advanced GIS	GIS

IRE	University College Dublin	BSEN40780	Remote Sensing and GIS	GIS
IRE	National Centre for Geocomputation	GY635	WORK PLACEMENT	GIS Internship/Work Placement
IRE	Technological University Dublin	?	Work Placement	GIS Internship/Work Placement
IRE	Technological University Dublin	?	Geographic Information Management 1 (Legal & Quality Issues)	GIS&T & Society
IRE	National Centre for Geocomputation	GY638	GEOGRAPHICAL INFORMATION SCIENCE IN PRACTICE	GISc
IRE	National University of Ireland, Galway	GEOM2151	Advanced Gis	GISc
IRE	Dublin City University	GY110	Introduction to environmental spatial analys.	Intro GIS/GISc
IRE	Institute of Technology Sligo	ENVR06066	Introduction to Geographic Information Systems	Intro GIS/GISc
IRE	Munster Technological University	ENVI8006	Environmental GIS	Intro GIS/GISc
IRE	Munster Technological University - Kerry	INFO61016	Geographical Info Systems	Intro GIS/GISc
IRE	Munster Technological University - Kerry	INFO81005	Geographical Information Systems Theory with QGIS	Intro GIS/GISc
IRE	Munster Technological University - Kerry	INFO81000	Geographical Information Systs	Intro GIS/GISc
IRE	National Centre for Geocomputation	GY304	GEOGRAPHICAL INFORMATION SYSTEMS AND SCIENCE	Intro GIS/GISc

IRE	National Centre for Geocomputation	NCG601A	INTRODUCTION TO GEOCOMPUTATION	Intro GIS/GISc
IRE	National Centre for Geocomputation	GY636	INTRODUCTION TO GEOGRAPHICAL INFORMATION SYSTEMS AND SCIENCE	Intro GIS/GISc
IRE	National University of Ireland, Galway	TI2102	Introduction To GIS	Intro GIS/GISc
IRE	Technological University Dublin	SSPL2011	Fundamentals of GIS	Intro GIS/GISc
IRE	University College Cork	GG6501	Introduction to Geographical Information Systems	Intro GIS/GISc
IRE	University College Cork	GG2037	Introduction to Geoinformatics	Intro GIS/GISc
IRE	University College Dublin	GEOG20230	Intro: GIS for Sustainability	Intro GIS/GISc
IRE	University College Dublin	ENVB40540	Introduction to ArcGIS	Intro GIS/GISc
IRE	University College Dublin	PLAN20020	Introduction to GIS	Intro GIS/GISc
IRE	University College Dublin	GEOG20220	Introduction to GIS for the Social Sciences	Intro GIS/GISc
IRE	University College Dublin	GEOG10140	Mapping a Sustainable World	Intro GIS/GISc
IRE	University College Dublin	COMP30110	Spatial Information Systems	Intro GIS/GISc
IRE	Technological University Dublin	?	GIS Modelling and Scripting	Programming & Development
IRE	Technological University Dublin	?	Introduction to Programming	Programming & Development

IRE	Technological University Dublin	?	Programming for GIS	Programming & Development
IRE	Technological University Dublin	?	Web and User Interface Design	Programming & Development
IRE	Technological University Dublin	?	Web GIS	Programming & Development
IRE	University College Cork	?	Computer Programming for GIS Applications	Programming & Development
IRE	University College Cork	GG6537	Internet GIS	Programming & Development
IRE	Dundalk Institute of Technology	AGRI S8Z30	Research Methods and GIS	Research Methods
IRE	University College Dublin	GEOG40950	Research Design II	Research Methods
IRE	Dundalk Institute of Technology	ENGR E6020	Applied Surveying	Surveying
IRE	Dundalk Institute of Technology	CENG E8007	Geodetic Surveying and Engineering	Surveying
IRE	Dundalk Institute of Technology	BLDS E8003	Measured Surveys 1	Surveying
IRE	Dundalk Institute of Technology	BLDS E7009	Measured Surveys 2	Surveying
IRE	Dundalk Institute of Technology	BDLU E8003	Measured Surveys 2	Surveying
IRE	Dundalk Institute of Technology	BLDS E7010	Measured Surveys 3	Surveying
IRE	Dundalk Institute of Technology	CENG E7004	Surveying 1	Surveying

IRE	Dundalk Institute of Technology	CENG E7009	Surveying 2	Surveying
IRE	Munster Technological University	SURV61000	Site Surveying 1	Surveying
IRE	Munster Technological University	SURV61001	Site Surveying 2	Surveying
IRE	Munster Technological University	SURV61002	Site Surveying 3	Surveying
IRE	Technological University Dublin	?	Advanced Geodetic Surveying	Surveying
IRE	Technological University Dublin	?	Applied Surveying	Surveying
IRE	Technological University Dublin	?	Applied Surveying 2	Surveying
IRE	Technological University Dublin	?	BIM for Geospatial Surveying	Surveying
IRE	Technological University Dublin	?	Geodetic Surveying 1	Surveying
IRE	Technological University Dublin	?	Geodetic Surveying 2	Surveying
IRE	Technological University Dublin	?	Surveying Computations	Surveying
IRE	Technological University Dublin	?	Topographical Surveying 1	Surveying
IRE	Technological University Dublin	?	Topographical Surveying 2	Surveying

IRE	University College Dublin	CDIC2021W	Surveying	Surveying
IRE	University of Limerick	WT4604	LAND SURVEYING	Surveying
IRE	National Centre for Geocomputation	NCG606	DISSERTATION	Thesis/Research
IRE	University College Cork	GG6511	Dissertation in Geoinformatics	Thesis/Research
UK	University of Glasgow	GEOG5025	TOPOGRAPHIC MODELLING AND LANDSCAPE MONITORING	Analytics & Modeling
UK	University of Leeds	GEOG3195	Geocomputation and Spatial Analysis	Analytics & Modeling
UK	University of Leeds	GEOG5255M	Geodemographics and Neighbourhood Analysis	Analytics & Modeling
UK	University College London	GEOG0114	Principles of Spatial Analysis	Analytics & Modeling
UK	University College London	IRDR0021	Social and Geospatial Data Analysis	Analytics & Modeling
UK	University College London	CEGE0097	Spatial Analysis and Geocomputation	Analytics & Modeling
UK	University of Glasgow	GEOG5102	APPLIED GIS	Applied GIS/GISc
UK	University of Glasgow	GEOG4111	GIS A:APPLIED SPATIAL ANALYSIS	Applied GIS/GISc
UK	University of Leeds	GEOG5937M	Applied GIS and Retail Modelling	Applied GIS/GISc
UK	University of Leeds	GEOG5060M	GIS and Environment	Applied GIS/GISc
UK	University of Leeds	SOEE2650	GIS for Geoscientists	Applied GIS/GISc

UK	Aberystwyth University	EAM3820	Applied Geospatial Skills in Industry	Capstone
UK	University of Glasgow	GEOG5040P	GEOMATICS MSC PROJECT	Capstone
UK	University of Glasgow	GEOG4098	MAP DESIGN AND GEOVISUALISATION	Cartography & Visualization
UK	University of Glasgow	GEOG5018	PRINCIPLES OF CARTOGRAPHIC DESIGN & PRODUCTION	Cartography & Visualization
UK	University of Glasgow	GEOG5026	VISUALISATION & MAP USE	Cartography & Visualization
UK	University of Leeds	GEOG5009M	Visualisation for Geographic Data Science	Cartography & Visualization
UK	University College London	INST0065	Data Visualization and GIS	Cartography & Visualization
UK	University College London	CASA0019	Sensor Data Visualisation	Cartography & Visualization
UK	Aberystwyth University	EAM5120	Advanced Skills in Remote Sensing	Data Capture
UK	Aberystwyth University	GS32020	Earth Observation from Satellites and Aircraft	Data Capture
UK	Aberystwyth University	EAM2920	Remote Sensing Issues	Data Capture
UK	University of Glasgow	GEOG4094	REMOTE SENSING	Data Capture
UK	University of Glasgow	GEOG5056	REMOTE SENSING OF THE ENVIRONMENT	Data Capture
UK	University of Leeds	GEOG5006M	Digital Image Processing for Environmental Remote Sensing	Data Capture

UK	University of Southampton	GEOG6087	Practical Skills in Remote Sensing	Data Capture
UK	University of Southampton	GEOG6027	Remote Sensing for Earth Observation	Data Capture
UK	University of Southampton	GEOG2007	Remote Sensing for Earth Observation	Data Capture
UK	University College London	CEGE0095	Sensors and Location	Data Capture
UK	University of Glasgow	GEOG5013	GEOSPATIAL DATA INFRASTRUCTURES AND LAND ADMINISTRATION	Data Management
UK	University College London	CEGE0052	Spatial Databases and Data Management	Data Management
UK	University of Glasgow	GEOG5014	HYDROGRAPHIC SURVEY	Domain Applications
UK	University of Leeds	GEOG5052M	Environmental Data Visualisation & Analysis	Domain Applications
UK	University of Leeds	GEOG5008M	GIS and Environment	Domain Applications
UK	University of Leeds	BLGY5117M	Introduction to GIS Skills for Ecologists	Domain Applications
UK	University of Southampton	ENVS6032	Geographical Information Systems for Environmental Consultants	Domain Applications
UK	University of Southampton	GEOG6094	GIS for Analysis of Health	Domain Applications
UK	University of Southampton	ARCH3044	GIS for Archaeology	Domain Applications
UK	University of Southampton	GEOG6095	GIS for Environmental Management	Domain Applications
UK	University of Southampton	SOES2037	Structural Geology and GIS	Domain Applications

UK	University College London	ARCL0027	Archaeological Surveying	Domain Applications
UK	University College London	SECU0005	Crime Mapping	Domain Applications
UK	University College London	SECU0022	Crime Mapping and Spatial Analysis	Domain Applications
UK	University College London	ARCL0095	GIS Approaches to Past Landscapes	Domain Applications
UK	University College London	ARCL0094	GIS in Archaeology and History	Domain Applications
UK	University College London	BENV0111	Heritage Data Mapping and Visualisation	Domain Applications
UK	University College London	BENV0093	Spatial Analysis of Energy Data	Domain Applications
UK	University College London	BPLN0077	Urban Lab II: Spatial Analysis	Domain Applications
UK	University of Glasgow	GEOG5012	APPLIED GEODESY AND GNSS	Earth Geometry & Geodesy
UK	University of Glasgow	GEOG5009	FUNDAMENTALS OF GEOMATICS I	Earth Geometry & Geodesy
UK	Aberystwyth University	EAM5220	Advanced Skills in Geographic Information Systems	GIS
UK	University of Glasgow	GEOG5006	DIRECTED STUDIES IN GEOMATICS	GIS
UK	University of Glasgow	GEOG4112	GIS B:THEORY & PRACTICE	GIS
UK	University of Glasgow	URBAN5111	PRINCIPLES AND APPLICATIONS OF GIS	GIS
UK	University of Leeds	SOEE1630	Field, GIS and Research Skills	GIS

UK	University of Leeds	GEOG5042M	Geographic Data Visualisation & Analysis	GIS
UK	University of Leeds	SOEE1475	GIS and Data Analysis	GIS
UK	University of Leeds	GEOG5032M	GIS Data Visualisation & Analysis	GIS
UK	University of Leeds	GEOG5001M	GIS Data Visualisation and Analysis 1	GIS
UK	University of Leeds	GEOG2150	Social and Spatial Data Analysis with GIS	GIS
UK	University College London	CASA0006	Data Science for Spatial Systems	GIS
UK	University College London	GEOG0030	Geocomputation	GIS
UK	University College London	CASA0009	Spatial Data Capture, Storage and Analysis	GIS
UK	University of Leeds	GEOG5002M	GIS Data Visualisation and Analysis 2	GISc
UK	University of Southampton	GEOG2021	Advanced Geographical Information Systems	GISc
UK	University of Southampton	GEOG3006	Advanced Geographical Information Systems	GISc
UK	Aberystwyth University	EAM4020	Fundamentals of Remote Sensing and GIS	Intro GIS/GISc
UK	Aberystwyth University	GS23710	Geographical Information Systems	Intro GIS/GISc
UK	University of Glasgow	GEOG5010	FUNDAMENTALS OF GEOMATICS II	Intro GIS/GISc
UK	University of Glasgow	GEOG5008	GEOSPATIAL FUNDAMENTALS	Intro GIS/GISc
UK	University of Glasgow	GEOG5128	INTRODUCTION TO GIS	Intro GIS/GISc

UK	University of Glasgow	GEOG5019	PRINCIPLES OF GIS	Intro GIS/GISc
UK	University of Southampton	GEOG6061	Core Skills in GIS	Intro GIS/GISc
UK	University of Southampton	STAT6122	Geographic Information Systems	Intro GIS/GISc
UK	University of Southampton	GEOG2010	Introductory Geographic Information Systems	Intro GIS/GISc
UK	University College London	GEOG0035	Environmental GIS	Intro GIS/GISc
UK	University College London	CASA0005	Geographic Information Systems and Science	Intro GIS/GISc
UK	University College London	CEGE0094	Geospatial Science	Intro GIS/GISc
UK	University of Glasgow	GEOG5015	WEB AND MOBILE MAPPING	Programming & Development
UK	University of Leeds	SOEE1160	Computers and Programming in Geosciences	Programming & Development
UK	University of Leeds	GEOG5003M	Programming for Geographical Information Analysis	Programming & Development
UK	University of Leeds	GEOG5012M	Web-based GIS	Programming & Development
UK	University of Leeds	GEOG5870M	Web-based GIS	Programming & Development
UK	University of Southampton	GEOG6109	Programming for GIS and Spatial Analyses	Programming & Development
UK	University of Southampton	GEOG6088	Programming Skills in Remote Sensing	Programming & Development

UK	University College London	CEGE0096	Geospatial Programming	Programming & Development
UK	University College London	CASA0013	Introduction to Programming for Spatial Analysts	Programming & Development
UK	University College London	CEGE0043	Web and Mobile GIS - Apps and Programming	Programming & Development
UK	University of Leeds	SOEE2930	Advanced Field and GIS Skills	Research Methods
UK	University of Glasgow	GEOG5099	APPLIED LAND SURVEYING	Surveying
UK	University of Glasgow	GEOG5020	LAND SURVEYING I	Surveying
UK	University of Glasgow	GEOG5023	LAND SURVEYING II	Surveying
UK	University College London	CEGE0014	Surveying and Field Studies	Surveying
UK	Aberystwyth University	EAM3060	Research Dissertation in Geographical Information Systems/Remote Sensing	Thesis/Research
UK	University of Southampton	GEOG6035	Dissertation (GIS)	Thesis/Research
USA	University of Denver	GEOG 3010	Geographic Information Analysis	Analytics & Modeling
USA	University of Denver	GIS 4110	Geographic Statistics	Analytics & Modeling
USA	University of Denver	GEOG 3110	GIS Modeling	Analytics & Modeling
USA	The Pennsylvania State University	SUR 341	Adjustment Computations	Analytics & Modeling
USA	The Pennsylvania State University	GEOG 465	Advanced Geographic Information Systems Modeling	Analytics & Modeling

USA	The Pennsylvania State University	GEOG 464	Advanced Spatial Analysis	Analytics & Modeling
USA	The Pennsylvania State University	GEOG 364	Spatial Analysis	Analytics & Modeling
USA	The Pennsylvania State University	SUR 241	Surveying Measurement Analysis	Analytics & Modeling
USA	Salisbury University	GEOG 315	Topics in GIS Modeling	Analytics & Modeling
USA	Sam Houston State University	GEOG 5374	Advanced GIS Analysis	Analytics & Modeling
USA	Sam Houston State University	GEOG 5312	GIS ModelBuilder	Analytics & Modeling
USA	California State University, Long Beach	GEOG 487A/GEOG 587A	Applications of Geographic Information Science (GIS): Environment and Natural Resources	Applied GIS/GISc
USA	California State University, Long Beach	GEOG 487B/GEOG 587B	Applications of Geographic Information Science (GIS): Urban and Economic	Applied GIS/GISc
USA	California State University, Long Beach	GISC 602	Applied GIS	Applied GIS/GISc
USA	California State University, Long Beach	GEOG 680	Seminar in Geospatial Science	Applied GIS/GISc
USA	University of Denver	GEOG 3710	Applied Geospatial Analysis	Applied GIS/GISc
USA	The Pennsylvania State University	GEOG 161	Applied Geographic Information Systems	Applied GIS/GISc
USA	The Pennsylvania State University	GEOG 487	Environmental Applications of GIS	Applied GIS/GISc

USA	The Pennsylvania State University	GEOG 483	Problem-Solving with GIS	Applied GIS/GISc
USA	The Pennsylvania State University	GEOG 479	Spatial Data Science for Cyber and Human Social Networks	Applied GIS/GISc
USA	Sam Houston State University	GEOG 4365	Applied Geographic Info Systms	Applied GIS/GISc
USA	University of Denver	GEOG 3170	Geospatial Analysis Project	Capstone
USA	The Pennsylvania State University	SUR 296	Independent Studies	Capstone
USA	Salisbury University	GEOG 650	Capstone GISystems Seminar	Capstone
USA	Salisbury University	GEOG 640	GISystems Co-Operative Experience	Capstone
USA	California State University, Long Beach	GEOG 482/GEOG 582	Advanced Digital Cartography & GIS	Cartography & Visualization
USA	California State University, Long Beach	GISC 603	Cartographic Visualization	Cartography & Visualization
USA	California State University, Long Beach	GEOG 380	Introduction to Digital Cartography & Analysis	Cartography & Visualization
USA	University of Denver	GIS 4504	Cartography and Geovisualization	Cartography & Visualization
USA	University of Denver	GEOG 2020	Computer Cartography	Cartography & Visualization
USA	The Pennsylvania State University	GEOG 467	Applied Cartographic Design	Cartography & Visualization
USA	The Pennsylvania State University	GEOG 486	Cartography and Visualization	Cartography & Visualization

USA	The Pennsylvania State University	GEOG 361	Cartography--Maps and Map Construction	Cartography & Visualization
USA	The Pennsylvania State University	GEOG 461W	Dynamic Cartographic Representation	Cartography & Visualization
USA	Salisbury University	GEOG 320	Cartographic Visualization	Cartography & Visualization
USA	Sam Houston State University	GEOG 5366	Cartography And Visualization	Cartography & Visualization
USA	Sam Houston State University	GEOG 3363	Computer Cartography	Cartography & Visualization
USA	California State University, Long Beach	GISC 606	Applied Remote Sensing	Data Capture
USA	California State University, Long Beach	GEOG 475/GEOG575	Geographical Applications in Remote Sensing	Data Capture
USA	California State University, Long Beach	GEOG 473	Remote Sensing	Data Capture
USA	University of Denver	GEOG 3230	Advanced Remote Sensing	Data Capture
USA	University of Denver	GIS 4690	GPS for GIS	Data Capture
USA	University of Denver	GEOG 3040	GPS for Resource Mapping	Data Capture
USA	University of Denver	GEOG 3190	Lidar: Theory and Applications	Data Capture
USA	University of Denver	GEOG 3200	Remote Sensing	Data Capture
USA	University of Denver	GIS 4700	Remote Sensing I	Data Capture
USA	University of Denver	GIS 4740	Remote Sensing II	Data Capture

USA	University of Denver	GEOG 3920	Remote Sensing Seminar +	Data Capture
USA	University of Denver	GIS 4750	UAS for GIS	Data Capture
USA	University of Denver	GIS 4770	UAS Ground School Practical	Data Capture
USA	University of Denver	GIS 4760	UAS Photogrammetry	Data Capture
USA	The Pennsylvania State University	GEOG 462	Advanced Observation of Earth and Its Environment	Data Capture
USA	The Pennsylvania State University	SUR 422	Digital Photogrammetry	Data Capture
USA	The Pennsylvania State University	GEOG 480	Exploring Imagery and Elevation Data in GIS Applications	Data Capture
USA	The Pennsylvania State University	SUR 162	Methods in Large Scale Mapping	Data Capture
USA	The Pennsylvania State University	SUR 222	Photogrammetry	Data Capture
USA	The Pennsylvania State University	GEOSC 482	Satellite Remote-Sensing For Earth Observation	Data Capture
USA	The Pennsylvania State University	GEOG 481	Topographic Mapping with Lidar	Data Capture
USA	Salisbury University	GEOG 321	Remote Sensing of the Environment	Data Capture
USA	Sam Houston State University	GEOG 5365	Digital Image Processing	Data Capture
USA	Sam Houston State University	GEOG 5373	Introduction to LiDAR & Radar	Data Capture
USA	Sam Houston State University	GEOG 4468	Remote Sensing	Data Capture

USA	University of Denver	GIS 4620	Geodatabase Application	Data Management
USA	University of Denver	GEOG 3140	GIS Database Design	Data Management
USA	The Pennsylvania State University	GEOG 484	GIS Database Development	Data Management
USA	Sam Houston State University	GEOG 5315	Spatial Database	Data Management
USA	California State University, Long Beach	GISC 604	Enterprise GIS Development	Design & Implementation of a GIS&T
USA	California State University, Long Beach	GEOG 484	Enterprise GIS Development	Design & Implementation of a GIS&T
USA	University of Denver	GEOG 3150	GIS Project Management	Design & Implementation of a GIS&T
USA	The Pennsylvania State University	GEOG 468	Geographic Information Systems Design and Evaluation	Design & Implementation of a GIS&T
USA	Salisbury University	GEOG 538	GIS Leadership	Design & Implementation of a GIS&T
USA	Salisbury University	GEOG 630	GISystems and Public Administration	Design & Implementation of a GIS&T
USA	Salisbury University	GEOG 619	Managing GISystems	Design & Implementation of a GIS&T
USA	Sam Houston State University	GEOG 5310	GIS Project Management	Design & Implementation of a GIS&T
USA	California State University, Long Beach	GEOG 471	Geographic Information Science (GISci) for Justice	Domain Applications

USA	California State University, Long Beach	GEOG 371	Geospatial Science for Health	Domain Applications
USA	University of Denver	GIS 4540	Conservation GIS	Domain Applications
USA	University of Denver	GIS 4530	Crime Mapping and Analysis	Domain Applications
USA	University of Denver	GIS 4650	Demographic Analysis Using GIS	Domain Applications
USA	University of Denver	GEOG 3120	Environmental/GIS Modeling	Domain Applications
USA	University of Denver	GIS 4570	Geographic Information Systems in Public Health	Domain Applications
USA	University of Denver	GIS 4200	Geospatial Intelligence	Domain Applications
USA	University of Denver	GEOG 3470	GIS & Environmental Health Geography	Domain Applications
USA	University of Denver	GIS 4685	GIS and Natural Hazards	Domain Applications
USA	University of Denver	GEOG 3860	GIS Applications and Natural Resources	Domain Applications
USA	University of Denver	GIS 4683	GIS for Disaster Management	Domain Applications
USA	University of Denver	GIS 4510	GIS in Business	Domain Applications
USA	University of Denver	GIS 4660	GIS in Municipal Government	Domain Applications
USA	University of Denver	GIS 4520	GIS in Telecommunications	Domain Applications
USA	University of Denver	GIS 4687	Hydrologic Modeling in GIS	Domain Applications
USA	University of Denver	GEOG 3410	Urban Applications of GIS	Domain Applications
USA	The Pennsylvania State University	GEOG 469	Energy Industry Applications of GIS	Domain Applications

USA	The Pennsylvania State University	GEOG 453	Geospatial Applications in Water Resources & Aquatic Ecosystems	Domain Applications
USA	Sam Houston State University	GEOG 4361	Geographic Information Systems for Public Health	Domain Applications
USA	Sam Houston State University	GEOG 5371	Geographic Information Systems in Engergy-Related Fields	Domain Applications
USA	Sam Houston State University	GEOG 5311	GIS in Law Enforcement	Domain Applications
USA	The Pennsylvania State University	SUR 262	Coordinate Systems in Map Projections	Earth Geometry & Geodesy
USA	The Pennsylvania State University	SUR 351	Geodetic Models	Earth Geometry & Geodesy
USA	The Pennsylvania State University	SUR 455	Precise Positioning Systems	Earth Geometry & Geodesy
USA	University of Denver	GEOG 3100	Geospatial Data	GIS
USA	The Pennsylvania State University	GEOG 363	Geographic Information Systems	GIS
USA	The Pennsylvania State University	GEOG 482	Making Maps That Matter With GIS	GIS
USA	Salisbury University	GEOG 419	Advanced Geographic Information Science	GIS
USA	Salisbury University	GEOG 519	Advanced Geographic Information Science	GIS
USA	Salisbury University	GEOG 304	Decision Making With GIS	GIS
USA	Salisbury University	GEOG 319	Geographic Information Science	GIS
USA	Salisbury University	GEOG 550	Topics in Geography* Topic Must Be: Open Source GIS	GIS

USA	Sam Houston State University	GEOG 5361	Geographic Information	GIS
USA	The Pennsylvania State University	GEOG 495G	Giscience Internship	GIS Internship/Work Placement
USA	California State University, Long Beach	GISC 601	GIS Professionalism	GIS&T & Society
USA	University of Denver	GIS 4670	GIS and the Law	GIS&T & Society
USA	University of Denver	GIS 4630	Public Domain Data for GIS	GIS&T & Society
USA	The Pennsylvania State University	SUR 372W	Legal Aspects of Land Surveying	GIS&T & Society
USA	The Pennsylvania State University	SUR 462	Parcel-Based Geospatial Information Systems	GIS&T & Society
USA	The Pennsylvania State University	SUR 471	Professional Aspects of Land Surveying	GIS&T & Society
USA	Sam Houston State University	GEOG 5313	Ethics in GIS	GIS&T & Society
USA	The Pennsylvania State University	GEOG 260	Geographic Information in a Changing World: Introduction to GIScience	GISc
USA	The Pennsylvania State University	GEOG 463	Geospatial Information Management	GISc
USA	Sam Houston State University	GEOG 5362	GIS Principles and Application	GISc
USA	California State University, Long Beach	GEOG 481	Geographic Information Science for Natural Sciences	Intro GIS/GISc

USA	California State University, Long Beach	GEOG 280	Introduction to Geospatial Techniques	Intro GIS/GISc
USA	California State University, Long Beach	GEOG 485/GEOG 585	Principles of Geographic Information Science	Intro GIS/GISc
USA	University of Denver	GIS 4100	Geospatial Technologies	Intro GIS/GISc
USA	University of Denver	GIS 4101	Introduction to Geographic Information Systems	Intro GIS/GISc
USA	University of Denver	GEOG 2100	Introduction to GIS	Intro GIS/GISc
USA	The Pennsylvania State University	GEOG 160	Mapping Our Changing World	Intro GIS/GISc
USA	The Pennsylvania State University	GEOG 6N	Maps and the Geospatial Revolution	Intro GIS/GISc
USA	Salisbury University	GEOG 219	Map Interpretation and Analysis, BSc (Urban and Regional Planning)	Intro GIS/GISc
USA	Sam Houston State University	GEOG 2364	Geo-Spatial Technology	Intro GIS/GISc
USA	Sam Houston State University	GEOG 2464	Intro to Geographic Info Sys	Intro GIS/GISc
USA	Sam Houston State University	GEOG 5364	Spatial Analysis	Intro GIS/GISc
USA	The Pennsylvania State University	SUR 362	Introduction to Geospatial Information Engineering	Intro Surveying
USA	California State University, Long Beach	GEOG 488/GEOG 588	Geographic Information Science (GIS) Programming	Programming & Development

USA	California State University, Long Beach	GISC 605	Programming for Geospatial Professionals	Programming & Development
USA	University of Denver	GIS 4007	Creative Problem Solving and Programming Concepts	Programming & Development
USA	University of Denver	GEOG 3130	GIS Programming with Python	Programming & Development
USA	University of Denver	GIS 4860	Internet Mapping	Programming & Development
USA	University of Denver	GIS 4080	Python Programming in GIS	Programming & Development
USA	University of Denver	GEOG 3160	Web GIS	Programming & Development
USA	The Pennsylvania State University	GEOG 489	Advanced Python Programming for GIS	Programming & Development
USA	The Pennsylvania State University	GEOG 485	GIS Programming and Software Development	Programming & Development
USA	The Pennsylvania State University	GEOG 365	Introduction to GIS Programming	Programming & Development
USA	Salisbury University	GEOG 535	GIS Programming	Programming & Development
USA	Sam Houston State University	GEOG 4367	GIS Programming	Programming & Development
USA	Sam Houston State University	GEOG 5367	GIS Programming	Programming & Development
USA	Sam Houston State University	GEOG 5363	Internet GIS	Programming & Development

USA	California State University, Long Beach	C E 130	Surveying and Mapping	Surveying
USA	The Pennsylvania State University	SUR 272	Cadastral Surveying	Surveying
USA	The Pennsylvania State University	SUR 313	Integrated Surveying	Surveying
USA	The Pennsylvania State University	SUR 111	Plane Surveying	Surveying
USA	The Pennsylvania State University	SUR 212	Route and Construction Surveying	Surveying
USA	The Pennsylvania State University	SUR 490	Seminar in Surveying	Surveying