

Project Number:

SUSTAINABLE TRANSPORTATION MAPPING AT THE ROYAL BOROUGH OF KINGSTON UPON
THAMES

An Interactive Qualifying Project Report

submitted to the Faculty

of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfilment of the requirements for the

Degree of Bachelor of Science

by

Maria Gioules

Lauren Hannmann

Jodi-Lee Smith

Evan Sullivan

25 June 2010

1. sustainability
2. transportation
3. map

Professor Robert Krueger, Primary Advisor

Professor Nikolas K. Kazantzis, Co-Advisor

This report represents the work of one or more WPI undergraduate students
submitted to the faculty as evidence of completion of a degree requirement.
WPI routinely publishes these reports on its web site without editorial or peer review.



WPI

Sustainable Transportation Mapping

Report Submitted to:

Leslie Lunt

Climate Change and Sustainable
Travel Officer
Directorate of Environmental
Services
Royal Borough of Kingston upon
Thames

Professors

Nikolas Kazantzis
and

Robert Krueger
Worcester Polytechnic Institute



Maria Gioules

Lauren Hannmann

Jodi-Lee Smith

Evan Sullivan

Worcester Polytechnic Institute

ABSTRACT

The Climate Change and Sustainable Travel Group at The Kingston Council aims to increase the integration of various modes of transportation and promote sustainable travel options. Consequently, the goal of this project is to design and create a localized multimodal transportation map for The Kingston Council that provides users with safe sustainable travel options for short trips within The Borough as well as design a website template. This report represents the initial development phase of a journey planner.

ACKNOWLEDGEMENTS

The successful completion of this project would not have been possible without the contribution from several persons. We would like to express our gratitude to Mr. Leslie Hunt and Mr. Masum Choudhury, our liaisons at The Kingston Council for assisting us in all stages of the project's on site development, and taking the time to ensure that we are acclimatised to our environment. The guidance provided by Professor Brattin, Professor Kazantzis, and Professor Krueger have been central to the success of this project. We would like to thank Professor Shockey for her comments and criticisms on the earlier versions of this project. We would like to thank Ivetta, Fiona and Darren for taking the time to provide us with GIS data, and answer many of our technical questions. Steve Wagstaff from the ICT Department has been instrumental in guiding the technical development. We express gratitude to the participants from our focus groups and interview for their frank suggestions and constructive criticisms: from The Kingston Council and the Kingston Wheelers. We also express an immense gratitude to anyone else who has assisted us during the creation of this map and website template.

AUTHORSHIP PAGE

This report has been compiled by the efforts of a student project group known as the Kingston Transportation Team, consisting of Maria Gioules, Lauren Hannmann, Jodi-Lee Smith, and Evan Sullivan. The introductory and background chapters are the result of equivalent writing and editing contributions from all group members. Sections of the methodology stand as a consequence of the efforts of all group members, with Maria Gioules authoring sections about GIS mapping; Lauren Hannmann authoring interview questions for the disabled; Jodi-Lee Smith authoring sections about GIS mapping, cartographic features, and developed questions for The Kingston Council focus group; and Evan Sullivan authoring sections about geo-referenced PDFs and developed questions for a cycling focus group. The report's findings have been summarized by the efforts of Maria Gioules, Jodi-Lee Smith, and Evan Sullivan while its final recommendations have been assembled by Jodi-Lee Smith and Evan Sullivan. The information gathered in the appendices stand as the outcome of a collective group effort, while the formatting of the appendices is largely the result of contributions by Maria Gioules, Lauren Hannmann and Jodi-Lee Smith. The arrangement of the document, such as the title page, the list of figures, the list of tables, headings, and the maintenance references was completed by Maria Gioules and Jodi-Lee Smith. External from the written report, Maria Gioules has produced the website template. Additionally, Lauren Hannmann has managed most of the ArcGIS tasks, from importing data to the formatting of the appearance.

TABLE OF CONTENTS

ABSTRACT	ii
ACKNOWLEDGEMENTS.....	iii
AUTHORSHIP PAGE.....	iv
LIST OF FIGURES	viii
LIST OF TABLES.....	viii
CHAPTER 1	10
1.0 INTRODUCTION	10
CHAPTER 2.....	14
2.0 LITERATURE REVIEW	14
2.1 The Royal Borough of Kingston	14
2.2 Strategic Transportation Planning Policies	17
2.2.1 European Union Transportation Policies and the Environment	18
2.2.2 United Kingdom Transportation Policies and the Environment	19
2.2.3 Greater London Transportation Policies and the Environment.....	20
2.2.4 Kingston Borough Transportation Policies and the Environment	21
2.3 International Guidelines for Sustainable Transportation and Factors Enhancing the Experience of Commuters.....	23
2.3.1 Important Factors Enhancing Commuter's Experience	23
2.3.2 Sustainable Transportation Evaluation and Guidelines	26
2.4 Aesthetics, Design, and Layout of Maps.....	29
2.4.1 The Cartographer's Design Goals.....	30
2.5 GIS Servers.....	37
2.5.1 ESRI Web ADF.....	38
2.5.2 ESRI REST	38
2.5.3 ESRI Flex API.....	38
2.5.4 ESRI JavaScript API.....	39
2.5.5 ESRI Silverlight API	39
2.5.6 Google Maps API	40
2.5.7 Google Transit Partner Program.....	40
2.5.8 Comparative Assessment of Various Mapping Applications.....	41
2.6 Evaluation of ArcGIS Server Web Applications	42
2.7 Website Design	44
2.7.1 Elements of Successful Website Design.....	44
2.7.2 Website Accessibility	46
2.8 Summary	47
CHAPTER 3.....	49
3.0 METHODOLOGY	49
3.1 Conduct a Ground Truth	50
3.2 Critical Review of Other Transportation Maps	51
3.3 Creation of Map Using ArcGIS 9.3.1	52
3.3.1 Identify Popular Destinations.....	53

3.3.2 Obtain Data for Mapped Attributes and Layers	53
3.3.3 Conduct an Audit of Georeferenced Data	54
3.3.4 Map Updates and Georeferenced Data Use	54
3.3.5 Edit the Map's Symbols and Layers to Enhance the Visual Appeal	55
3.4 Feedback on Map Design and Content.....	57
3.4.1 Focus Group with Employees of The Kingston Council.....	58
3.4.2 Focus Group with Members of a Cycling Club	59
3.4.3 Interview with a Member of the Disabled Community	59
3.5 Evaluating Different Website Mapping Applications.....	60
3.6 Design a Website Template to Host the Interactive Web Application	60
3.7 Feedback on Website Template: Informal Interview With Members of The Kingston Council	61
CHAPTER 4.....	63
4.0 FINDINGS	63
4.1 Making the RBK Map Distinct from the TfL Map	63
4.2 Best Practices for Map Design	65
4.3 RBK Map and How It Reflects Best Practice	68
4.4 The Advantages and Disadvantages of Website Mapping Applications	73
4.5 Feedback: Presentation and Analysis of Findings	74
4.5.1 Feedback: The Focus Group Conducted with Employees of The Kingston Council	74
4.5.2 Feedback: Interview With a Member of the Disabled Community.....	79
4.5.3 Feedback: Focus Group With Members of a Cycling Club	83
4.6 Feedback for Website Template: Interview Conducted with Members of The Kingston Council	85
4.7 Summary	88
CHAPTER 5.....	90
5.0 RECOMMENDATIONS.....	90
5.1 Improving the Map so it has a Wider Scope of Use	90
5.2 Responding to the Needs of Cyclists Within the Borough.....	92
5.2.1 Improving the Content of the Map	93
5.2.2 Recommendations for Cycling Infrastructure	95
5.3 Improving the Map so it Responds to the Needs of the Disabled Community	97
5.4 Providing for an Online Interactive Journey Planner.....	99
5.5 Developing a Website Template	101
5.6 Raising Awareness	101
5.7 Chapter Summary	103
CHAPTER 6.....	104
6.0 EXECUTIVE SUMMARY	104
GLOSSARY	106
AAPPENDICES.....	110
APPENDIX A: FOCUS GROUPS AND INTERVIEWS	110
Focus Group Conducted with Employees of The Kingston Council: Notes	110
Topic: How Do You Plan Your Journey?.....	110
Accessibility Interview: Notes.....	129

Topic: Accessibility in Transportation Mapping	129
Focus Group Conducted with Members of a Cycling Club: Notes	136
Follow-up interview with Employees of The Kingston Council: Notes.....	143
APPENDIX B: REVIEWED MAPS	145
APPENDIX C: Summative Team Assessment.....	152

LIST OF FIGURES

Figure 1: The Royal Borough of Kingston as shown within Greater London	11
Figure 2: Percentage of Residents who Utilize the Various Modes of Transportation in the Kingston Borough.....	16
Figure 3: Breadth of Focus in Transportation Policies	18
Figure 4: Cartographer's Design Goals Modified From.....	30
Figure 5: Example of an Unreadable Map	31
Figure 6: An Example of a Map that is Difficult to Read because it is Unclear	32
Figure 7: An Example of a Relatively Well Designed Map that Reflects User Convenience	33
Figure 8: Aspects of Map Design Modified From	34
Figure 9: Two Transportation Routes Offset	52
Figure 10: Symbols by Resemblance	56
Figure 11: Comparison Between the RBK Map and the TfL Map	64
Figure 12: Bus Stop Symbol Comparison	69
Figure 13: Zoomed in View of Car Parking and Rail Station Symbols	70
Figure 14: Zoomed in View of Cycle Parking and Library Symbols	71
Figure 15: Portion of the RBK Map	72
Figure 16: Selected Colour Scheme	72
Figure 17: Flowchart Depicting a Summary of Topics Discussed	75
Figure 18: Marketing and Advertising Ideas Obtained from the Focus Group	79
Figure 19: Screenshot of TfL's Advanced Options for those Who Have Mobility Requirements.....	81
Figure 20: Zoomed Out Screenshot of RBK Map Showing Accessible Crossings	82
Figure 21: Zoomed Out Screenshot of RBK Map Showing Accessible Crossings	83
Figure 22: Tabs on Website Template	85
Figure 23: Website Template Prior To Receiving Feedback.....	87
Figure 24: Screenshot of Website Template After to Receiving	88
Figure 25: TfL Website: Mobility Options	131
Figure 26: RBK Map: Accessibility Crossings	133
Figure 27: Suggested Features.....	134
Figure 28: Cambridge, UK Cycling Map.....	145
Figure 29: Portland, Oregon, USA Cycle Map	146
Figure 30: Journey Planned using Google Maps	147

LIST OF TABLES

Table 1: Car Ownership in the Royal Borough of Kingston.....	16
Table 2: The EST Guidelines	28
Table 3: Comparison Between Symmetrical and Asymmetrical Layouts of Maps	35
Table 4: Comparison of Mapping Applications.....	42
Table 5: Advantages and Disadvantages of Different Website Mapping Application Options.....	73
Table 6: Sorting Focus Group Data	123
Table 7: Sorting Focus Group Two Data.....	141
Table 8: Evaluation of Layout.....	148
Table 9: Evaluation on Use of Symbols	149
Table 10: Evaluation of Use of Colour	150

Table 11: Evaluation of Content Presented 151

CHAPTER 1

1.0 INTRODUCTION

During the urban population boom of the 1980s, many European cities promoted public transportation. City dwellers gradually became more concerned with the repercussions of increased use of motorized transportation methods. Thus, measures were implemented to decrease pollution from private automobile use. This European phenomenon became known as EST, Environmentally Sustainable Transport, and was a foundation for a new age of urban transportation (Fujimoto, 2008).

Key advances in transportation initiatives began to take place in the United Kingdom and accordingly, the UK began to reform its transportation policies. The prime objectives of the transportation reform were to implement an environmentally sustainable transportation plan that emphasized clean and efficient public transportation (Fujimoto, 2008). As London entered the 21st century, the Greater London Authority (GLA) saw the need to design and implement additional urban and environmental directives. In 2001, the Greater London Authority published the first “Mayor’s Transport Strategy” (MTS) due to anticipated increases in population, commerce, and tourism (Greater London Authority, 2009). In an age of waning public health and suspected climate change, the MTS directed its boroughs to enhance sustainable transportation options such as walking, cycling, car clubs, car sharing, bus, light rail, and provide the public with better information.

To further promote “strategic planning” the GLA created *The London Plan* (Greater London Authority, 2009). This plan encompasses economic, social, and sustainable development. *The London Plan* is a collaborative effort of the Mayor of London, the corporation of the City of London, and the 32 London boroughs. A borough’s local development documents have to be “in general conformity” with *The London Plan* (Greater London Authority, 2009). This is also legally part of the development plan that has to be taken into account when planning decisions are taken in any part of London, unless there are planning reasons for why they should not (Greater London Authority, 2009).

This study will focus solely on sustainable transportation development through transportation mapping within The Kingston Borough. Considering the legal obligations that *The London Plan* imposes, it is imperative that each of the 32 boroughs adheres to

these developmental guidelines. The Royal Borough of Kingston is no exception. Kingston located in Southwest London, is indicated by the dark green shaded area shown here in Figure 1.



Figure 1: The Royal Borough of Kingston as shown within Greater London
(The Royal Borough of Kingston, 2010)

Key issues generally considered in the development of sustainable transportation maps include geographic and demographic factors. Specifically, we need to identify transportation routes, commercial centres, and educational institutions. These factors will be examined to create an efficient multimodal transportation map that responds to the community's social and economic needs.

Kingston's transportation system is central to supporting the socio-economic structure of The Borough and includes connections to national rail systems, inter-Borough buses, car-clubs, automobile arteries, and motorways. It is connected to Twickenham, Richmond, Wimbledon, and London Waterloo by national rail trains. Unfortunately, while many public transportation options are available, a majority of the commuters within The Borough utilize private automobiles (Royal Borough of Kingston Council, 2006). If the use of automobile transportation continues to increase, the need to construct larger arteries and motorways will also increase. This does not harmonize well with The Kingston Borough's goals for community safety and environmental health, as established by *The London Plan*. While increased public transportation is appealing,

simply enhancing public transportation options does not effectively limit private vehicle use or stimulate participation in sustainable transportation routes (Royal Borough of Kingston Council, 2006). Before the public can be expected to readily use alternative transportation options, there is a dire need to provide the public with easy access to comprehensible travel information.

In an attempt to comply with legal guidelines and to mitigate the effects of private automobile use through sustainable transportation, The Borough of Kingston formed The Kingston Council's Climate Change and Sustainable Travel Group. This was primarily in response to the Greater London Authority's Mayor's Transport Strategy (MTS). The main objectives of the group are to reduce private automobile traffic congestion by improving sustainable transportation options. This may pose to be challenging as Kingston is predominately suburban and more reliant on automobiles than other areas of London. A problem facing The Kingston Council is that they are unable to effectively market sustainable transportation options, as there is no efficient resource that provides the public with various types of transportation options within The Borough (The Royal Borough of Kingston, 2010).

The goal of this project is to design and create a localized multimodal transportation map that provides users with safe sustainable travel options for short trips within The Borough and design a website template. We will use Arc GIS software, which will allow all existing cycle, walking, and public transportation routes to be accessible from a single source. Other key features that will be included on the map include: bus stations, car parking, car club locations, educational facilities, electric car charging points, hospitals, libraries, recreational areas, and train stations.

One of the anticipated salient features of the website is that it will offer single and multimodal transportation options. For instance, one can travel solely on the bus, or use an alternate route using the bus and train. This map will be accessible on The Kingston Council website and will be printable and easy to use. Its ease of use is anticipated to motivate commuters to consult the website as a primary means of planning their quotidian journeys. Through the creation of this map, The Kingston Borough expects that people will have better awareness, encouragement, and cognizance regarding their transportation choices.

In sum, the motivating forces behind this report come from policies established by various governmental organizations that promote sustainable transportation. In meeting the goals set out by these policies, The Kingston Council will ultimately create an interactive online map that will provide commuters with various single and multimodal transportation routes. Assuming sufficient public use of this map, The Kingston Council's Climate Change and Sustainable Travel Group anticipates that the alternate travel routes provided will reduce the use of private automobiles.

CHAPTER 2

2.0 LITERATURE REVIEW

The focus of this project is to design and create a localized multimodal transportation map that provides users with safe, sustainable travel options for short trips within the borough. Our project represents the initial development phase of a journey planner. To this aim we will focus primarily on ensuring that the map is both functional and visually appealing. Within this section we intend to investigate and analyse important factors that both motivate and facilitate the creation of this map. Consequently, we will:

- Review the policies that have influenced The Kingston Council's interest in establishing a resource that facilitates multimodal transportation
- Investigate and analyse the effect of aesthetics, design and layout of maps on a user's interpretation of maps;
- Evaluate several web applications that can be used to create an interactive map, which represents the second phase of the map development;
- Investigate elements of successful web design.

2.1 The Royal Borough of Kingston

Once an inland port, Kingston has flourished into a highly transit-dependent community. With the help of the railway in 1838, the population boomed creating a means for commercial activity. In 1875, horse drawn buses were the primary mode of transport and were succeeded by electric trams in 1906. Twenty-five years later, buses replaced the trams and in 1927, the Kingston by-pass was constructed and is still being used to this day (Lambert, 2001).

Despite a long history associated with London, The Royal Borough of Kingston was only established in 1936. Spanning 38.7 square kilometres, it is the smallest of the thirty-three boroughs (Royal Borough of Kingston , 2009). It is comprised of four distinct centres, Kingston Town, Surbiton, New Malden, and Tolworth. The Borough centre is Kingston Town, which is located in the Northwest region of the Borough. Located within Kingston Town there are numerous retail establishments and a smaller quantity of civic and retail buildings. The geography of Kingston creates a number of challenges and opportunities for a sustainable transportation strategy. Seven main roads converge in the

Kingston town centre and as a result create traffic congestion during peak travel hours (Royal Borough of Kingston , 2006). Therefore, a multimodal transportation map would likely provide a means to reducing the traffic congestion in The Borough.

According to population trends for 2006, there are about 64,687 households that house about 155,900 people (Royal Borough of Kingston , 2009). The population is expected to increase by 0.5% each year. However, only 9.8% are retired, which suggests that Kingston is a young community. This further suggests that promoting alternate modes of transportation within The Borough would be advantageous from a strategic planning perspective.

The Kingston Borough has an active workforce. The employment rate, according to the 2007 *Medium Term Plan for the Royal Borough of Kingston*, is 65.1% full-time employment and 9.1% of these workers are part time employees who work straight from their home. Since less than a tenth of employees work from home, it is apparent that the majority travel to work daily. This creates the need for efficient transportation services for workers who are employed in Kingston yet reside outside The Borough as well as Kingston residents with jobs in central London who require reliable links to the city (Royal Borough of Kingston , 2006).

It is also important to identify primary methods of transportation; considering that there are approximately 75,893 residents who are employed in The Borough (Royal Borough of Kingston , 2006). The 2001 London Area Travel Survey (LATS) shows a trend of less reliance on the car for work and educational trips; which includes students being driven or driving to school themselves. According to The Kingston Council, 11.5 kilometres is the average distance that Kingston residents travel to work (Royal Borough of Kingston , 2006). This commute is not made by car but typically using public transportation, with the majority of travellers relying on trains. Furthermore, 80% of the workers who use public transportation to get to work are car owners (Royal Borough of Kingston , 2006). Alternatively, students travel to school using cars or by walking. It is planned that this trend of decreasing reliance on cars will continue as more people begin to use alternate modes of transportation (Royal Borough of Kingston , 2006).

Roughly 76% of households in The Kingston Borough own at least one car. The following table provides a more detailed analysis of automobile ownership in the borough.

Table 1: Car Ownership in the Royal Borough of Kingston
(Royal Borough of Kingston , 2009)

	Number of households	Percentage of households
No car	14,621	23.8
One car	29,049	47.3
Two cars	14,336	23.3
Three cars	2,669	4.3
Four or more cars	751	1.2
Total households	61,426	100

On average, residents make three trips a day. Due to high automobile ownership: car, van, and lorry usage constitute 52% of the transportation share in The Borough. Walking then follows with 29%, use of public transport accounts for 15%, and cycling with only 3% (see Figure 2).

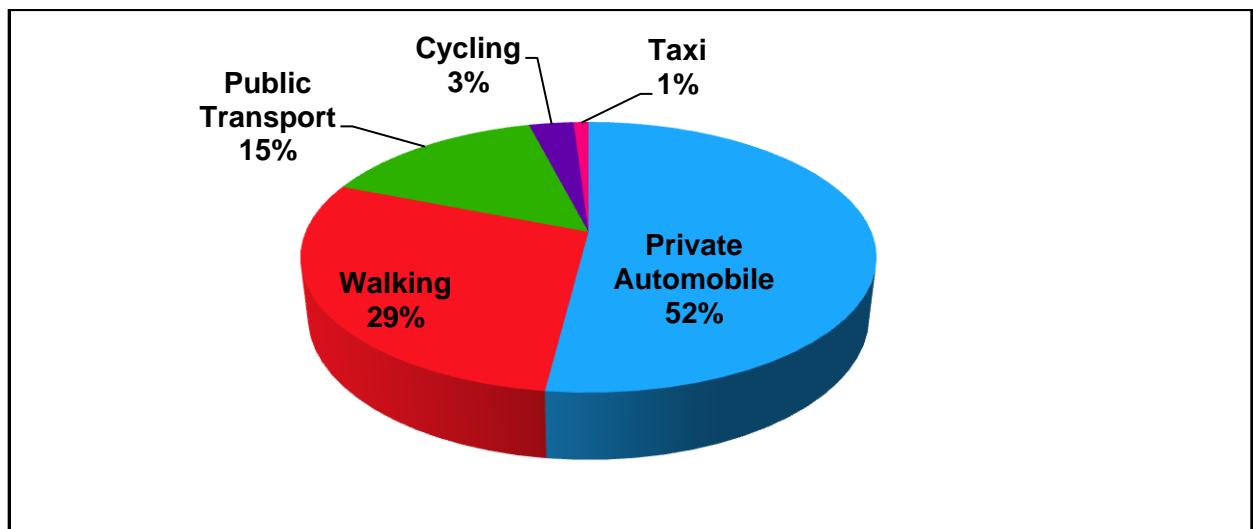


Figure 2: Percentage of Residents who Utilize the Various Modes of Transportation in the Kingston Borough
(Royal Borough of Kingston , 2009; Kingston Council, 2009)

These statistics are imperative to understanding the dependency residents have on current forms of transportation. It is evident that in order to compete with private automobile use, alternative transportation options must be presented in an appealing manner to attract new users (Royal Borough of Kingston , 2006).

One of the focal points of our project is concerned with the primary modes of transportation used for short journeys within The Borough. Data taken from 2001 shows a heavy reliance on cars, vans, and lorries for short distance trips. Better public transportation orbital links could help reduce car trips as The Kingston Council is expecting an increase in the public's use of multimodal transportation options from the year 2001 to 2011. It is anticipated that residents will further increase their use of public transportation with the establishment of a resource that simplifies the use of multimodal transportation (Royal Borough of Kingston , 2006).

Examining demographics, community layout, and transportation usage in Kingston does not provide us sufficient analysis of the forces behind transportation development. Understanding the strategic design of multimodal transportation networks and their respective historical usage trends will complement the aforementioned information and help us better comprehend the driving forces for a multimodal transportation map.

2.2 Strategic Transportation Planning Policies

Transportation policies directly influence the modes of transportation that are made available to potential travellers. Therefore, it is important to review transportation policies that may influence both planning decisions and people's habits. The following section examines transportation policies at different levels of government to convey the hierarchical pathways of transportation planning. In Figure 3, each pyramid level represents the political boundaries policies have and how they are specifically developed to meet certain concerns.

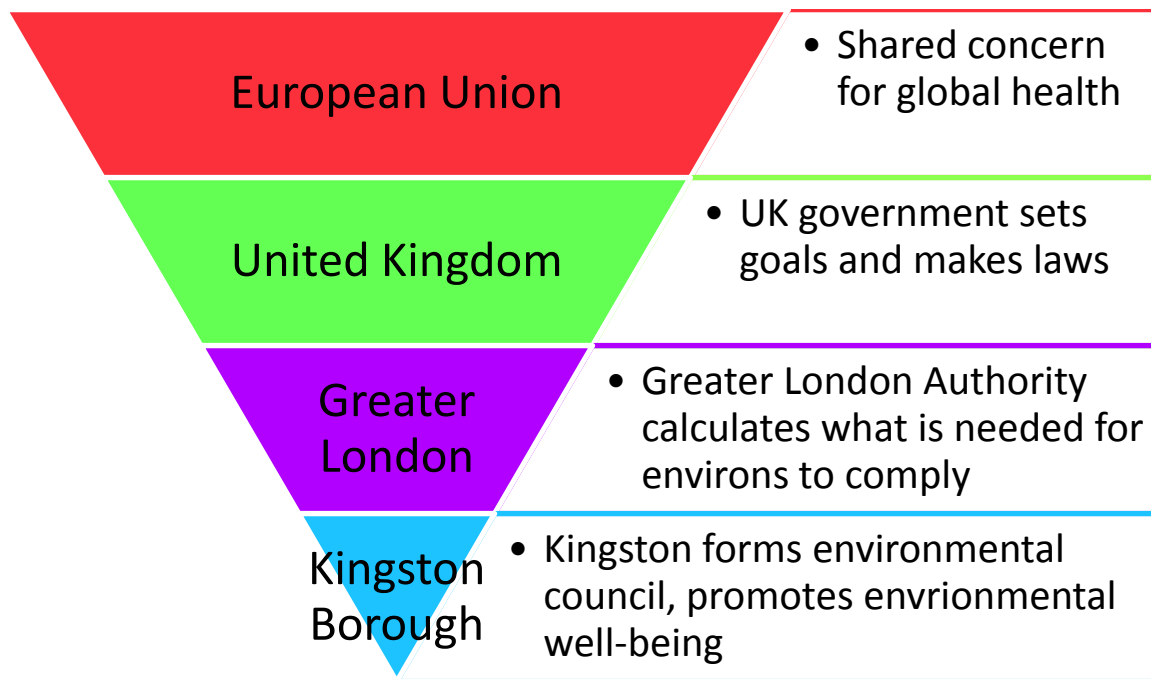


Figure 3: Breadth of Focus in Transportation Policies

Transportation policies developed in an atmosphere of democratic dialogue express both governmental and residential consciousness of mobility. We envision transportation policies developed in Western Europe to be the result of governments anticipating the future transportation needs of its citizens, where citizens conversely define their personal transportation needs by degrees of political interest and economic constraint. The following section examines international, national, regional and municipal policies. These examinations will establish the motivating factors behind this project.

2.2.1 European Union Transportation Policies and the Environment

In 2001, the European Union published *European Transport Policy for 2010: Time to Decide*. The document is a proposal specifically for transportation policies within the EU. It establishes the vital role transportation has on economic development and observes an, “unequal growth in the different modes of transport” (European Union, 2001). In an age of rapid transport, the automobile has congested many of the main roads

and urban centres throughout EU nations. Overall, this has posed, “negative effects on the environment and public health” (European Union, 2001).

The increased usage of private automobiles has greatly contributed to the degradation of public and environmental health and thus becomes a specific concern in the report. According to data made available to the EU, 84% of EU CO₂ transportation emissions came from road transportation alone (European Union, 2001). The authors of the report argue that widespread use of the automobile is irrational because of the relative inefficiency in an automobile’s energy usage versus passenger capacity when compared to the energy usage and passenger capacity in other transportation options such as buses and trains (European Union, 2001).

To address this issue, the EU proposes the development of “high-quality urban transport” along with emphasizing “intermodality” (European Union, 2001). This demands that forms of public transportation need to be more integrated. Metro lines, national rail stations, bus stations, and car parks would need to be linked in order to allow the rapid interchange among different modes of transportation. The EU report asserts that permitting a trend of increased automobile use in its member nations is dangerous and affirms that its proposed transportation revisions will help the EU collectively reduce automobile use in order to attain CO₂ reduction goals set by the Kyoto Protocol. By upholding CO₂ reduction goals, it is believed that environmental and public health can be improved (European Union, 2001).

2.2.2 United Kingdom Transportation Policies and the Environment

In 1998, several years before the EU took a definitive stance on the future of 21st century mass transit, the necessity of alternative transportation, and the reduction of CO₂ emissions from automobiles, the United Kingdom’s Department for Transportation published a document called *A New Deal for Transport* (DfT). Much like the EU did a couple of years later, the government took a critical stance on CO₂ emissions from automobiles. The authors point to carbon dioxide’s suspected role in contributing to climate change, a phenomenon that would result in increased occurrences of severe weather and long term environmental changes. The DfT maintains that the onset of these environmental incidents would jeopardize the cultural and economic stability of the United Kingdom (United Kingdom Department for Transport, 1998). The DfT also finds

road traffic levels and congestion problematic. Congestion negatively impacts the state of urban health by concentrating hazardous emissions, subtracting from the nation's aims for personal and economic efficiency, and unnecessarily imperilling drivers, pedestrians, and cyclists. (United Kingdom Department for Transport, 1998). The DfT contends that congested roads are a large consequence of the automobile.

The DfT furthermore forecasts an increase in private automobile use. They blame recent consumer automobile options for the diminished state of public transportation. They state that increased voluntary automobile use led to decreased public transportation ridership, therefore compelling transportation authorities to reduce services and increase fares (United Kingdom Department for Transport, 1998). This established a widespread perception to potential users that public transportation was unreliable, inaccessible, and expensive. Considering the malignancies of automobile transportation and the merits of public and non-motorized transportation, the United Kingdom's DfT announces its plan for a paradigm shift in transportation. The DfT highlights the methods required for such a shift, which most notably include,

- “integration within and between different types of transport - so that each contributes its full potential and people can move easily between them;
- integration with the environment - so that our transport choices support a better environment;” (United Kingdom Department for Transport, 1998).

Much as the EU would suggest three years later, the UK's DfT proposes that bolstering park and ride schemes with rail stations, increasing bus ridership, and rendering non-motorized options such as cycling and walking more amenable would all be proper channels for decreasing automobile use and establishing a more suitable 21st century transportation network.

2.2.3 Greater London Transportation Policies and the Environment

As policies were drafted and published by the EU and UK, London was not far behind in assessing the future of its region wide transportation system. In fact, after considering the onset of rapid urban changes and heightened environmental awareness, London's local governing body,

known as the Greater London Authority (GLA), began developing binding strategic planning policies for the metropolis in 1999. These strategies were compiled, published, and endorsed in 2004 and came to be known officially as *The London Plan*. A new version was drafted in 2009 and a second final edition is expected in 2011 (Greater London Authority, 2009).

The London Plan (TLP) addresses a breadth of issues that modern cities encounter, such as housing, development, commerce, culture, and public health issues. Most notably however, the document attends to transportation infrastructure, urban planning, and environmental concerns (Greater London Authority, 2009). Although each of these topics are allotted their own respective chapters in the document, the GLA suspected that strategically planning for these issues beside other metropolitan issues constricted the proper focus necessary to outline effective transportation proposals and policies.

Thus, a separate strategic planning document entitled *The Mayor's Transport Strategy* (MTS) was drafted in 2001 in conjunction with the first drafts of TLP (Greater London Authority, 2009). The MTS was recently redrafted in 2009 for reassessment with the expectation that a refined second edition will be published in the spring of 2010 (Greater London Authority, 2009). The MTS directive outlines hundreds of transportation proposals and policies. The GLA states that attaining these directives,

“...will require a transport system with enhanced capacity and connectivity, that is: efficient and integrated; encourages mode shift to cycling, walking and public transport; is accessible and fair to users; offers value for money; contributes to improving quality of life and the environment...”(Greater London Authority, 2009).

The MTS specifically calls for all government bodies within greater London, including borough councils, to locally implement proper measures in order to align London's transportation infrastructure with the aims of the GLA.

2.2.4 Kingston Borough Transportation Policies and the Environment

In order to adhere to the strategic transportation planning policies outlined in the MTS, The Kingston Council published a Local Implementation Plan (LIP). It was first drafted and reviewed in 2005 and the first edition was published in 2006. The document was approved by the GLA as specific guide for The Kingston Council to manage its transportation policies up to the year 2011. The Kingston Council believed that

increasing local transportation demands in The Borough could be better fulfilled with, “greater reliance on non-car modes of transport” (Royal Borough of Kingston , 2006). Central to the LIP is instituting a decrease in private automobile usage for local journeys within The Borough.

The LIP approaches the issue of automobile use similar to the aforementioned international, national, and metropolitan policies. With the support of congestion data, innovative plans are established to make walking and cycling more appealing as transportation options to residents. Various local bus services are also slated for service improvements in order to increase ridership. In order to deliver these bolstered alternative transportation options to travellers and persuade them from using automobiles for short distance travel, the document calls for the creation of a journey planner.

Chapter 3, Section 17 of the LIP refers to data collected by Transport for London (TfL), a government organization that administers public and alternative transportation options for greater London. A July 2004 study suggested that when TfL implemented personalised journey planners for several areas of London, there was an overall 14% reduction in car driver trips, 12% increase in public transport usage, 15% increase in walking, and 67% increase in cycling (Royal Borough of Kingston , 2006). This indicates that if a personalised journey planner was designed and implemented to dissuade Kingston travellers from automobile use and persuade them to use public transportation modes, The Council may be better equipped to accomplish its strategic transportation goals. Furthermore, any mechanism potentially attendant to the vision of Kingston’s LIP would consequently satisfy ambitions of the *Mayor’s Transport Strategy, The London Plan*, and numerous national and international policies that aim to lead Western Europeans into more efficient and environmentally sensible modes of transportation.

Review of Kingston’s demographics, layout, and transportation usage in conjunction with The Borough’s governing transportation policies has determined some of the motivating factors behind creating a multimodal transportation map. Our background research suggests that The Council has made alternative transportation modes a priority as a result of environmental factors. A multimodal transportation map would greatly assist commuters with their travel plans and ultimately fulfil the overall objectives of Kingston’s Climate Change and Sustainable Travel Group. Therefore, the

need to identify successful elements of cartographic design and effective interactive mapping platforms is highly relevant as a further point of research.

2.3 International Guidelines for Sustainable Transportation and Factors Enhancing the Experience of Commuters

Currently the information provided to the public about various transportation modes and their respective routes fail to be convenient enough to make them competitive with private automobile use (Kenyon & Lyons, 2002). In order to better understand the key factors in creating a successful multimodal journey planner, we reviewed the WISETRIP case study and the OECD report. The WISETRIP project is an international survey of internet based journey planners, which was conducted throughout the EU and Japan (Aditjandra, Nelson, & Wright, 2008). The OECD report evaluates several countries and outlines ten goals for progressing towards an environmentally sustainable transportation future. These case studies highlight pertinent points that can be compared to our own proposed study, such as the need to decrease public reliance on single mode transportation and increase the use of multimodal transportation by promoting sustainable travel options through the integration of existing modes. With this in mind, we investigated the success factors that various countries and cities have had with respect to:

- 1) Establishing multimodal transportation mapping;
- 2) Providing the commuters with this information.

After revising the WISETRIP study and OECD report we were able to identify main features, which will enhance the commuter's experience in using multimodal transportation.

2.3.1 Important Factors Enhancing Commuter's Experience

András Siegler, Director of the European Commission's DG RTD Transport Directorate, stated, "Transport is one of the Europe's major strengths, and must remain one of its priorities. An efficient transport system is a fundamental condition for sustainable development, wealth and prosperity in Europe", (European Union Transport Research, 2009). Like the EU's Directorate-General for Mobility and Transport, The Kingston Council's Climate Change and Sustainable Travel Group is concerned about the environmental impact of transportation. Both entities acknowledge that before the public

can be expected to readily use alternative multimodal transportation options, there is a need to provide the public with easy access to comprehensible travel information.

The common challenge facing the European Union and The Kingston Council is the visual presentation of multimodal transportation options. While the EU seeks to offer multimodal travel routes primarily within the EU, Kingston Council's Climate Change and Sustainable Travel Group seeks to promote multimodal transportation options within The Borough. The primary question is, what methods does the WISETRIP case study suggest that The Kingston Borough could use to stimulate a modal shift?

While faced with a similar predicament, these two entities seek to create a resource that educates the public on single or multimodal transportation routes within their respective regions. According to András Siegler, "Transport is facing another tough challenge: the reduction of its impact on the environment," (European Union Transport Research, 2009). It therefore comes as no surprise that both the EU and The Kingston Council have a common goal to promote sustainable transportation through the integration of existing transportation modes and the development of intermodal systems. The challenge presented is how to structure a multimodal trip planner so it is comprehensible to a wide cohort of persons.

To minimize the challenges encountered during the establishment of a multimodal transportation resource, the WISETRIP project examined other international case studies from countries within the EU and Japan. The purpose of their investigation was to identify key factors that make multimodal transportation successful. Unfortunately, this case study did not investigate challenges encountered, or areas of failure encountered while creating a website with a multimodal transportation map. All the cases investigated within the WISETRIP case study emphasized the colossal effect transportation information has on a commuter's transportation choices.

The primary aspects affecting a commuter's choices are accessibility, availability, and the quality of the information provided (Kenyon & Lyons, 2002). Although route and schedule information are the most common feature of all multimodal transportation resources, there are other factors that can enhance user satisfaction. According to the international surveys conducted by WISETRIP, the three main factors include: "mode

type covered, information display, and criteria to calculate itineraries” (Aditjandra, Nelson, & Wright, 2008).

Based on the extensive survey conducted by the WISETRIP case study, the following conclusions were deduced. The majority of journey planners cover two groups of multimodal transportation: public transportation and private car journey information in addition to public transportation options (Aditjandra, Nelson, & Wright, 2008). This is an effective way of sorting the information presented to the commuters.

It is known that visual displays of transportation information enhance user comprehensibility. It is therefore not surprising that, “map based information supported by tabulated results are the most common means of presenting results to users” (Aditjandra, Nelson, & Wright, 2008). Additionally, these tabulated results are usually accompanied with route diagrams (Aditjandra, Nelson, & Wright, 2008). Since The Kingston Council’s primary goal is to decrease automobile use and increase alternative transport use, it is imperative that we consider the effect of these visual tactics on simplifying information.

Almost all journey planners reviewed by the WISETRIP case study calculate personalised travel directions based on minimizing travel time as well as the number of transfers between and within modes (Aditjandra, Nelson, & Wright, 2008). The Intermodal Journey Planner from Germany enables users to plan their journeys by specifying a variety of factors which include: the number transfers desired, walking speed, and undesired modes of transportation (Aditjandra, Nelson, & Wright, 2008). This aspect of online multimodal journey planners appears to enhance user satisfaction, as it provides a user with quick and efficient routes (Aditjandra, Nelson, & Wright, 2008).

In order to create an efficient multimodal journey planner it is vital that the public is provided with accurate comprehensible travel information. While it is important not to crowd a map with irrelevant information, it is crucial that a map displays enough information to assist commuters in making informed travel decisions. The preceding paragraphs highlight three successful features of multimodal journey planners that relay vital pieces of information:

- “Display of information
- Criteria to calculate information

- Mode type covered” (Aditjandra, Nelson, & Wright, 2008)

Since the key is to provide the public with comprehensible information, it is not surprising that these three features have been observed to enhance the commuter’s experience in using multimodal transportation. In sum, it can be said that these features refine the process of using an online resource. They provide the commuter with detailed information that allows for more informed choices thus reducing travel time, increasing flexibility, and ultimately make their use competitive with the private automobile. These features begin to form the core of a multimodal journey planner.

It should be noted that our project goal is to create a multimodal transportation map, not a multimodal journey planner. However, we believe that this would be the next step for The Kingston Council to consider in order to increase public use of alternative transportation options. Consequently, the WISETRIP case study will aid us in formulating a list of recommendations that the Council can consider during the design of a multimodal journey planner. In order to formulate efficient and feasible recommendations for The Kingston Borough, the following section examines an implementation and maintenance process for establishing multimodal transportation mapping.

2.3.2 Sustainable Transportation Evaluation and Guidelines

The Organisation for Economic Co-Operation and Development (OECD) has overviewed various sustainable transportation systems that provide “economically viable and socially acceptable access to people” (Thaler, 2010). This report examines the establishment of sustainable transportation in: Austria, Canada, France, Germany, Italy, Japan, The Netherlands, Norway, Sweden, and Switzerland, and summarizes the strengths and weakness encountered during implementation and operation.

Problematic issues arise in trying to evolve a sustainable transportation system. Economically, supporting a new transportation infrastructure induces public ambivalence. The general public’s conception of present-day transportation versus sustainable transportation is a key issue. In the United States, data identifies an emerging support for sustainable development. However, the data also suggests that the public is not ready to reduce their dependency on private automobiles. In the UK taxes on petrol, congestion

charges and parking fees are also proving to be undesirable tactics, as negative reinforcement causes public opposition to sustainable transportation to rise.

Researchers suggest as the public's education increases, opinions will eventually change, however no major change has been evaluated in the United States. Moreover, to effectively change travel options requires considering three topics: "land use and location, modes offered and chosen, and overall activity patterns". Ultimately, sustainable transportation implementation can only be achieved by addressing public opinion and support (Deakin, 2003). Public opinion and support can be garnered through the availability of online resources, which will raise awareness of alternative travel options.

Since the cultivation of public support is a key factor in the success of sustainable transportation networks, it is vital that setbacks are diminished. For this reason, sustainable transportation setbacks have been thoroughly examined in the abovementioned countries. Consequently, the OECD has promoted ten essential guidelines to stimulate progress toward a more viable and environmentally sustainable transportation system. The primary guideline of the OECD report is a long-term goal that is practical, follows policies, and motivates action. Other factors are "determining whether the country or town is on the right path", incorporating "health and environmental quality objectives" into all transportation policies, and evaluating the economic implications of constructing an environmentally sustainable transportation system. Additional guidelines include the necessary developments or changes needed in technology to advance transportation options, a detailed schedule to effectively implement a sustainable transportation plan, and a monitoring system for the developing infrastructure changes. The most fundamental guideline is garnering public support. If these guidelines can be implemented, the result would likely promote a transportation system with minimal setbacks (Organisation For Economic Co-Operation And Development, 2001). Table 2 presents these guidelines on the following page.

Table 2: The EST Guidelines
(Organisation For Economic Co-Operation And Development, 2001)

Guideline 1.	<i>Develop a long-term vision of a desirable transport future</i> that is sustainable for environment and health and provides the benefits of mobility and access.
Guideline 2.	<i>Assess long-term transport trends, considering all aspects of transport</i> , their health and environmental impacts, and the economic and social implications of continuing with ‘business as usual’.
Guideline 3.	<i>Define health and environmental quality objectives</i> based on health and environmental criteria, standards, and sustainability requirements.
Guideline 4.	<i>Set quantified, sector-specific targets</i> derived from the environmental and health quality objectives, and set target dates and milestones.
Guideline 5.	<i>Identify strategies to achieve EST</i> and combinations of measures to ensure technological enhancement and changes in transport activity.
Guideline 6.	<i>Assess the social and economic implications of the vision</i> , and ensure they are consistent with social and economic sustainability.
Guideline 7.	<i>Construct packages of measures and instruments</i> for reaching the milestones and targets of EST. Highlight ‘win-win’ strategies incorporating, in particular, technology policy, infrastructure investment, pricing, transport demand and traffic management, improvement of public transport, and encouragement of walking and cycling; capture synergies (e.g., those contributing to improved road safety) and avoid counteracting effects among instruments.
Guideline 8.	<i>Develop an implementation plan</i> that involves the well-phased application of packages of instruments capable of achieving EST taking into account local, regional, and national circumstances. Set a clear timetable and assign responsibilities for implementation. Assess whether proposed policies, plans, and programmes contribute to or counteract EST in transport and associated sectors using tools such as Strategic Environmental Assessment (SEA).
Guideline 9.	<i>Set provisions for monitoring implementation and for public reporting on the EST strategy</i> ; use consistent, well-defined sustainable transport indicators to communicate the results; ensure follow-up action to adapt the strategy according to inputs received and new scientific evidence.
Guideline 10.	<i>Build broad support and co-operation for implementing EST</i> ; involve concerned parties, ensure their active support and commitment, and enable broad public participation; raise public awareness and provide education programmes. Ensure that all actions are consistent with global responsibility for sustainable development.

Overall, the *EST* Guidelines provide a compilation of the ultimate strategies toward achieving a better transportation system. The strategies of development and implementation towards a sustainable transportation system are directly correlated to public support. In order to effectively implement the *EST* process, the public must be involved to “ensure widespread awareness, understanding, commitment, and acceptance” (Thaler, 2010).

In conclusion, the OECD report specifically aids us by providing recommendations for further development of the multimodal transportation map. Furthermore, after evaluating both the WISETRIP case study and the OECD report, we are now better able to design a multimodal transportation map which will meet the public’s need. In the next section we will review distinctive features in order to establish an effective layout for The Borough’s multimodal interactive map.

2.4 Aesthetics, Design, and Layout of Maps

A well-designed map is an effective tool for communicating directions (Agrawala & Stolte, 2000). A good map has data presented efficiently so it is informative without being overwhelming (Agrawala & Stolte, 2000). Producing an effective map requires an accurate representation of data and information with a legend that efficiently displays symbols and their respective meanings (Ormsby, Napoleon, Burke, Groessl, & Feaster, 2004). According to Agrawala & Stolte, an effective map should have four design goals: “readability, clarity, completeness, and convenience”. In order to make a good map that will garner public support we will be examining the effect of aesthetics, design, and layout on the functionality of maps. Within this section we will investigate:

- General design goals
- Specific aspects of map design

It should be noted that the document written by Agrawala & Stolte refers specifically to the design of route maps. Although we are designing a sustainable transportation map and not a route map, this document provides relevant information about the cartographer’s design goals and variables.

2.4.1 The Cartographer's Design Goals

Design goals are central to making an effective map. They provide the cartographer with key characteristics that are essential to making a good map. Consequently, prior to creating and designing a map it is important that we obtain a thorough understanding of the four design goals. Figure 4 indicates the relationship between the four goals. From Figure 4 it can be seen that each goal is equally important and dependent on the other.

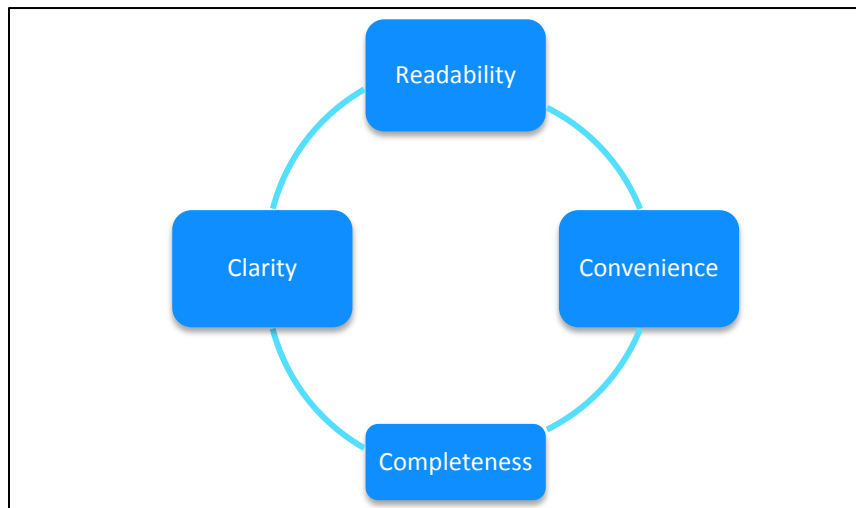


Figure 4: Cartographer's Design Goals

Modified From
(Agrawala & Stolte, 2000)

"Readability": Each feature of the map should be discernable (Agrawala & Stolte, 2000). This suggests that text, symbols, and images should be appropriately sized and located on the map in order to make it more accessible to all persons with disabilities (WGAG, 2010). For example, from the map displayed in Figure 5 we see that the text is hardly visible. Unfortunately, a zoom option is not included on the website to allow users to obtain a closer look at the information. While the name of the park is clearly displayed, users cannot obtain information on key areas of interest in the park and thus the map fails to communicate its intended message.



Figure 5: Example of an Unreadable Map
(Parramatta Park Trust, 2009)

“Clarity”: Users should be able to ascertain information from a cursory glance; as a result features should be appropriately labelled (Agrawala & Stolte, 2000). It is important that the cartographer carefully evaluates each piece of information ensuring that it relates to the intended purpose of the map. Only relevant information should be included and

extreme care must be taken in ensuring that the information presented does not overwhelm the user (Agrawala & Stolte, 2000). Figure 6 shows that excessive information quickly complicates a map. Since the map is cluttered with information, it is impossible for users to quickly plan their transportation route.

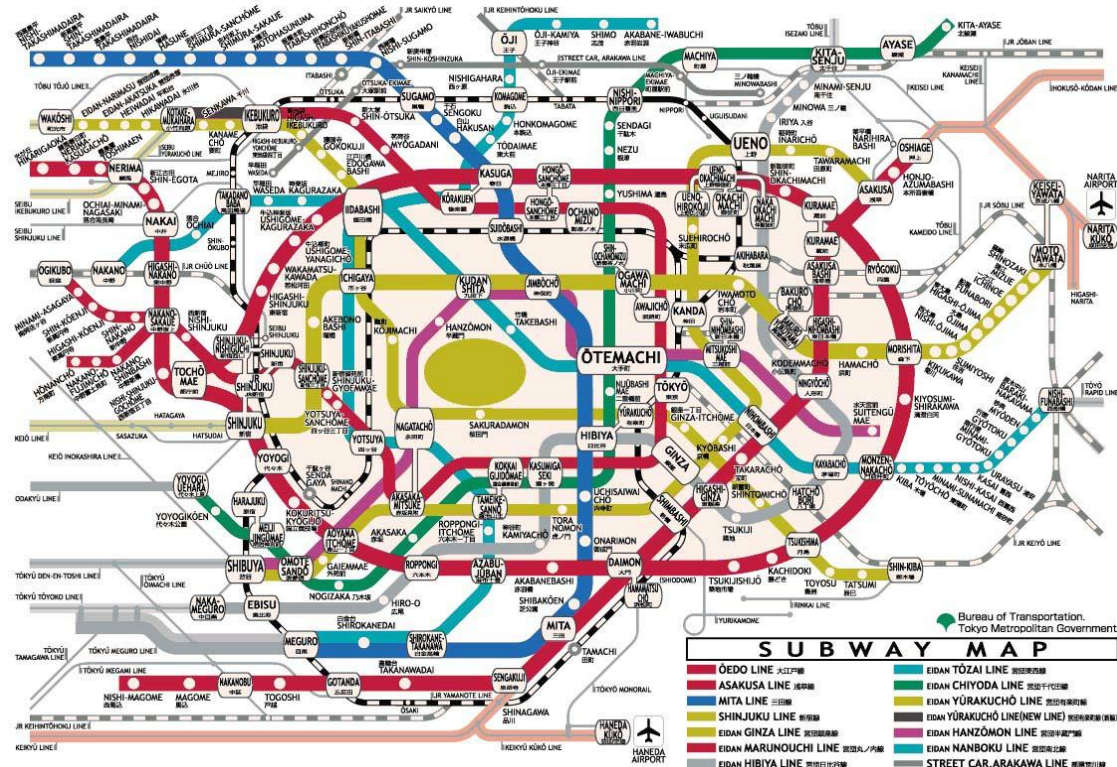


Figure 6: An Example of a Map that is Difficult to Read because It Is Unclear
(Tomorrow Bulletin of Singapore Bloggers, 2005)

- **“Completeness”**: “The map must provide all necessary information for navigation” (Agrawala & Stolte, 2000). Similarly, the multimodal interactive map we create must include all possible transportation options for The Borough including: bus, cycling, private automobile, train, and walking.
- **“Convenience”**: A map should be created with the audience and intended use in mind in order to successfully express information to a user (Agrawala & Stolte, 2000). Figure 6 above provides an example of a map that was created for a niche audience. It almost successfully presents the information to the user. Certain map

characteristics (e.g. symbolization) affect “how we see and interpret maps” (MacEachren, 2004). In particular the map presented in Figure 7 contains two main symbols, and lists the address of each location. The downside of the map is that the Wi-Fi spots are numbered to the side but do not appear on the map. Additionally, the map does not have a key indicating that the number of waves alongside the pin indicates the strength of the Wi-Fi signal.

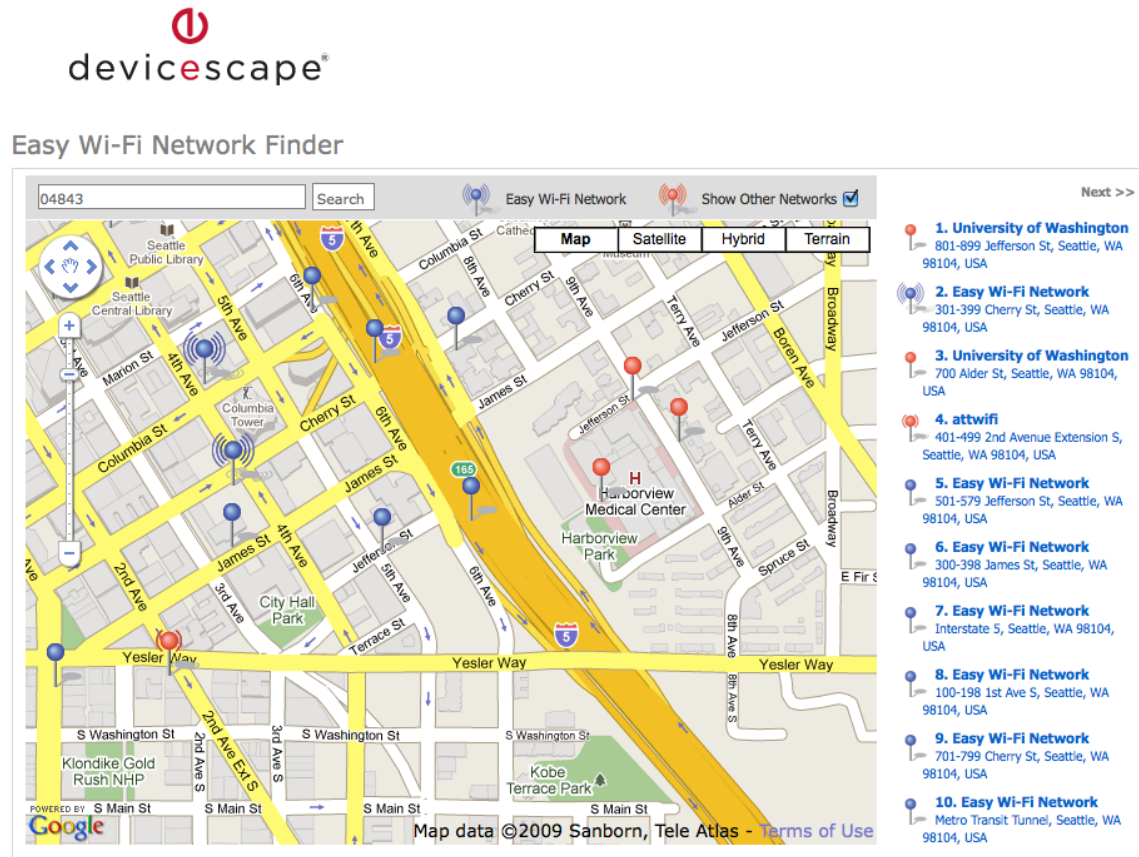


Figure 7: An Example of a Relatively Well Designed Map that Reflects User Convenience (FLEISHMAN, 2009)

It should be noted however that accomplishing the four design goals simultaneously is quite a challenge and thus requires that compromises are made during the design process (Agrawala & Stolte, 2000). This suggests that the cartographer must carefully evaluate when compromises are necessary and unacceptable.

2.4.2 The Cartographer's Aspects of Map Design

Although the design goals govern the basic content and layout of the map, there are more specific aspects of map design that we must consider. The four aspects of map design are: “symbols, colours, layout, and critiquing the whole map” (Krygier & Wood, 2005). Figure 8 located below displays how each aspect of map design interacts with the other and illustrates that once a final product is critiqued, necessary changes should be made to the particular aspect that did not meet design goals.

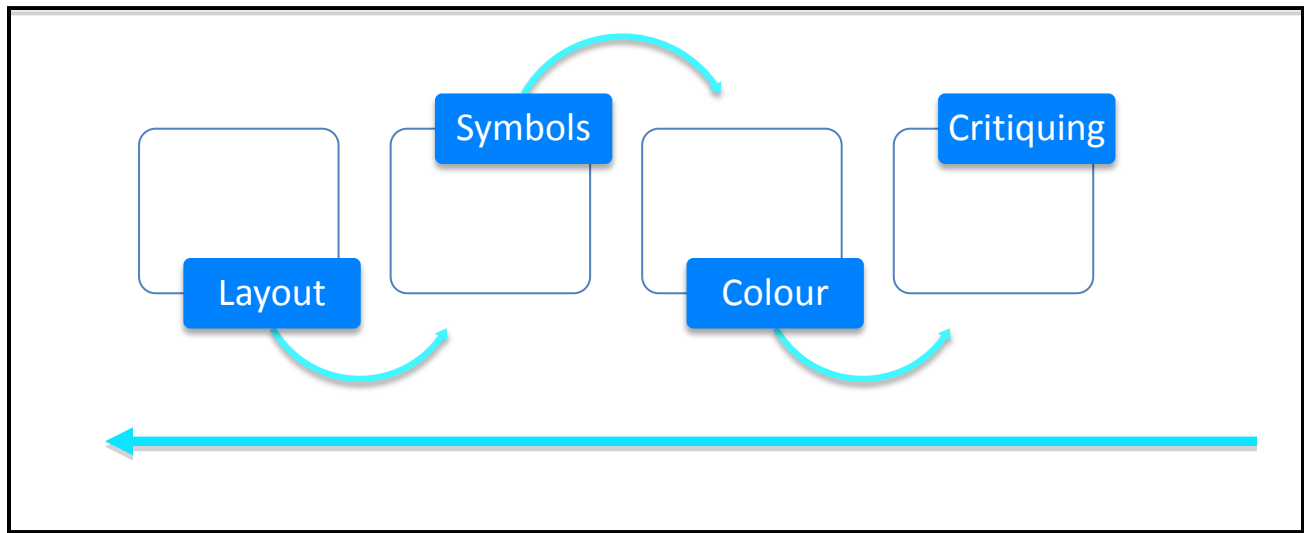


Figure 8: Aspects of Map Design

Modified From
(Krygier & Wood, 2005)

Layout

The layout of a map is very important to its success. A good layout has aesthetic appeal and helps users to efficiently accomplish their goal. “An awkward layout however will distract users from the content of the map” (Krygier & Wood, 2005). Considering the high effect that layout can have on user experience, it is imperative that map layout is considered during the initial stages of design. Consequently, the cartographer must consider:

- “The location of map pieces such as: title, legend, scale, explanatory text, directional indicator, sources and credits, a border, insets, and locator maps;
- How will users view the map;

- The balance of the map; elements should be arranged so they enhance the understanding of the map. “Heavier, larger, and darker, and more complex elements should be placed closer to the edge of the map. On the other hand, lighter, smaller, and simpler elements should be placed on the centre of the map. Additionally, symmetrical or asymmetrical layouts are acceptable.”
(Krygier & Wood, 2005)

It should be noted that there are benefits to utilizing either a symmetrical or asymmetrical layout since users perceive each differently. Table 3 below displays how users may interpret the two different layouts.

Table 3: Comparison Between Symmetrical and Asymmetrical Layouts of Maps
Modified From
(Krygier & Wood, 2005)

Symmetrical	Asymmetrical
Traditional	Modernity
Simplicity	Complexity
Rule following	Creativity

Considering the information presented in Table 3 above it may be best to consider the symmetrical design. Since the aim of this project is to create a map that is easy for most people to use, it is likely that a symmetrical design may be most helpful.

Symbols

“A map symbol is a visual mark systematically linked to the data and concepts shown on a map” (Krygier & Wood, 2005). Symbols can be used to display two main types of data, quantitative and qualitative. With this in mind it is imperative that the appropriate symbols are chosen so they effectively accomplish the cartographer’s goal. Symbols on a map can be selected based on the following categories:

- “Symbols by relationship
- Symbols by resemblance

- Symbols by convention”
(Krygier & Wood, 2005)

After carefully reviewing literature related to the abovementioned categories of symbols, it is apparent that symbols by “resemblance” and by “convention” are the most relevant to our project. Krygier & Wood also suggest that representing symbols by relationship is only a good option when variety in size or quantities need to be displayed on a map, and consequently would not be a good representation for our data. The category “symbols by resemblance” refers to utilizing symbols that resemble concepts, or images that users will be familiar with (Krygier & Wood, 2005). In addition, Judith A. Tyner’s “Principles of Map Design” and Brewer’s “Designing Better Maps: A Guide for GIS Users”, further address symbol selection and symbol design. Symbol selection involves finding the best type of symbol to display a desired location. An example includes using an airplane symbol to represent an airport. The category “symbols by convention” is very similar to category by resemblance, however the symbol is not necessarily an accurate representation of the data. Furthermore, “there is no single best way to represent the data” (Tyner, 2010). An example would include using the symbol of a burger to represent restaurants, even though all restaurants represented on the map may not serve burgers.

Colours

The selection of colours can be quite a challenge. This is because “the appearance of any colour on a map is dependent on the colours surrounding it” (Krygier & Wood, 2005). Colour selection is important because cartographers use colour to efficiently convey the intended message. With this in mind it is important that the map is carefully reviewed to ensure that symbols used convey information in a functional and appealing manner. “An understanding of how to manipulate the three perceptual dimensions of colour (hue, saturation and lightness) is required to create attractive and logical colour sequences for maps” (Harrower & Brewer, 2003).

Critiquing the map

After all the editing has been completed it is important that the map is critically reviewed. This stage of map design involves a detailed review of the map. Areas of failure should be identified so it can be redesigned to produce a higher quality map.

Key questions that must be asked include:

- Does the map accomplish your goal?
- Does the content presented relate to the intended purpose of the map.
- Will the map confuse the user?
- How does the map look on its final medium?

(Krygier & Wood, 2005)

It is evident that the above questions do not cover all the possible ways of evaluating a map. They act more as a guideline, identifying particular questions which we should consider when reviewing the map. After considering these guidelines and understanding the basic mapping concepts of aesthetics, design, and layout, it is important for us to now consider ways to present map information in an interactive way. The following section will provide details on these methods.

2.5 GIS Servers

Mapping applications known as “mash-ups” entail either generating interactive maps with the use of ESRI software or overlaying GIS information onto renowned mapping services, such as Google Maps. In order to select a mapping application that is the most feasible, user friendly, and visually appealing, it is important that we carefully evaluate each option. After performing a detailed evaluation of each mapping application, we will compare them based on their respective features and user familiarity. Within this section we will review:

- ESRI Web ADF
- ESRI REST
- ESRI Flex API
- ESRI JavaScript API

- ESRI Silverlight API
- Google Maps API
- Google Transit Partner Program

2.5.1 ESRI Web ADF

ESRI Web ADF is a web browser based application that includes a wide range of services. It can be accessed through the Web Mapping Application (WMA), a previously formatted application that easily overlays ArcGIS maps. The Web Mapping Application can be accessed with no further development and minimal coding knowledge. However, scaling Web ADF applications creates a major challenge. Since all Web ADF applications are directly linked through an ArcGIS server, the size of the application becomes problematic. “Large use of local connections to ArcGIS server” decreases the overall functionality of the Web ADF interactive map (ESRI, 2010).

2.5.2 ESRI REST

ESRI REST (Representational State Transfer) API (Application Programming Interface) like the Web ADF (Application Developer Framework) application can be used with ArcGIS servers to communicate GIS data on websites. These applications have many different commands that can output various layers of GIS data available on an ArcGIS server. Through the use of REST, a user can produce a particular map display on their web browser given a unique URL (Uniform Resource Locator). This URL, accessed through any standard web browser, is generated through HTML code (ESRI, 2010). Some of this code has been predefined through examples on ESRI’s assistance website. Although REST initially appears user-friendly, these maps are not necessarily comprehensible or visually appealing for the average intended user.

2.5.3 ESRI Flex API

ESRI Flex API is a mapping application that requires a substantial amount of programming within Adobe’s Flex Builder. Development requires a specific ArcGIS file to be opened and edited within Flex Builder software. Once added, the appropriate ArcGIS server must be accessed through Flex Builder using specific commands in order to develop a map. Interactive features and special Adobe Flex software components can be added to each map. Additionally, potential tasks include:

- “Querying
- Locating addresses
- Finding attributes
- Identifying features”

(ESRI, 2010)

2.5.4 ESRI JavaScript API

ESRI JavaScript API is another web application in which web users can access ArcGIS server information in an interactive manner. This platform uses Adobe Flash along with Adobe’s own programming language known as JavaScript. Although this Flash framework does not provide many multi-platform features to users, JavaScript API is easy and quick to develop on account of the sample development code that ESRI has made free to use on its website. Additionally, like most ArcGIS server tools, the JavaScript API can be viewed through any standard web browser (ESRI, 2010). JavaScript API has its advantages, as it uses relatively simple HTML commands and does not require any special programming software.

2.5.5 ESRI Silverlight API

ESRI Silverlight API can access information on an ArcGIS server and visually present it to a user. This platform uses Adobe Flash, a multimedia website development tool, to deliver an interactive map with Microsoft’s unique programming language, Silverlight. This framework, when developed with additional programming software, has the ability to:

- “Search for features or attributes in your GIS data and display the results
- Locate addresses and display the results
- Calculate routes and display graphical results and directions
- Create mash-ups information combined from multiple Web sources”

(ESRI, 2010)

Silverlight API produces highly interactive maps through a standard web browser. It is integrated with Microsoft’s web development software, Visual Studio.

2.5.6 Google Maps API

Google Maps API is another potential online mapping application option. The main advantage with Google Maps API is its respective visual appeal and user familiarity. Commuters are more likely to use this web application when compared with the possible ESRI options. Google also has the ability to generate specific directions based on a users defined search options. However, a major disadvantage with Google Maps presents is that it only works with single transportation options rather than multimodal transportation options. This is a limitation because it may inhibit the creation of a multimodal transportation map. Additionally, Google Maps has strict copyright guidelines. This is a constraint because the data which we need to overlay with Google Maps API is owned by the British Ordnance Survey. Due to this restraint, one could not include: property lines, ward lines, and any other non-derived data (Google, 2010).

A final disadvantage to Google Maps concerns a mapping technicality. The projection data Google uses is different from British Ordnance standards. Google perceives the planet as round using longitude and latitude coordinates whereas the latter perceives the planet as flat and consequently uses different projection data. Alternatively, longitude and latitude coordinates are universal in every country whereas projection data varies from each country. Although Google Maps has several drawbacks, there is no cost involved and the Street View option enhances the user's experience (Google, 2010).

2.5.7 Google Transit Partner Program

Google's Transit Partner Program enables agencies that maintain transportation data to display local transit options on the highly popular Google Maps. An agency wishing to participate in this program can provide Google with specific sets of data and display transit stops, routes, schedules, and estimated fares as well as estimated journey times and step-by-step directions. The agency wishing to make their transit options viewable on Google Maps must produce files known as "General Transit Feed Specifications" that include information pertaining to stops, routes, trips, stop times, and route calendars. Optional files can be submitted in order to integrate fares, frequencies, and transfers into the system. It should be noted that although implementing Google Transit Partner Program is free, it is not possible to develop in the near future as there is currently a waiting list (Google, 2010).

New York City's Metropolitan Transit Authority participation with Google is an operating example of the Google Transit Partner Program. Google Transit Maps enables the display of New York's cycling and subway routes as layers. Additionally, users can obtain journey details for an array of transportation options, which include walking, cycling, subway, and car. When provided with journey details, users are also provided internet links to relevant transportation resources in New York City (Google, 2010). Similar to Google Maps API, this application does not facilitate multimodal transportation options. This is an important factor to consider since it will inhibit the creation of multimodal options for the transportation map (Google, 2010).

2.5.8 Comparative Assessment of Various Mapping Applications

To provide a summary of the abovementioned options, Table 4 presents a comparison between the five ESRI options (REST, Web ADF, Flex API, JavaScript API, and Silverlight API), and the two Google options.

Table 4: Comparison of Mapping Applications

	ESRI Rest	ESRI Web ADF	ESRI Flex API	ESRI JavaScript API	ESRI Silverlight API	Google API	Google Transit
Journey Plan	✓	✓	✓	✓	✓	✓	✓
Multimodal Journey Plan	✓	✓					
Access ArcObjects		✓	✓		✓		
Add/Remove/Re order map service layers		✓	✓		✓		
Change layer definitions on map service layers	✓	✓				✓	✓
Maptips (point, polygons)	✓	✓	✓	✓	✓		
IDE integration and controls		✓	✓		✓		
Custom Data Sources	✓	✓	✓	✓	✓		
Prints ArcMap (layouts)		✓	✓	✓	✓	✓	✓
Add/Remove/Re order map service layers		✓	✓		✓		✓
User familiarity	Unknown	Unknown	Unknown	Unknown	Unknown	High	High
Mobile Devices	✓		✓	✓	✓	✓	✓

In sum, the ESRI website does not explain the development and outcome of REST or Web ADF for people who have limited knowledge of HTML coding and GIS databases. JavaScript API, Silverlight API, and both Google mapping applications appear to be the best possible options in developing a visually appealing interactive map (ESRI, 2009).

2.6 Evaluation of ArcGIS Server Web Applications

After completing significant research on a range of web mapping applications compatible with ArcGIS server, we will evaluate each application considering specific criteria. The goal of this project requires the synthesis of maps that are easy to use,

attractive, unambiguous, and utilitarian. Therefore, we will evaluate each application based on its user interface and visual appeal. The ideal web application should permit the development of various interactive features, such as GIS layer management and query tools.

We will then evaluate web applications based on their ease of development, maintenance, compatibility, and use. Consequently, we would like to suggest a web application for The Kingston Council that is quick to develop yet does not compromise functionality or user interface quality. Functionality and user interface are deciding factors because the map must assist The Kingston Council achieve their goal of increasing the integration of transportation modes through public support.

Each application will then be critically evaluated with respect to its performance reputation. The performance reputation of a web application will be achieved by appraising the statements and opinion of professional programmers who work with web mapping applications regularly. The evaluation of this parameter is important because we would like to provide The Kingston Council's GIS and ICT Department with a web application that is simple to maintain. Therefore, we will identify the programming language of each application to see if it is the same as any of the ICT's main programming languages and if it is compatible with their software packages. The ICT Department's level of familiarity with the programming language of the selected web application is important because an adequately maintained map is central to providing the commuters with relevant and accurate transportation information. The interactive map will only be a practical endeavour to The Kingston Council if it can be easily integrated into the council's pre-existing technology.

The information we will be processing and completing for use on the worldwide web is subject to Copyright restrictions. Consequently there are possible legal constraints for improper use and distribution. This is an area of concern for the project because some of the ArcGIS information we will be using is under strict ownership of the British Ordnance Survey. Allowing a web application to present copy written GIS data to an unauthorized agency would be a legal offence and could result in legal action against The Kingston Council.

In sum, we will evaluate each web application based on: ease of development, use and maintenance, and the protection of sensitive data. Once we have critically reviewed each web application we will then recommend the most appropriate one for The Kingston Council. This process will enable us to suggest a resource for The Kingston Council that can be easily maintained and updated, enabling The Council's ICT Department to continuously provide borough residents with an accurate multimodal transportation map. The selection of a web application prompts us to outline a detailed process for its development.

2.7 Website Design

Website design can determine a website's effectiveness and visual appeal. The presentation of information on a particular website layout can either inhibit access to information and frustrate a user or confer information clearly and promote increased web traffic. Therefore, a successful internet based presentation of alternative travel options for The Royal Borough of Kingston is extremely important. We anticipate that commuters will not only utilize the map and its web layout because they are unfamiliar with journey details but also learn more about alternative transportation options. Disorder and ineffectiveness of the map's respective web page must be minimized because choosing alternative transportation options such as walking, cycling, and bus over the automobile is already considered an inconvenience. Consequently, successful website design is defined as the production of a web page that is clear and intuitive.

2.7.1 Elements of Successful Website Design

The academic and professional field of information technology overwhelmingly comments on successful web site design. Professor Jonathan Palmer evaluates web site design in his paper, "Web Site Usability, Design, and Performance Metrics." Palmer defines website success with frequency of use, a user's likelihood of return, and the overall satisfaction of a user's experience (Palmer, 2002). Professors Ping Zhang and Gisela M. von Dran make a similar argument in "Satisfiers and Dissatisfiers: A Two-Factor Model for Website Design and Evaluation." According to Zhang and von Dran, an indication of successful website design involves a situation where, "Satisfied users may spend a longer time at a Website, may revisit the Website, and may recommend the

Website to others” (Dran & Zhang, 2000). These definitions of website success are important to consider. Successful web design may contribute to commuters learning more about alternative transportation options within The Borough, therefore decreasing local automobile trips.

Several of Palmer’s conclusions are relevant and suggest ways to construct a successful website. He states that navigation patterns must be consistent and coherent on a web site. Additionally, Palmer contends that web site content and interactivity should be enhanced through clear and readable layouts (Palmer, 2002). Examining website design from a different perspective, Von Dran and Zhang state that a website should retain a harmonious mixture of two website design factors known as “hygiene” and “motivator”. Hygiene factors are defined as the “functional and serviceable” elements of a website and motivator factors are defined as elements that pertain to user satisfaction (Dran & Zhang, 2000). Von Dran and Zhang contend that both of these factors influence the effectiveness of a website’s design and ultimately determine its success.

To further support the arguments of Palmer, von Dran, and Zhang, an article entitled “Determinants of Successful Website Design: Relative Importance and Recommendations for Effectiveness” by Professors Dave Gehrke and Efraim Turban offers specific suggestions for website designers who want to make successful e-commerce websites. The authors compile a large amount of website design theories from information technology journals and draw conclusions based upon predominant recommendations of colleagues. Their initial findings reaffirm some of the arguments in the abovementioned literature. Making graphics, “simple and meaningful,” and providing “clear and concise text” with proper spelling and grammar are indeed some of the most essential design elements (Gehrke & Turban, 1999).

Gehrke and Turban assert that the visual appearance of a website should not be overwhelming and the use of textures should be minimized. Conversely, they recommend that “hot buttons” or objects that provide links to other pages be visually distinct and compelling. This can be accomplished by incorporating more colours, textures, and shapes into hot button design (Gehrke & Turban, 1999). Not surprisingly, users often scan websites more quickly than they would scan a paper document because of computer monitor eye strain and the internet’s overwhelming nature. As a result, the authors

contend that, “Headings, subheadings, and text should contain only about one-half of the words one would normally use in a paper document” (Gehrke & Turban, 1999). Thus, the simplification of website text can be accomplished by constructing simple headings, writing brief sentences, composing concise paragraphs, emphasizing select text, and bulleting lists.

2.7.2 Website Accessibility

In order to provide all users with an opportunity to view information on the map’s respective website, it is important to consider accessibility standards, as the rights of the disabled should be taken into account. The UK’s Disability Right’s Commission (DRC), an independent body created by Parliament in 2000, has developed a publicly available document to address general accessibility issues. Entitled, “PAS 78: A guide to good practice in commissioning accessible websites,” the document provides basic guidelines regarding how information technology sectors can make electronic resources accessible to those with disabilities (Disability Right’s Commission, 2006). The document suggests four procedures for web developers who want to make their website accessible.

“Summary for commissioning an accessible website

a) Consider what the site should do and for whom:

— write the accessibility policy/specification (see Clause 6).

b) Consider who is going to create it, and how accessibility can be assured:

— investigate the reputation of those designing and developing the site and the guidelines/processes they uphold (see Annex C).

c) Consider how the web developers are going to create and maintain the website:

— investigate whether the website will be created and maintained manually, using a CMS, or by using an automated web application (see 6.5.3)

— ensure that a plan is in place to maintain levels of accessibility during the website lifecycle (see 8.5).

d) Consider how accessibility will be tested (see Clause 8).”

(Disability Right's Commission, 2006).

The Kingston Council has developed its website with accessibility issues in mind. Its website accessibility policy statement reveals that the website was developed considering the Web Content Accessibility Guidelines (WCAG) of the World Wide Web Consortium (W3C), a technology group that advocates for the disabled and maintains global influence on the accessibility standards of websites (Royal Borough of Kingston, 2010, Disability Right's Commission, 2006). The borough has also tested the accessibility of its website and welcomes further comments from disabled users in order to improve its accessibility interface. Since the design of our website will likely follow a template provided by The Kingston Council's ICT department, the accessibility of the website itself should not be an issue. Feedback from potential disabled users could be sought out with the assistance of The Kingston Council if necessary. The following section synthesizes the preceding literature for creating a multimodal transportation map.

2.8 Summary

The goal of this project is to design and create a localized multimodal transportation that provides users with safe sustainable travel options for short trips within the borough and design a website template. Prior to approaching our project goal it is important that we understand the context of the problem. To this aim we researched historical, geographical, and demographic information on the Royal Borough of Kingston. We then reviewed international and governmental policies that have contributed to the formation of our project. In order to better understand the key factors in creating a successful multimodal journey planner, we reviewed the WISETRIP case study and the OECD report. Each case study contributed important information that will help us to formulate our methodology.

With respect to our proposed product, we have reviewed documents related to map design and layout. This provided us with insight on the visual appeal of map design. Furthermore, we examined possible software applications that we can utilize as a platform to display our final product.

The critical review and analysis of the abovementioned topics has enabled us to understand the context of the problem and identify effective map making practices. This

understanding has prompted us to identify and formulate a specific list of objectives. For each objective we will compose specific tasks which will enable us to accomplish each objective and eventually facilitate the successful completion of this project. To this aim we have identified the following objectives:

- Conduct a ground truth
- Create an ArcGIS Map
- Critical review of other transportation maps
- Edit the map's symbols and layers to enhance the visual appeal
- Obtain feedback on map design
- Evaluate different ArcGIS server web application
- Develop a web application - ESRI JavaScript API
- Develop a website to host the web application

The following section provides a detailed description of how we intend to accomplish each objective, so we can create a multimodal transportation map and design website template.

CHAPTER 3

3.0 METHODOLOGY

The Kingston Council's Climate Change and Sustainable Travel Group is responsible for reducing traffic congestion and the associated pollution caused by private car use in The Kingston Borough. They aim to promote sustainable travel options such as walking, cycling, public transport, car clubs and car sharing. Central to the promotion of sustainable travel options is public support. This support is commonly obtained by providing the public with accessible information on transportation within their environs. The problem facing the Climate Change and Sustainable Travel Group is that there is not a single effective travel map of The Kingston Borough that offers commuters single and multimodal transportation options. To this aim The Kingston Council has outlined a list of goals, which they hope to ultimately accomplish through the creation of a multimodal transportation map. These goals include:

- Reducing traffic congestion caused by private car use in The Borough
- Promoting sustainable travel options
- Raising awareness of alternative travel options and the fact that they can be quicker, cheaper, and healthier.

Considering The Kingston Council's goals, we have generated our own project goal, which will guide us during the design and implementation process. The goal of this project is to design and create a localized multimodal transportation map for The Kingston Council that provides users with safe sustainable travel options for short trips within The Borough, and design a website template. In order to accomplish our goal, we have organized the following objectives:

- Conduct a ground truth
- Create an ArcGIS Map
- Critically review other transportation maps
- Edit the map's symbols and layers to enhance the visual appeal
- Obtain feedback on map design
- Evaluate different ArcGIS server web applications

- Design a website template to host the interactive multimodal transportation map
- Obtain feedback on the design of the website template

In sum, The Kingston Council's goals in conjunction with our specific project goal have aided us in creating our methodological approach. We acknowledge that The Kingston Council's goals are long term; and the effects of our project on their goals cannot be measured within the seven week time period. However, each of our objectives has been carefully designed based on The Kingston Council's goal and our team's project goal. The following sections provide a detailed review of each of our objectives and their associated tasks.

3.1 Conduct a Ground Truth

Currently The Borough supports five main modes of transportation that include: bus, car, cycling, train, and walking. The Kingston Council would like to increase public reliance on these alternative options by highlighting the fact that they can be quicker and easier. It is imperative that the map independently communicates this message while effectively displaying the various transportation options available to commuters. We must therefore obtain a basic understanding of the current transportation practices that exist within the various neighbourhoods. To familiarize ourselves with The Kingston Borough's transportation infrastructure we will take two tours; one by car, and one by bicycle. This process should provide us with additional insight on The Borough's multimodal transportation network. It will facilitate a better understanding of The Kingston Council's goals and help us determine the next several steps of our methodological approach.

We will first tour Kingston utilizing Streetcar, a car club program. This will allow us to observe The Borough's transportation infrastructure and understand the spatial layout of The Borough from a citizen's perspective. This tour will be guided by our liaison, and will cover the following areas: Kingston Town, New Malden, Norbiton, Surbiton, and Chessington. During this tour we shall have a copy of The Kingston cycle maps so we can relate the physical attributes of The Kingston Borough to the symbols and layout presented on the map.

The Local Implementation Plan states that only 3% of residents utilize cycling as their primary mode of transportation (Royal Borough of Kingston , 2006). However, The

Council aims to increase public use, eventually making this one of the primary means of commuting. These points all emphasize the need for a cycling tour. This tour will enable us to understand travelling from a cyclist's perspective and will help us to more effectively design a map that responds to a cyclist's needs.

Overall, this process should provide us with additional insight on The Borough's multimodal transportation network. It will help us to have a better understanding of The Kingston Council's goals and assess how we can further refine our methodological approach. In conjunction, both tours will ultimately assist us in designing a map that meets the commuter's needs from a practical standpoint.

3.2 Critical Review of Other Transportation Maps

In order to enhance the visual presentation of our map, we will review other transportation maps and consider certain attributes. While reviewing these maps we will be primarily paying attention to the: layout, use of symbols, display of polygons, and use of colours. Since there is no perfect map we will obtain this information from looking at a variety of transportation maps from different countries. These include:

- Cambridge, UK Cycling Map
- Portland, Oregon, USA Cycle Map
- Google Maps

Images of these maps are located in Appendix B.

We will first look at the layout of the maps. This refers to the way the map is structured, that is, the arrangement of features including: routes, symbols and labels. For example, we shall examine the offset display of routes in cases where several modes of transportation run parallel to each other. Figure 9 displays three routes, a red route, and an orange and green route which have been offset. By examining these maps, we will be able to gain insight on effectively manipulating features to enhance the presentation of data. Furthermore, we will focus on the location of the title and legend and determine if a symmetrical and asymmetrical layout is best.

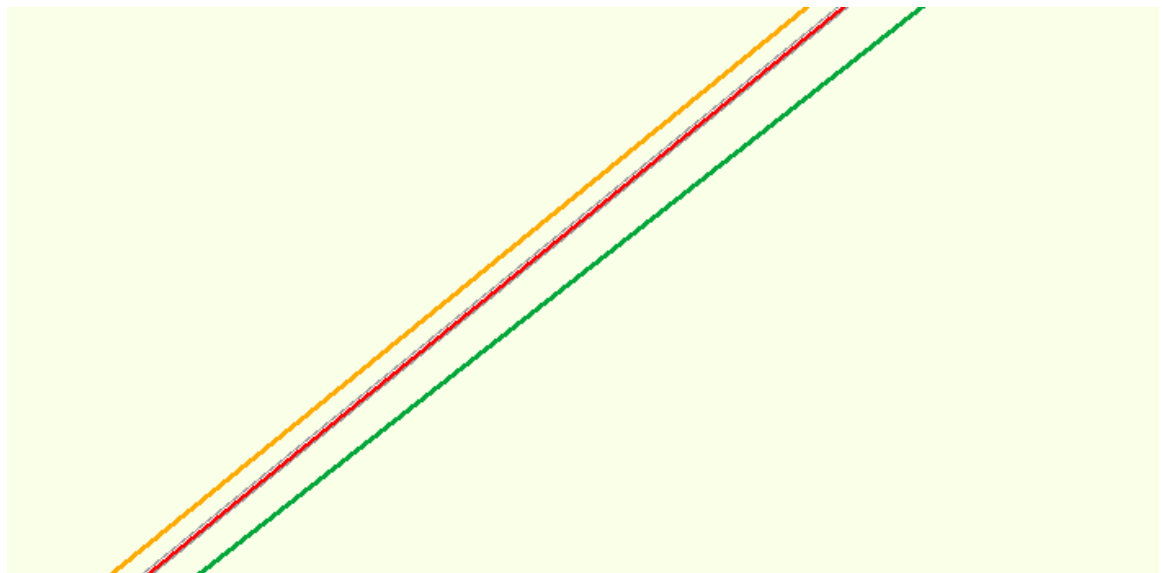


Figure 9: Two Transportation Routes Offset

Selecting symbols is key in creating an effective map that quickly relays information to the user (Krygier & Wood, 2005). From this we can deduce that labels also play an equally important role. Thus we will consider the different symbols used to identify landmarks. We will try and identify if there are particular colours that are commonly used to represent particular concepts. Once we have critically examined the symbols on each of the maps, we will then look at the fonts utilized. We will identify labels, specifically considering the font used, the font size, and the halo surrounding the letters.

Lastly, we will identify the map as a whole regarding its overall appeal and usability. This will enable us to determine whether the layout, colour, symbols, and labels clearly reveal the aim of the map. By examining these characteristics we will be able to gain insight on particular features that enhance the presentation of data. These details are particularly crucial in producing a map that is appealing and user-friendly. By using these maps as guidelines in conjunction with the relevant literature we reviewed, we will be able to effectively edit our map and customize it to achieve our goal.

3.3 Creation of Map Using ArcGIS 9.3.1

A company called Environmental Systems Research Institute (ESRI) produces one of the most popular and effective software mapping tools. They offer a wide variety

of software packages that allow agencies and industries to catalogue, formulate, and distribute spatial data. The Kingston Council's GIS Department utilizes software and electronic services developed by ESRI in order to provide other departments with geographically linked information, which assists with planning decisions pertaining to The Borough (Environmental Systems Institute, Inc, 2010).

In order to be consistent with The Kingston Council's spatial planning software, we will be using specific ESRI software entitled ArcMap, which allows users to import, edit, and publish geographic data in the form of electronic maps. For simplicity, we will continuously refer to this program as ArcGIS 9.3.1, which is the title of a software package ArcMap is often a part of. The next several subsections outline specific tasks we will complete using ArcGIS 9.3.1 in order to begin constructing the multimodal transportation map. To accomplish these tasks we will work closely with our reviewed literature and The Kingston Council's GIS Department.

3.3.1 Identify Popular Destinations

We will identify all of the educational facilities, hospitals, commercial centres, and recreational facilities within The Borough of Kingston. Identifying these landmarks will allow travellers using the map to orient themselves and plan their journey effectively. To this aim we will acquire the location of each landmark from The Kingston Council's GIS database. After this we will add the attributes to the base map as a layer. Since these attributes are all considered as one layer within The Kingston Council's GIS database we will have to add filters so we can group the data into relevant categories. Once data is filtered and categorized, georeferenced data within the same category will have the same symbol; for example all schools will have a book symbol. This is an important aspect of preparing the map since it will allow persons to quickly identify their desired destination. In sum, by mapping these landmarks, the multimodal journey map will be a resourceful tool that commuters can use to plan their journey.

3.3.2 Obtain Data for Mapped Attributes and Layers

After familiarizing ourselves with The Borough we will schedule a meeting with our liaison. This meeting will enable us to establish the specific features that The Kingston Council would like to be displayed on the map. Based on this discussion we

will then compose a master list of the information The Council would like included. After this we will submit a request to the GIS department for the georeferenced data. Once we have obtained the georeferenced data, we will upload the files into ArcGIS 9.3.1.

By uploading these files we begin the process of creating a multimodal map. Once the layers are presented on the map it will provide commuters with a single resource that displays alternative transportation options and promotes the integration of modes. It is essential that this resource provides the public with accurate information so they can efficiently plan their journeys. Consequently, our next objective will outline how we intend to validate the georeferenced data.

3.3.3 Conduct an Audit of Georeferenced Data

Since public support is crucial to the success of our project, it is imperative that the information provided is accurate and up to date. Before we begin editing the aesthetics of the map we will be conducting an audit to determine that all data is up to date, especially the cycle routes that have not been upgraded recently. To facilitate this process we will be creating a list of all layers and attributes that we obtained. We will then present this list to our liaison to determine if there are any layers or attributes that we neglected to include. We will also correspond with the GIS department to ensure that the data obtained has been updated to reflect any recent changes in transportation infrastructure. The completion of this audit will enable us to generate a list of unmapped features that are not currently included on our map.

3.3.4 Map Updates and Georeferenced Data Use

After we have conducted the audit we will then obtain the layers and attributes for which we are missing data. By collecting these we aim to ensure that the map displays all desired modes of transportation and their supporting services. Additionally, if the audit indicates that some of the georeferenced data does not reflect recent changes to transportation infrastructure, we will have to manually implement them in ArcGIS 9.3.1. Overall, this will aid us in having all key modes of transportation and their supporting services on the map so it is truly a multimodal map and offers commuters a wide variety of transportation options in one resource. Once we have completed this process, our next objective will be to display popular destinations such as: educational facilities, hospitals, commercial centres and recreational

facilities. In conclusion, mapping the transportation infrastructure and popular destinations will enable users to effectively plan their routes to their desired destinations using one or several modes of transportation.

3.3.5 Edit the Map's Symbols and Layers to Enhance the Visual Appeal

A well designed map is an effective device for communicating information (Agrawala & Stolte, 2000). The difference between creating a multimodal transportation map and an effective multimodal transportation map is a purposeful and conscious design process. In order to make an effective map that will garner public support, we will be outlining our methodological approach to enhance the visual appeal of the map. In particular, this process should enhance: the aesthetics, the design, and the layout of the map. In order to enhance the aesthetics of the map we will edit the symbols in such a manner that they effectively communicate: the various transportation modes, user-friendliness, and ease of use. Editing the symbols is a process that involves three main stages:

STEP 1: Review all default symbols:

Firstly, we will review all default symbols and determine if they are a good representation of the information we would like to display. Since the purpose of this map is to aid commuters in planning their respective journeys, it is imperative that all symbols utilized explicitly represent transportation facilities and popular destinations. If we use symbols that are abstract, commuters will be confused, and may therefore be less inclined to use the map.

Considering the previously mentioned points in conjunction with the literature and maps we reviewed, we have decided that we will represent symbols based on “resemblance”, or “convention”(Krygier & Wood, 2005). In order to fulfil this requirement, symbols must depict concepts or images that users are already familiar with. For example, it would be more appropriate to use a symbol of a world to represent Chessington World of Adventures. Figure 10 (a) displays the logo for Chessington World of Adventures and Figure 10(b) the symbol that will be used to represent Chessington World of Adventures on the map. From both Figure 10 (a) and Figure 10 (b) it can be seen that it will be easy for commuters to identify symbols on the map once it relates to a concept that they are already familiar with.

**(a) Actual Logo for Chessington
World of Adventures**



**(b) Proposed Symbol for Chessington
World of Adventures**



Figure 10: Symbols by Resemblance
(Merlin Entertainments Group, 2010)

If the default symbol does not depict a particular concept or image that users are already familiar with, then we will include it on a list of symbols that must be changed.

STEP 2: Change symbols

If we identify symbols that do not depict concepts or images that users are already familiar with, then we will have to change the symbol. ArcGIS 9.3.1 has a file with alternative symbols that we can utilize. However, since there are only a limited amount of options for symbols within the ArcGIS 9.3.1 program, we will be downloading more appropriate images from the Internet. After we have downloaded these images, we will then convert them to a .bmp file so they can be uploaded in ArcGIS 9.3.1. By changing these images we will help users to quickly obtain information from the map. We would like commuters to obtain their information primarily from symbols and spend less time consulting the legend.

STEP 3: Change the colour of symbols and layers

After we have selected appropriate images that explicitly relay information to the user, we will then begin to change the colour of the symbols and layers on the map. The selection of colours is a very important aspect of map design. To this aim we intend to use colour effectively to enhance the users' comprehension of the data presented. For example, we will be changing the colour of cycle routes to green, since the cycle routes within The Kingston Borough are marked out with green paint. By selecting the colours that users associate with a particular mode of transportation, we will make it even easier for users to quickly obtain information from the map. This is an important point since when commuters are on the go, obtaining information should be a quick and easy

process. The appearance of a specific colour on the map is dependent on the surrounding colours. With this in mind we will have to review the entire map ensuring that the colour of each symbol and layer looks the same against the varying background of the map.

In sum, the editing of the map's symbols and layers is a process that aids in enhancing the visual appeal of the map. It is important to note that this is not a direct process, and revisions of steps two and three will be carried out during the editing phase as deemed necessary. Steps one through three suggest that editing the map requires a conscious effort.

Although the graphical representation of images on the map has a high effect on user's comprehending the information presented, the layout of the map can also affect the user's interpretation. With this in mind we will have to ensure that the layout and the images on the map work together to display the correct message. Once we have thoroughly edited the graphics and layout of the map, we will convert it to a form that the public can easily use and access. To accomplish this we will be creating an interactive version of the multimodal transportation map.

3.4 Feedback on Map Design and Content

Following the creation of the map, we will need to present the concept of our map and receive feedback from the participants. Understanding our target audience and what they expect from the map is an important process in map design. To this aim, we will conduct two focus groups and an interview to obtain a better understanding of who our target audiences are and how we can create a map that responds directly to their transportation needs. The feedback will assist us in identifying the strengths and weakness of the anticipated interactive map and website. Consequently, each focus group and interview must be appropriately structured so we can attain relevant data within the given time frame.

The questions and leading statements will serve to highlight whether the multimodal maps and the proposed website are sufficient in responding to the needs of the public. The data collected will be used to further suggest which features are the most or least appealing including: appearance, comprehensibility, content, and feasibility. In order to obtain this information, we will be:

- Conducting a focus group with employees of The Kingston Council
- Conducting a focus group with members of a bicycle club
- Conducting an interview with a member of the disabled community

Furthermore, we will use the analysis to compile a set of recommendations for The Kingston Council. A copy of the focus group questions and leading statements is provided within Appendix A.

3.4.1 Focus Group with Employees of The Kingston Council

To best use the time on site, we will conduct a discussion among six people from each of the following sample populations:

- Persons who rely primarily on public transportation
- Persons who rely primarily on bus
- Persons who rely primarily on cycling
- Persons who rely primarily on train
- Persons who rely primarily on walking

The Kingston Council will select the persons for the focus group based on convenience sampling. Since the participants will be volunteers, we will create a promotional email with an attached flyer. We will design this flyer so that it entices persons to volunteer their time and participate. A copy of this flyer is located in Appendix A. Another strategy that we will be employing to attract volunteers is offering a free lunch to each participant.

Prior to conducting the focus group we will establish a date and time for the focus group. We will then reserve a room with multimedia capabilities so we can effectively present the information to the participants while facilitating group discussion.

Information shall be presented in the form of a PowerPoint presentation that includes screen shots, since a functioning version of the website and interactive map may not be ready by the proposed date. In order to facilitate the focus group we will need a facilitator and a minute taker. The facilitator will guide the conversation and the minute taker will collect data from the conversation by actively listening and taking notes.

After we have conducted the focus group and collected the data we will commence the process of analyzing the information. Overall, the focus group will help us assess the attributes, images, comprehensibility, accessibility of the map, and aid us in

determining if the map is responsive to commuters' needs. We will then use this assessment to provide a list of recommendations. The recommendations will assist The Kingston Council in further developing and refining the ArcGIS 9.3.1 map before it is developed into a functional interactive website application.

3.4.2 Focus Group with Members of a Cycling Club

One of The Kingston Council's primary goals is to reduce the amount of automobile based journeys and increase the amount of cycle based journeys within The Borough. Therefore, it is necessary that we gain insight not only on the needs of Kingston's current cyclists but also on the types of map features that would draw Kingston's non-cyclists into utilizing cycling as a means of transportation. In order to do this, we will conduct a focus group with a local cycling group called the Kingston Wheelers, an organization that arranges rides and social events for cyclists with different skill levels. We will present them with open ended questions about journey planners and then eventually shift the discussion towards topics pertaining to the layout and design of our map. The participant feedback from this focus group is intended to assist us in compiling findings and recommendations. We will use the findings to generate a set of recommendations that will assist The Royal Borough of Kingston in refining the multimodal transportation map so it best responds to a cyclist's needs.

3.4.3 Interview with a Member of the Disabled Community

To gain insight on additional accessibility information to include on the map, an interview will be conducted with a disabled member from The Kingston Council. There will be an interviewer and minute taker present in order to prompt and document the responses of the individual. The interviewee will be asked a series of questions to establish her transportation usage. She will then be shown a screen shot from the Transport for London's website of the advanced options feature regarding accessibility, and will be asked about its usefulness. Following this she will be given a print out of The Royal Borough of Kingston's map highlighting the map's accessibility features such as dropped curves. Her comments and suggestions will be taken into consideration and will be presented as recommendations to The Kingston Council.

3.5 Evaluating Different Website Mapping Applications

Website mapping applications translate and communicate ArcGIS data hosted on ArcGIS servers, providing internet users access to a map's respective information in a highly interactive manner. The goal of this project necessitates the synthesis of a map that is easy to use, attractive, unambiguous, and functional. Therefore, we will evaluate each website application explained in Chapter 2. We will pay special attention to each application's interface, visual appeal, and development requirements. The ideal web application should permit the assembly of various interactive features such as layer selection and query tools. We will also compare each website application based on anticipated user familiarity.

Once we have completed our analysis on the range website mapping applications, our focus will shift to developing ESRI JavaScript API, a website mapping application. The purpose of creating the web application is to provide commuters with an interactive medium that effectively promotes the integrated use of transportation modes. Developing an interactive website application will give potential users a greater variety of journey planning options. In order to develop ESRI JavaScript API, we must export our modified GIS data as a specific file, commonly referred to by its official file extension, ".mxd". We will give this .mxd file to an authorized employee from the ICT department so they can place our data on The Kingston Council's highly secure ArcGIS server. Once our data is properly loaded onto The Kingston Council's ArcGIS server, ESRI JavaScript API will communicate the hosted ArcGIS data to users in a highly interactive manner.

3.6 Design a Website Template to Host the Interactive Web Application

The website will serve as a platform to host the interactive map. This website will be accessible from a link located on The Kingston Council's main website, <http://www.kingston.gov.uk>. A limitation that we have encountered is that none of the members of the project team has experience in computer programming. Consequently, we will only be creating a static website template. In order to design the website template we will utilize Microsoft PowerPoint and Paint.

While creating the website, we shall keep in mind that it is important that the website helps both users and the owner of the site achieve their goals. The goal of users is to be able to obtain useful information that can help them to plan their single or

multimodal journey. To this aim we intend to provide links to useful sites. For example, each car park charges an hourly individual fee. We shall provide a link to the car park web page within The Kingston Council website that provides each car park's hourly rate as well as links to buy car park season tickets. We believe that inserting hyperlinks to related websites shall enhance the users' experience since they will be able to plan their journey more effectively.

Although content of the website is important, the layout is also a focal point during design. Within the website we shall also pay attention to the amount of focus we give to each element. For example, primary things which will be highlighted include: the name of the webpage, the site logo, a link to a help bar, the various layers, and the map. Other components, which will have less of a focus, may include site navigation, and contact information for the company.

In sum, the creation of the website will enable The Kingston Council and commuters to accomplish their respective goals. Once users successfully plan their journey through the use of the website, The Kingston Council would have improved sustainable transportation use within The Borough. To ensure that both the website is user-friendly and displays relevant information, we will conduct a focus group. The information obtained from the focus group will highlight the strengths and weaknesses of the website. This will therefore enable us to identify recommendations for improving the resources.

3.7 Feedback on Website Template: Informal Interview With Members of The Kingston Council

As our map is intended for use on the internet, it is important that we evaluate it for functionality. We will do this by presenting our website template to former participants of our first focus group, which was comprised of individuals who use various forms of transportation. We will conduct informal interviews lasting no longer than ten minutes, as we figure that this should be adequate to receive a substantial amount of comments and suggestions. We will show each participant five different samples of the website template. The first sample will present the home page which lists all the journey planning options. The other four samples each display an image of the main town centres: Kingston Town, Surbiton, Tolworth, and Chessington. We will also briefly explain how

we intend for users to interact with the website. Each participant will be given sufficient time to view the template before responding with their impressions. The participants' comments and suggestions will be recorded while the interview is being conducted. We will then evaluate the responses in order to provide The Kingston Council with recommendations for improving the content and layout of the proposed website.

CHAPTER 4

4.0 FINDINGS

The goal of this project is to design and create a localized multimodal transportation map for The Kingston Council that provides users with safe sustainable travel options for short trips within The Borough, and design a website template. As we completed each methodological objective, we compiled the results. The analysis of our results has led us to identify several recurrent themes which represent our major accomplishments and findings.

- Making the RBK map distinct from the TfL map
- Best practice for map design
- RBK map and how it reflects best practice
- Feedback for map
- Findings for website template

This section presents a critical analysis of each theme highlighting the strengths and the weaknesses in the data collected.

4.1 Making the RBK Map Distinct from the TfL Map

The creation of The Royal Borough of Kingston (RBK) map was prompted by the need to create a local travel map that focuses on getting around in The Borough using single or multimodal transportation. Through the creation of this map The Kingston Council aims to promote sustainable travel options such as walking, cycling, public transportation, and car clubs. It should be noted however, that the purpose of this map is not to replace the TfL map but to compliment it, offering more personal and localized journey planning within The Borough. Although the proposed RBK map will be a micro scale version of the TfL map, it will provide the user with more detailed information while fulfilling the requirements of the Local Implementation Plan (LIP). Figure 11 presented on the following page highlights the differences between the TfL map and the RBK map.

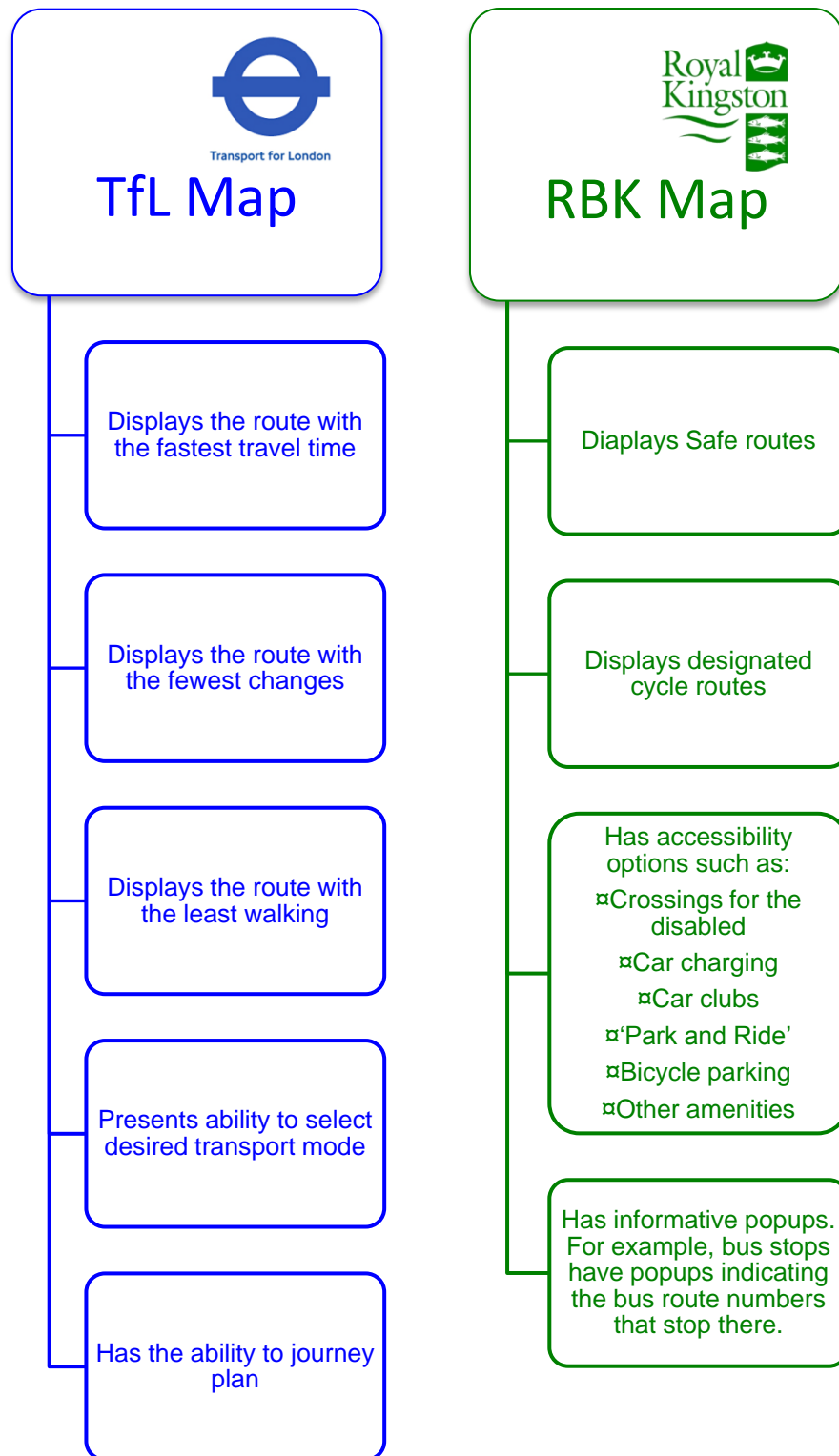


Figure 11: Comparison Between the RBK Map and the TfL Map

An advantage of the RBK map that was not presented in Figure 11 is the fact that this map will allow users the ability to view its content without searching for a particular route.

While Figure 11 highlights the differences between the two maps it is important to remember that the purpose of this map is to compliment the TfL map. It is our aim to present these features in such a way that the map efficiently communicates the message to users. To this aim, the proceeding section shall discuss the best practices of map design; highlighting features that we will include and edit so that the map is readable, visually appealing, informative, and easy to use.

4.2 Best Practices for Map Design

In order to determine best practice for map design, we evaluated three transportation maps. Although the evaluation of these maps has not directly contributed to our conclusions and recommendations, it has positively affected the final design of our map. Before presenting our map to receive feedback we found it highly effective to improve our initial map by examining how other agencies have approached transportation map design. It is important to note that the maps we have reviewed were published by both public and private agencies. Furthermore each map has been specifically catered to the needs of a cyclist. We considered reviewing cycle maps because The Kingston Council is working towards significantly improving cycling resources and increasing the public's reliance on cycling.

Examining these maps for demonstrations of best practice has helped us gain great insight on how to create a visually appealing map. We first evaluated each map based on its layout. Table 8 displayed in Appendix B, presents our analysis of each map's layout by evaluating the effectiveness of the location of titles, scales, and legends. We realised that each map piece should be consciously placed on the map so it does not obstruct the content displayed. For example, although the Portland Cycle Map provides a useful scale, the corresponding map legend is in a location that we, as potential users, considered a hindrance. The Cambridge Cycle Map had a more effective and less obstructive layout for its respective scale and legend. On the other hand, we considered the lack of a legend and the presence of a simplified scale in The Google Transit Cycle Map unexpectedly effective. The use of a legend in a map formatted by Google would likely be redundant considering Google's minimal but relatively effective use of symbols. However, because our map conveys a large amount of information, we have found it appropriate to include a clear and proportional legend.

We continued to look for additional effective features in each of the transportation maps and consequently decided to focus on the use of symbols. An analysis of the Cambridge Cycle Map, as seen in Appendix B, Table 9, has lead us to conclude that an overuse of symbols can be overwhelming and thus negatively affect the user's ability to quickly and easily obtain information from the map. However, the Cambridge Cycle Map displays an example of best practice for map design through its use of simple dotted lines to communicate when cycle routes conjoin with other transportation networks. Another example of best practice for map design is the Portland Cycle Map's utilization of a small yet noticeable symbol to indicate one-way traffic flow on particular streets. We believe that this could be particularly helpful to pedestrians and cyclists so they can plan their journeys more efficiently. Interestingly, the strength of the Google Transit Cycle Map is not necessarily its usage of symbols but rather its overall lack of symbols. However, after considering the vast amount of information that our map communicates, we felt that an overall lack of cycle route information may dissuade a user from making use of alternative transportation. We correspondingly came to modify several of the symbols in our map after observing the dynamic qualitative and quantitative use of symbols in the maps we observed. Several symbols were simplified and some map features were consolidated from the use of multiple symbols to the use of a single symbol. Other symbols and features were removed from our map, as they were considered to be overwhelming.

Besides the use of symbols, the colour scheme of a map greatly influences a user's first impressions. Overwhelming users with superfluous colours may make them less likely to consult the map when planning a journey. On the other hand, a lack of difference in colour and tone could obstruct the effective presentation of map data and even make it lacklustre to use. To this aim we conducted an examination of each map's colour scheme. This examination was a subjective yet indispensable task and involved considering the user's interpretation as well as the overall visual appeal. The goal of this project requires that our map not only persuade travellers to utilize Kingston's alternative transportation network but also serve as a standard resource for residents who already use alternative transportation. An effective colour scheme should communicate information clearly and draw a user in. Our analysis of each map's use of colour is shown in

Appendix B, Table 10. Table 10 highlights some of the weaknesses and strengths we identified regarding the use of colour in map design.

Based on our observations we believe that the use of colour to differentiate between the types of routes is an example of best practice. The Cambridge Cycle Map efficiently uses different route colours since they appear to complement each other and achieve great visual appeal. The Portland Cycle Map also achieves effective route colouring by utilizing bright tones. We concluded that the use of distinctive route colours is highly effective and thus incorporated this concept into our map since it communicates route information clearly and quickly to a user.

More specifically, both the Cambridge Cycle Map and the Portland Cycle Map utilize different colours to describe each type of cycle route, whether it is on-street, beside the street, or off-street. Although Google Maps' salient quality is its simplicity, it fails to use colour to differentiate between different modes of transportation, and types of cycle routes. Comparing the Google Transit Cycle Map to the other two cycle maps, we have decided that it is more beneficial to use colour to indicate the type of cycle route. Even though our current map does display multimodal transportation routes, it does not differentiate between the types of cycle routes within The Kingston Borough. After observing the strength of both the Cambridge Cycle Map and the Portland Cycle Map in their use of colours to indicate differences in the type of cycling route, we would like to integrate this feature into our map. Unfortunately, our time constraint has prevented us from implementing this feature.

Aesthetics aside, the type of information that a transportation map displays can determine whether a person decides to use it to plan their journeys. Consequently, we found it important to evaluate the abovementioned set of maps based upon their content. The content of a transportation map typically includes routes, symbols, labels, and other key features. The presentation of these elements can heavily influence the user's interpretation of the map, and its message. For this reason, determining a group of elements that are relevant for our transportation map must be established in order to create a useful and desirable map. Looking at the Portland Cycle Map in Appendix B, Figure 13, relevant points of interest such as cycle parking, and bike shops are included. However, this map fails to include side street name labels. Learning from this, we have

included all street name labels so users can easily orient themselves. Conversely, the Google Transit Cycle Map provides points of interest that are sometimes irrelevant to the map's purpose. We kept this in mind when deciding which points of interest to include on our map and correspondingly chose to include major destinations such as school, libraries, recreational areas, museums, and shopping centres on our map. Another example of best practice was The Cambridge Cycling Map's use of zoomed-in images to display areas in better detail. For example, the map shows the town centre and surrounding towns on a smaller scale to reveal greater detail. Although this practice will be incorporated in the final PDF file, it is irrelevant to the development of the web application, as it allows users to interactively zoom.

The evaluation of the Cambridge Cycle Map, The Portland Cycle Map and the Google Transit Cycle Map has helped us to shape the design of our multimodal transportation map for The Royal Borough of Kingston. By identifying examples of best practice regarding symbols, colour, and content we have been able to effectively create our map. In order to create a map that successfully communicates the intended message to the target audience we have designed, reviewed, and redesigned our map to ensure that we have effectively applied the examples of best practices that are displayed in each of the three maps. Using the information we obtained from our evaluation of these maps in conjunction with the literature we reviewed the following section will present our analysis of how our map reflects best practice.

4.3 RBK Map and How It Reflects Best Practice

After the completion of our map it was important that we conducted a critical analysis to identify how the RBK map reflects best practice. In order to identify and evaluate best practice we used three main sources:

- The literature we reviewed concerning map design
- Our analysis of the Cambridge Cycle Map, Portland Cycle Map, and Google Transit Cycle Map
- Feedback from the focus groups and interview

By utilizing these sources we can ensure that our map responds to the needs of our target audience.

Feedback from both focus groups suggested changing the selected symbols of the RBK map to those of the Ordnance Map Survey Symbols. These symbols are universal and well recognized by people. This suggestion was taken into consideration and brought to the attention of Kingston Council, employee Tony Klein. Klein is a land surveyor who “took on the role of taking charge of all Ordnance Survey mapping (ordered ‘ARI’ sheets!), copyright and license issues” (Longest Serving ALO Competition!, 2010) in The Borough. Despite his connection with the Ordnance Survey Map, he recommended that we keep these symbols because they are more colourful, personalised, and represent the concept the concept presented in the map. The difference in bus symbols, for example, can be shown in Figure 12 below.



Figure 12: Bus Stop Symbol Comparison
(Map Symbols, 2002)

The RBK bus symbol, located in the lower right hand corner of the figure above is different from the Ordnance Survey symbol. We believe that the RBK symbol, although not standardized with the nationally used Ordnance Survey symbols, still offers a user the same degree of clarity. We also believe that due to the extensive use of the traditional “roundel” symbol in London’s public transportation network, the RBK symbol case may be more easily identified and understood by users. Therefore the symbols of our map represent best practice. Further supporting evidence follows.

Some of the symbols we have chosen to use follow the principle “symbols by resemblance” (Krygier & Wood, 2005). These symbols resemble the concept exactly. For example, the car park symbol shown in Figure 13, is a blue square with a white capital “P” in the centre. This symbol is well known by many and is the standard for representing car parks. Another example is the railway stations’ symbol which is also shown in Figure 13 below. This symbol is the National Railway Symbol and it is common knowledge that it represents a rail station.

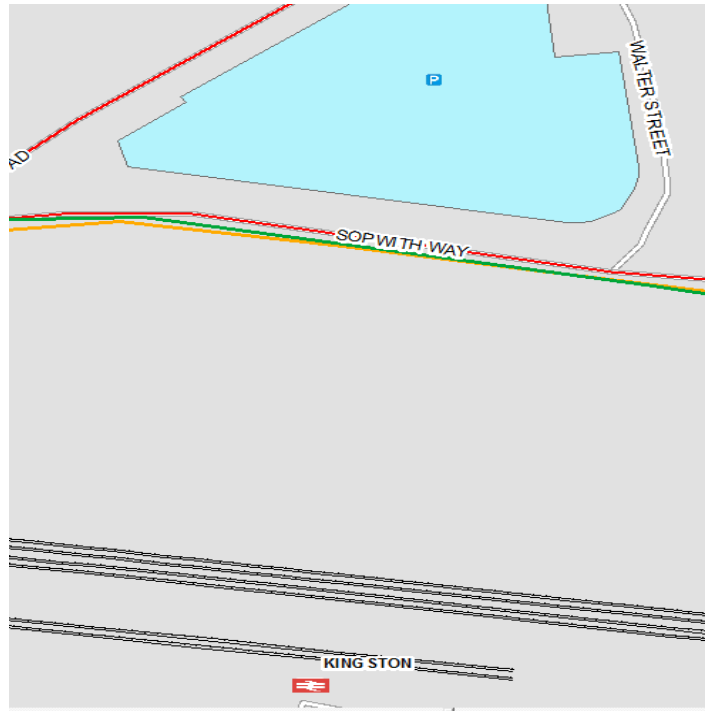


Figure 13: Zoomed in View of Car Parking and Rail Station Symbols

Symbols are also presented on our map through the use of “symbols by convention” (Krygier & Wood, 2005). These symbols do not necessarily resemble the concept accurately but rather provide a way to characterize the concept. For example, the bicycle symbol shown in Figure 14 on the following page is meant to represent cycle parking. However, this symbol is not universally known and consequently there are many ways to interpret its meaning. Another example is the library symbol, which is also shown in Figure 14 on the following page. This symbol shows a person reading a book. Once again this symbol does not have a clear meaning, and instead displays an image that represents a known concept.

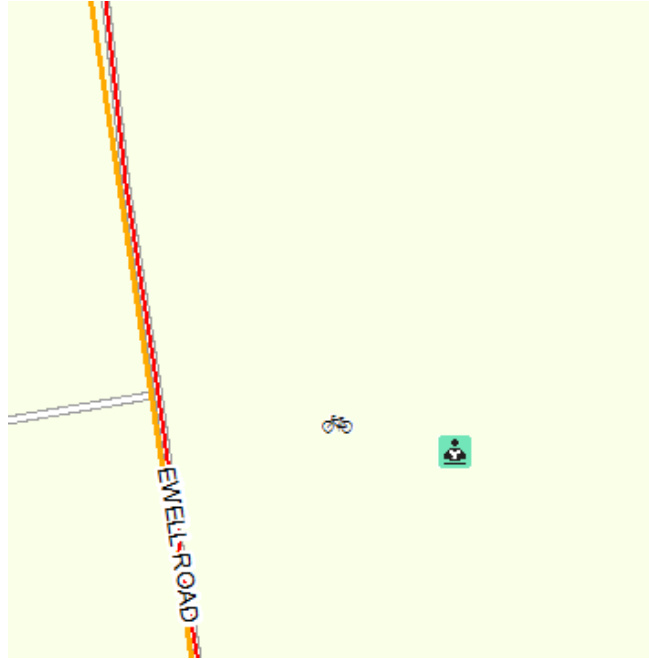


Figure 14: Zoomed in View of Cycle Parking and Library Symbols

Colours play an important role in relaying information to users and are “required to create attractive and logical colour sequences for maps” (Harrower & Brewer, 2003). The background colours chosen demonstrate the best practice to making the map appealing. For example, the light coloured background shown in Figure 14 above makes it easy to see the symbols, routes, and labels. Another example of how the RBK map displays best practice is evident in Figure 15 through our use of the bright red, green and orange colour to display the difference in the respective routes for the various modes of transportation. Figure 15 located on the following page shows how the colours complement each other to display a clear and functional design that is appealing for the users.

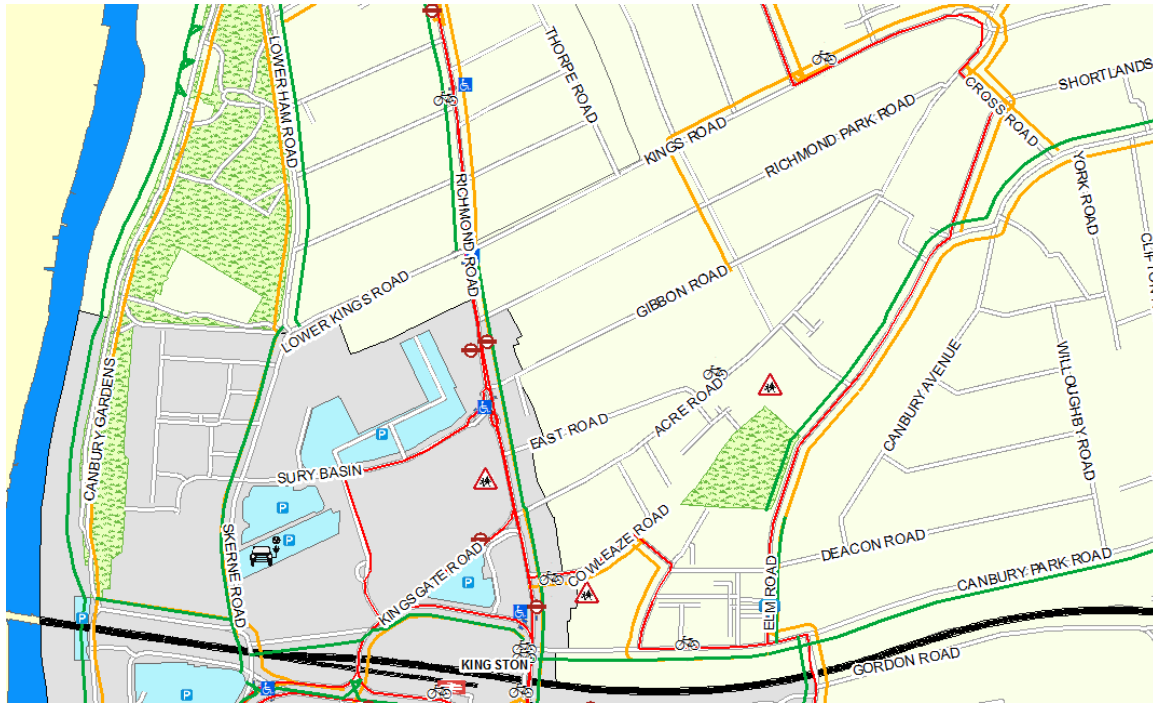


Figure 15: Portion of the RBK Map

Figure 16 located below displays the colours we selected so we could effectively and aesthetically display the map and its intended message.

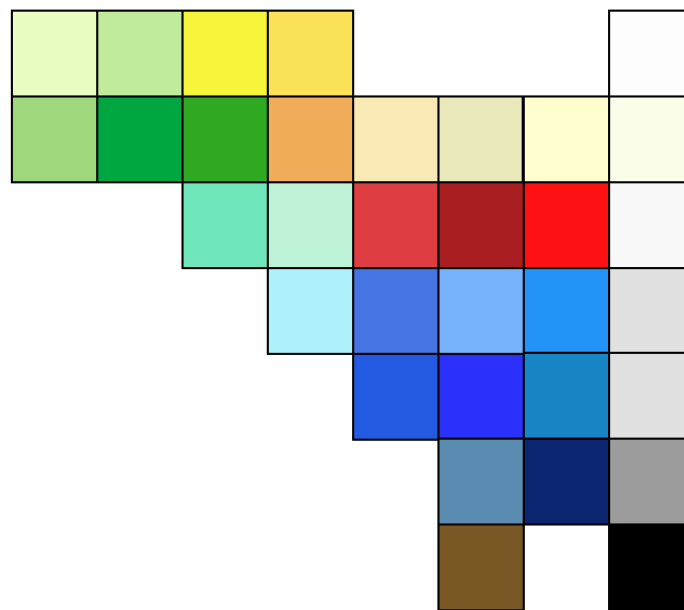


Figure 16: Selected Colour Scheme

4.4 The Advantages and Disadvantages of Website Mapping Applications

After completing significant research on a range of web mapping applications, we evaluated each application. The goal of this project requires the synthesis of a map that is easy to use, attractive, unambiguous, and functional. Therefore, we evaluated each application based on its user interface and visual appeal. The ideal web application should permit the development of various interactive features, such as GIS layer management and query tools. In order to select a web application that has most of these features and will be relatively easy for the ICT Department to maintain, we created Table 5. Table 5 offers a brief summary of our findings. It compares seven software options and allows for a quick synthesis of data. We have utilized colours to depict our findings. The significance of these colours is displayed in the legend located below the table.

Table 5: Advantages and Disadvantages of Different Website Mapping Application Options

Advantages and Disadvantages of Different Website Application Options	Google API	Google Transit Partner Program	ESRI REST	ESRI Web ADF	ESRI Flex API	ESRI Silverlight API	ESRI JavaScript API
Advantage	Visually appealing User familiarity	Visually appealing	Ease of use Ease of development	Visually appealing	Visually appealing	Visually appealing Council's primary programming language	Visually appealing Can be integrated with Google Maps Quick and easy to develop
Disadvantage	Copyright issues Projection problems	Copyright issues City wide, not borough wide	Unappealing	Confusing for user and developer Maintenance is challenging Development is complicated	High capital cost	Longer development time Requires more development software	Not the primary programming language of the council

Legend:	Not as feasible	Feasible	Highly feasible
---------	-----------------	----------	-----------------

4.5 Feedback: Presentation and Analysis of Findings

The purpose of conducting two different focus groups and an interview was to present the concept of our map and receive feedback from the participants. Understanding the target audiences and what they expect from the map is an important process in map design. To this aim we will utilize the feedback to obtain a better understanding of who our target audiences are and how we can create a map that responds directly to their transportation needs. The proceeding sections will present an analysis of the findings from:

- The focus group conducted with employees of The Kingston Council
- The focus group conducted with members of a local cycling club
- The interview with a member of the disabled community

4.5.1 Feedback: The Focus Group Conducted with Employees of The Kingston Council

We presented the map to five employees of The Kingston Council. It is possible that this introduced biases since the majority of participants were familiar with each other and work with the entity sponsoring the project. However, it is also possible that it encouraged the participants to be more open and honest with their answers since they were comfortable with their environs. In order to maintain confidentiality we will refer to each participant as either: “Person A”, “Person B”, “Person C”, “Person D”, or “Person E”. The focus group was conducted for approximately 40 minutes.

The objective of holding this focus group was to obtain certain pieces of information that could help us to refine our map so it responds to the needs of travellers within The Borough. Prior to conducting the focus group we had identified key information we hoped to obtain, this included:

- An evaluation of the concept for a local transportation map

- Feedback on the map and its features
- Factors that might encourage map usage

We obtained valuable information that pertained to each of the abovementioned points. A thorough analysis of the data collected has identified within these three main points five subtopics of discussion. These included: general impressions, motivation to use the map at the current stage of development, motivation to use sustainable transportation, suggestions, and comments. Figure 17 presents a summary of the general topics discussed within the focus group.



Figure 17: Flowchart Depicting a Summary of Topics Discussed

One of the most important reasons for conducting the focus group was to have persons evaluate the concept for a local transportation map. The purpose of this was to gauge how receptive the public would be of this map. Participants’ responses varied and highlighted areas of concerns, as well as expressed their general impressions and motivations to use the map at the current stage of development. The proceeding paragraphs shall evaluate the feedback received from the focus group.

“Person B” believes that the map has a limited scope of use. He reaffirmed this claim stating that, “there are a limited number of journeys that people will utilize a journey planner for... persons who live in The Borough are already familiar with getting

around.” Due to this geographical limitation he believes that the map would only be useful to travellers who “...are interested in time, or if [the] traveller does not know where they are going, or if they are planning their first journey.” For these reasons he concludes that the map is “not as useful as the TfL map”. This is a point that has been raised by another member of staff in an informal conversation. Since these persons are very familiar with travelling within The Borough, it appears that in order to make the map more useful for a wider range of journeys, it should cover a larger geographical area. This is a valid point for consideration since one of our priorities is to produce a map that will acquire public support.

Although “Person B” rose a valid point, it should be noted that there were several opposing views presented by other participants. They particularly discussed factors of the map that motivate them to use it at its current stage of development. An opposing point of view presented by “Person A” is that “[the map is]... a good idea for persons who would like to go on walks, especially family walks,” since it locates alternate routes. Another person stated that this map is a good alternative for the disabled since it identifies accessible crossings. On the other hand, “Person C” stated that the map is a good idea simply because, “TfL is difficult to use.” As a cyclist, “Person C” states that the map is good because it “already shows cycle paths.” “Person D” thinks that the map’s best feature is that it displays alternate routes that travellers can use when roads are closed due to roadworks or emergencies. Although, these were individual opinions and there was no general consensus on a particular idea raised, the variety in responses identified several features of the map that would motivate use.

Receiving the participants’ feedback is an important aspect of the map design process. After all the editing has been completed it is important that the map is critically reviewed. Areas of failure should be identified so it can be redesigned to produce a higher quality map. Critiquing the map is important in order to determine if the map accomplishes our goal and if the content and layout are suitable for the intended audience. The focus group discussion generated a variety of suggestions. In sum, they identified several ways we could improve the map by altering the design and information displayed. These suggestions included:

- Providing additional mapped features

- Editing symbols
- Addressing accessibility issues
- Advertising and marketing suggestions

During the discussion, many persons queried the possibility of including a feature that identifies roadworks. Although The Kingston Council aims for this map to increase the integration of various modes of transportation and decrease the public's reliance on the private automobile, a person stated that this could be particularly useful for drivers. There was a general consensus that this feature would be useful since "If there is a feature that identifies roadworks then persons can use the map to effectively plan their journey to avoid those routes." This point was reiterated throughout the discussion and thus highlights the participants' interest in a roadwork attribute. It should be noted however that mapping roadworks might not be a feasible task since it would require the tedious task of uploading GIS data on a weekly or monthly basis.

In support of the roadwork argument presented above, "Person E" highlights that mapping roadworks could potentially have more value than we currently anticipate stating that, "[identifying Roadworks is]...important for disabled persons who need to have access to designated alternate routes." Prior to conducting this focus group our advisor, Robert Krueger, Ph.D., Assistant Professor of Geography, Director of the Environmental Studies Program at WPI, and Leslie Hunt, Sustainable and Travel Officer at The Kingston Council, had also suggested that we consider making the map accessible and useful to a wide range of persons. These comments suggest that there is a need for the map to be further evaluated and edited so it can be useful to the disabled. To this aim we decided to look further into the government's current stance on accessibility issues via their website "UK government: Directgov".

According to the "UK government: Directgov" website, in order to comply with the Disability Discrimination Act 2005, it is important that "Person E's" comment is considered. One of the objectives of The Disability Discrimination Act is to enable disabled people to use public transportation easily (Crown , 2010). It is imperative that we produce a map that is inclusive and can be used by a wide range of persons. In order to achieve this we must gain a better understanding of the situation. "Person E" has

suggested that we conduct an interview with “Person F” who is a wheelchair user and lives in The Borough.

The main modes of transportation that The Kingston Council wishes to promote are walking and cycling. Providing cyclists with safe routes is very important to The Kingston Council since it abides by the government’s cycling strategy to get “more people cycling, more safely, more often” (Department for Transport, 2008). This highlights the importance of evaluating the map to ensure that it responds to the needs of a cyclist. “Person C” an avid and experienced cyclist suggests that we map the location of roundabouts since “she gets confused at busy roundabouts.” “Person B” and “Person C” suggest that we should depict the grade of the land using contours, so persons can plan their journeys to include or avoid inclines. In sum, these comments suggest that the content of the map does not efficiently respond to cyclists’ needs. These points prompted us to contact Kingston Wheelers and eventually conduct a focus group so we can provide The Kingston Council with recommendations on how they can improve the map.

Providing the public with sufficient information is just as important as not overwhelming them with information. “Person A” and “Person C” both agree that the map is overwhelming due to the large amount of attributes that have been mapped. “Person A” suggests that we layer each feature since, “cyclists do not want to think about buses or other layers. They are mainly interested in cycle parking, cycle routes and bridges.” “Person B” suggests that in order to make the map less overwhelming we simplify the symbols. In accordance with this, “Person D” suggests that we use the Ordnance Map Survey symbols since they are the universal standard. However, we had purposefully designed this map using “symbols by resemblance” and “symbols by convention,” (Krygier & Wood, 2005) so that each symbol represents familiar concepts. Based on the strategy we will not be changing the symbols, but we will identify ways to manipulate the data presented to make it less confusing.

Understanding the target audiences and what they expect from the map is an important part of marketing and advertising. Consequently, the information obtained from one of our objectives of the focus group was to identify factors that might encourage map use. We received a variety of ideas that ranged from utilizing popular social networks to hosting events. Figure 18 displays these ideas.

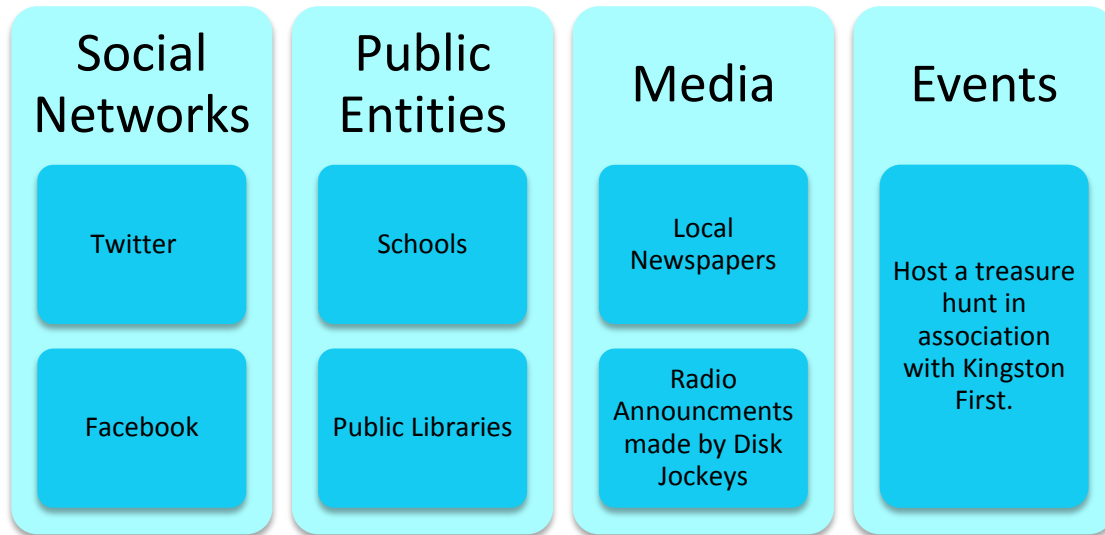


Figure 18: Marketing and Advertising Ideas Obtained from the Focus Group

(For further information regarding the treasure hunt see Appendix A.)

The majority would require a low cost to implement or maintain. While the social network strategy would be free it should be noted that utilizing social networks would require frequent posts and updates. An effective marketing and advertising strategy will more than likely be a combination of two or more ideas. These marketing and advertising ideas have presented us with insight on recommendations that we can propose to The Kingston Council so they can obtain sufficient public use.

In order to garner public support, the map must efficiently and quickly convey the relevant information without being overwhelming. By receiving feedback from these individuals we have received insight on refining the content and presentation of information on the map. This feedback will enable us to identify changes that need to be implemented so the map best responds to the needs of commuters within The Borough. We will also use the feedback in conjunction with The Kingston Council's vision for the map in order to create relevant and appropriate recommendations.

4.5.2 Feedback: Interview With a Member of the Disabled Community

In order to make the map more functional for those who require accessibility resources, we interviewed a member of the disabled community, who we will refer to as "Person F". We promptly set up a meeting with "Person F" after we conducted the

abovementioned focus group, wherein several participants suggested that we meet with “Person F” not only because of her accessibility requirements but also because of her contributions to disabled advocacy groups that work with surrounding communities. In this section we find it appropriate to reiterate and analyze some of “Person F’s” thoughts and remarks. A more detailed account of the interview can be found in Appendix A. In the first portion of the interview she discussed some of the difficulties disabled persons encounter while travelling. In the latter half of our interview she expressed her opinion on the concept of a multimodal transportation map, and made suggestions on how we can improve the content of the map so it better suits the needs of a disabled person. Overall, the discussion with “Person F” has significantly contributed to our findings and recommendations.

“Person F” utilizes an electric wheelchair to fulfil her mobility needs. At the beginning of the interview, she stated that she primarily uses an automobile as her primary mode of transportation. At times, she uses the bus as an alternate mode of transportation. However, this can be an inconvenience since the accessibility ramp may be out of order, or the bus may not be equipped with an accessibility ramp. She believes that this is rather inconvenient because waiting for another bus to come that has an available and operating ramp makes her late. She also mentioned that several accessible pedestrian crossings are rather dangerous for those with disabilities, especially, the crossing near Guildhall by Zizzi’s Restaurant and the crossing on St. James Road. These are crossings through which drivers tend to speed, heightening the risk factor disabled persons encounter in certain situations.

To plan her automobile journeys, “Person F” said that she primarily uses a “Tom Tom”, a turn-by-turn GPS device for use in automobiles. She also uses the widely popular “A to Z” London street guide, Kingston’s public access GIS database known as Integrated Spatial Information System (ISIS), and Google Maps. She said that even though most of her journeys are local and recurring, she occasionally plans journeys to destinations that she has never been to before. As an automobile user who needs accessibility resources, she investigates the position of disabled parking bays and accessible toilets relative to her final destination. Occasionally, “Person F” travels with friends who have sensory disabilities such as blindness and deafness, and consequently

makes it a habit to investigate the location of resources that are available to them prior to departure.

After becoming oriented with “Person F’s” needs and travel habits, we began to solicit her feedback on Transport for London’s journey planner, which features an interactive menu where users can specify mobility requirements. We presented her with a screenshot, which can be seen in Figure 19.

My mobility requirements

- ☐ I cannot use stairs
- ☐ I cannot use escalators
- ☐ I cannot use lifts
- ☐ I use wheelchair accessible vehicles

Select any of the above statements that apply to you.
For station access details [click here](#)

Cycling options

Select any which apply:

- ☐ I want a cycle only route
- ☐ I want to leave my bicycle at the station
- ☐ I want to take my bicycle on public transport

I don't want to cycle for longer than minutes

Walking options

I don't want to walk for longer than minutes

My walking speed is:

☐ I'd rather walk if it makes my journey quicker

Journey Planner

From

To

[Advanced options](#) [Leave now](#)

Figure 19: Screenshot of TfL’s Advanced Options for those Who Have Mobility Requirements

“Person F” responded and said that she has seen the feature before but does not use it because it pertains mostly to Underground and National Rail services. She has not used London’s subway and light rail services, “for a good twenty-five years,” as the entrances to many of London’s suburban trains and central subway cars are gapped and elevated. This prohibits the seamless and linear movement which she requires to enter a rail car from the platform. Consequently, all of Kingston’s suburban rail stations need advanced notice on the arrival or departure of a disabled passenger, in order to assist a person who is disabled. “Person F” indicated that this is an inconvenience and may contribute to her missing a train. She would prefer to travel in the relative comfort of a bus where she less frequently encounters accessibility issues, as the majority of Greater London’s buses are fully accessible.

The interview then focused on the development of our multimodal transportation map. We recounted to her its intended design as an interactive journey planner and informed “Person F” of our development status. We then provided her with a screenshot of the RBK map, which can be seen below and on the following pages in Figure 20 and Figure 21.

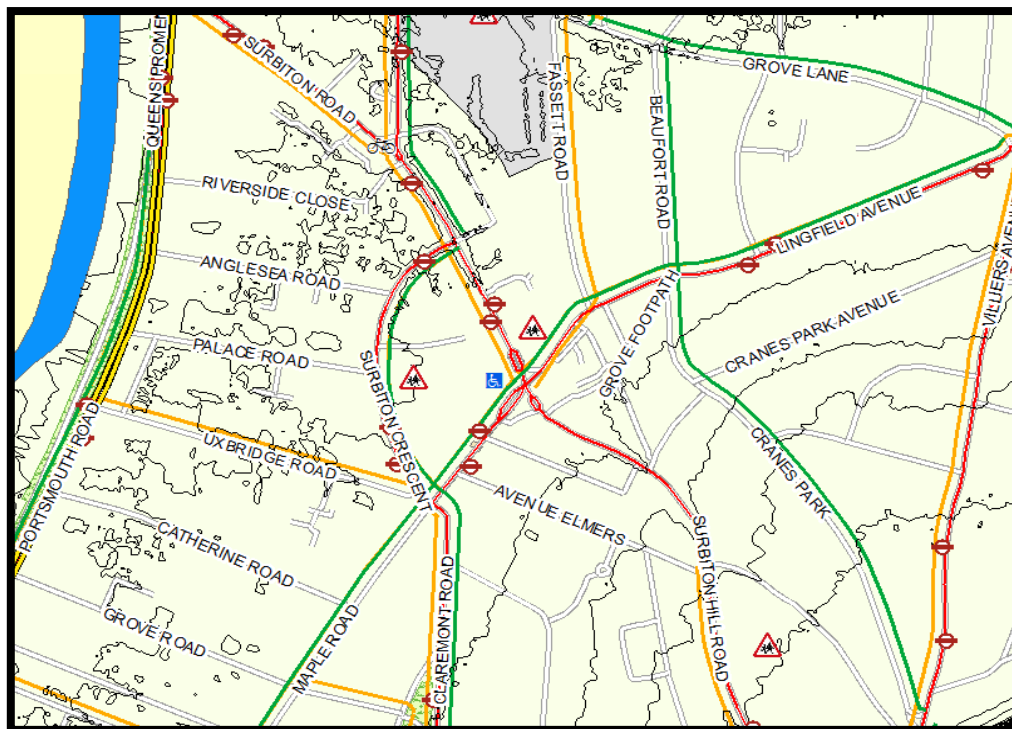


Figure 20: Zoomed Out Screenshot of RBK Map Showing Accessible Crossings

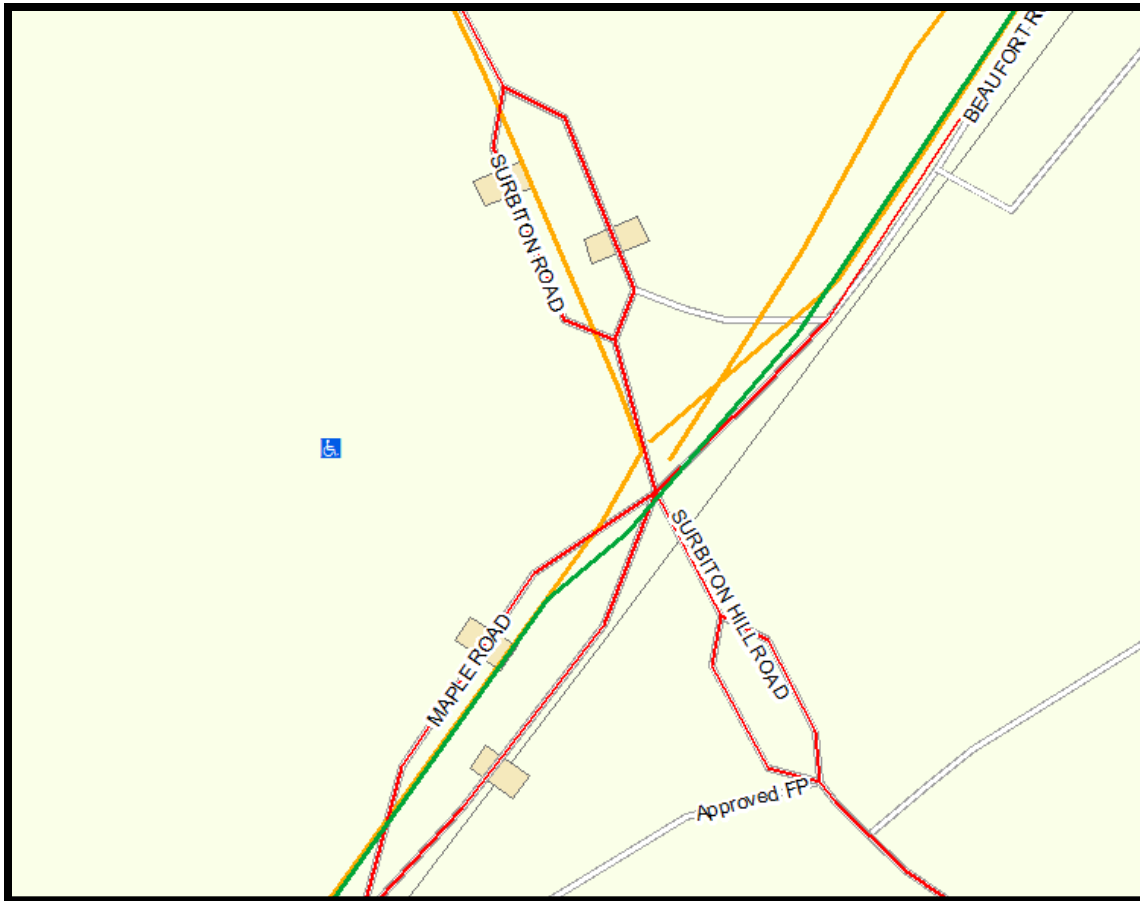


Figure 21: Zoomed In Screenshot of RBK Map Showing Accessible Crossings

This screenshot highlighted some of the accessibility resources we were able to include on our map, such as the location of accessible crossings and the precise location of dropped curbs. Upon reviewing the screenshot, “Person F” suggested that we change the colour of the dropped curb polygons from beige to blue, in order to reflect the blue symbol often used to convey disabled access. Regardless of the colour feedback, she thought that the inclusion of disabled access crossings and their precise location was an extremely important feature to incorporate into the map.

4.5.3 Feedback: Focus Group With Members of a Cycling Club

One of The Kingston Council’s primary goals is to reduce the amount of automobile based journeys and increase the amount of cycle based journeys within The Borough. Therefore, it was necessary to gain insight not only on the needs of Kingston’s current cyclists but also on the types of map features that would draw Kingston’s non-cyclists into utilizing cycling as a means of transportation. In order to do this, we

conducted a forty-five-minute focus group with three members of a local cycling organization called The Kingston Wheelers. In order to maintain confidentiality we will refer to each participant as either: “Person G”, “Person H”, or “Person I”. The session was conducted in the casual setting of a local café with three note takers and one primary facilitator.

The focus group began with the facilitator asking the three participants about their use of journey planners and their opinions about them. Initial responses indicated that they do not often use journey planners because they become aware of cycle routes either by intuition or routine. However, the participants mentioned that they will use Google Maps or an open source map called Open Street Maps when necessary. “Person G” and “Person H” indicated that they often use a printed map to plan safe cycle journeys with their children. When asked about the weaknesses of journey planners, every participant agreed that there is no particularly reliable journey planner for cyclists. “Person H” pulled out his printed version of The Kingston Council’s cycle map. The participants began to examine the map on the table. They gave us examples of good routes highlighted on the map, which direct cyclists along The River Thames and avoid central urban areas such as Kingston Centre, and examples of poor routes, which direct cyclists through busy traffic crossings and urban areas with a significant amount traffic. The focus group participants found The Kingston Council’s Cycle map helpful because of its use of colour to specify the type of route. The Kingston Council’s Cycle map uses colour to depict the level and proximity of nearby automobile traffic. When shown a screenshot of our developed map, the participants repeatedly suggested that if our journey planner could display not only cycle routes but also indicate which cycle routes had low and high levels of automobile traffic, then the map would be more effective for cyclists.

The focus group participants were willing to share with us the challenges that cyclists in The Borough face. “Person I” was the first to point out that although the Kingston Cycle map may describe a cycle route’s proximity to various degrees of automobile traffic, the exact setting and condition of a cycle route is not always apparent. Even when designated by proximity to various degrees of automobile traffic, “Person I” indicated that some cycle routes can become unbearably slim and nearly fade away into the rest of traffic without warning, putting a cyclist in a situation that they may be

uncomfortable with. “Person G” and “Person H” indicated that this is a difficult circumstance to encounter when cycling with children. Another challenge for cyclists that may not be apparent on a cycling map is elevation change. Even though drastic changes in elevation are not prevalent in The Borough, there are particular precipitous sections of cycle routes that a cyclist may want to avoid because of a lack of ability or unwillingness. “Person G” and “Person H” also indicated that hills are a feature they tend to avoid while travelling with children. The participants of the focus group overall inferred that maps and journey planners, regardless of their attention to detail, can occasionally mislead cyclists in The Borough. To this aim they suggest that during the design phase we conduct a ground truth, or consult with cyclists so we can determine the best routes for various types of journeys.

4.6 Feedback for Website Template: Interview Conducted with Members of The Kingston Council

After the completion of our website template it was important that we received feedback to determine if our website content and layout responds to the needs of commuters within The Borough. In order to determine this we conducted brief informal interviews with four out of the five participants from the focus group that was conducted with Kingston Council Employees. The fifth participant “Person A” was unavailable at the time. The informal interview consisted of us approaching “Person B”, “Person C”, “Person D”, and “Person E” and asking them to share their comments and suggestions so we can improve the website template.

Overall the feedback we received was positive, with all participants expressing their like and approval for the design, content and layout. Upon seeing the website template “Person E” said, *“I think it is quiet clever. Well done, well done!”* A feature that all participants liked was the tabs located at the top, which display Kingston Town, Surbiton, Tolworth, and Chessington. Figure 22 displays an example of the tabs.

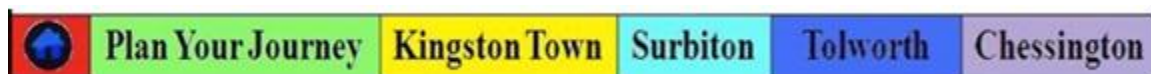


Figure 22: Tabs on Website Template

They thought this would be a great way to plan your journey if you were unsure of your exact destination. Additionally, “Person D” likes the “turn layers on and off” feature. “Person D” was extremely pleased that we were asking for their feedback and took it so seriously stating that, *“TfL thinks they know how to do things so they do not ask for local feedback. They think they know all but they do not.”* This suggests that some members of public could be genuinely interested in improving the development of local infrastructure, and prompts us to consider the possibility of providing users with a feedback feature on the website.

Despite the positive feedback received, each participant provided us with recommendations that we could use to improve user comprehensibility. “Person B” suggested that in order to improve the comprehensibility of the information displayed, we make “Plan Your Journey” the main tab, and have the town centres presented as sub tabs. Additionally, “Person B” suggested that we change how the journey planning advanced options are displayed so it can be more easily understood. For example, he suggested that we change the “Near Hospital” requirement to say “To Hospital”, since you want a route that takes you to a hospital and not near a hospital. “Person B” believes that making the quickest route the default option could simplify the process of journey planning.

The majority of the comments that we received pertained to enhancing the content presented on the website template. “Person B” suggests that we could enhance a user’s experience by presenting a fifth option on the webpage that enables users to select a “zoom into my location” feature. “Person E” believes that including the bus timetable would be an extremely helpful journey planning feature, and states that *“if times were unavailable, then I would use another one [another journey planner]”* This is not a feature that we could have developed, as it requires an extensive amount of computer programming, however we will recommend that The Council investigates the possibility of developing this feature.

We also received a few editing and formatting suggestions so we could enhance the quality of the template. These changes were implemented immediately after we completed the interviews. Some of these changes include:

- Changing the “near Accessibility crossings” options to read “Accessibility Crossings” options.

- Changing “near the River Thames” option to read to “along the rivers” seeing as there is not only the River Thames but also the Hogsmill River
- Providing an option called “show nearest cycle parking to destination”.
- Changing “To to From” to “From to To”
- Changing the term safety
- Changing “Car Blub Bay” to “Car Club Bay”

Figure 23 and Figure 24 provide examples of our first draft prior to receiving feedback and our second draft which we revised after we received the feedback.

Royal Kingston

Plan Your Journey **Kingston Town** **Surbiton** **Tolworth** **Chessington**

From:

To:

By:

☐ Foot ☐ Car

☐ Cycling ☐ Train

☐ Bus

☐ Accessibility
Check box for accessibility requirements

☐ Different Language

Requirements:

☐ Safety ☐ Electric Car Charging Points

☐ Leisure ☐ Hospitals

☐ Near Accessibility Crossings ☐ Libraries

☐ Car Parks ☐ Parks

☐ Car Blub Bay ☐ River Thames/Others

☐ Cycle Parking ☐ Schools

Figure 23: Website Template Prior To Receiving Feedback

Royal Kingston

Plan Your Journey Kingston Town Surbiton Tolworth Chessington

From:

To:

By:

☐ Foot ☐ Car

☐ Cycling ☐ Train

☐ Bus

☐ Accessibility
Check box for accessibility requirements

☐ Different Language

Show Nearest to Destination:

☐ Electric Car Charging Points

☐ Car Parks

☐ Car Club Bay

☐ Cycle Parking

Show Along The Way:

☐ River Thames/Hogsmill River

☐ Electric Car Charging Points

☐ Accessibility Crossings

Other Options:

☐ Leisure

☐ With Children

Figure 24: Screenshot of Website Template After Receiving Feedback

In sum, we have used the feedback we received from the participants to edit the website template and generate a list of recommendations for The Kingston Council. The participants' suggestions for editing were implemented shortly after. Consequently, the website template that we present in Figure 24 is our final prototype. This template should assist future project teams in developing the webpage to host the map. To this aim future project teams could base the design and development of the webpage off our template.

4.7 Summary

The analysis of our results assisted us in identifying several recurrent themes. These include making the RBK distinct from the TfL map, best practice of map design, how the RBK map displays best practice, feedback for the map, and feedback for the

website template. Since this project represents the initial phase of development for the interactive multimodal journey planner, it is important that we present some recommendations to The Council for future development. Based on the feedback we received and the goals of The Kingston Council, we have compiled recommendations regarding the following areas:

- Improving the map so it responds to the needs of cyclists
- Improving the map so it responds to the needs of members of the disabled community
- Improving the map so it has a wider scope of use
- Raising awareness of the map

The following chapter will present each of the abovementioned areas of recommendations.

CHAPTER 5

5.0 RECOMMENDATIONS

Based on our findings we have identified and compiled several recommendations. In order to present The Kingston Council with relevant recommendations we have reviewed their goals. It is imperative that our recommendations are congruent with what they wish to accomplish. The Council's goals include:

- Reducing traffic congestion caused by private car use in The Borough
- Promoting sustainable travel options
- Raising awareness of alternative travel options and the fact that they can be quicker, cheaper, and healthier.

Due to the nature of our project our recommendations shall primarily focus on promoting sustainable travel options and raising awareness of alternative travel options. More specifically our recommendations address areas of failure, concern, or improvement that were identified during our feedback sessions. We are presenting these recommendations to The Kingston Council so they can produce a higher quality map. In sum, they will assist The Council in ensuring that the content, layout, and design are suitable for the intended audience. To this aim we have composed recommendations that will address the following areas:

- Improving the map so it responds to the needs of cyclists
- Improving the map so it responds to the needs of members of the disabled community
- Improving the map so it has a wider scope of use
- Raising awareness of the map

The proceeding sections provide specific recommendations for the abovementioned areas.

5.1 Improving the Map so it has a Wider Scope of Use

A participant in the focus group conducted with employees of The Kingston Council stated that, "Persons who live in The Borough are already familiar with getting

around,” and thus concluded that it has a “limited scope of use.” His comment echoed the sentiments of another employee of The Council who was concerned about the relatively small target audience. Taking their concern into consideration we do agree that since The Kingston Borough is so small, many of the residents may not need a journey planner to get around. In order to improve the map so it has a wider scope of use and thus a wider target audience we recommend the following:

1. Increasing the geographical coverage of the map so it includes neighbouring boroughs.

This would increase the target audience and scope of use since there is already a need for efficient transportation services for workers who are employed in Kingston yet reside outside The Borough as well as Kingston residents with jobs in central London who require reliable links to the city (Royal Borough of Kingston , 2006).

2. Creating a mobile application

We believe that the creation of a mobile application would enable The Council to reach a larger target audience. A participant had stated that “...*We overlay on Google maps, [it is] more approachable. It is a better option since people are more familiar with it. We need to start thinking that way, since we can then create mobile apps.*”

Although there are several copyright issues with overlaying our spatial data onto Google Maps we believe it is worthwhile to investigate the possibility of a mobile application so persons can plan their journeys even when they are on the go.

3. Developing journey planning capabilities

- a. This will enable the map to be comparable to TfL and Google maps. Including journey planning capabilities will enable persons to:
 - i. Plan their journeys more efficiently and quickly
 - ii. Obtain graphical and textual directions to assist them in getting from point A to point B
 - iii. Personalise their travel itinerary by including relevant advance search options.

- b. Anticipated Features of the Journey Planner:
 - i. Enable users to turn on and off layers
 - ii. Include a zoom in and out feature
 - iii. Ability to generate text and graphical direction
 - Display a PDF version of the travel itinerary
 - iv. Enable users to generate travel itinerary based on the following categories:
 - Mode of transportation: foot, car, cycling, bus, car, and train
 - Show nearest to destination: electric car charging points, car parks, car club bay, and cycle parking
 - Show along the way: River Thames or Hogsmill River
 - Other options: travelling with children

4. Conducting a ground truth

We recommend that The Kingston Council checks that the pedestrian, cycle, and bus routes represented on our map respond to the travel needs of the intended target audience. If the project team realises that a given route is inconvenient or unsafe for pedestrians or cyclists we recommend that they modify the route displayed on the map or the journey planner.

In sum, each of the abovementioned recommendations has the potential to increase the scope of use. It should be noted that these are general recommendations and do not respond to the needs of a specific target audience. In order to ensure that the map is useful to cyclists and disabled persons we have provided more specific recommendations based upon feedback received from the focus group and interview.

5.2 Responding to the Needs of Cyclists Within the Borough

One of The Kingston Council's primary objectives is to reduce the public's reliance on private automobiles and increase their reliance on cycling as a primary means of transportation. Therefore, it was necessary to gain insight not only on the needs of Kingston's current cyclists but also on the types of map features that would entice

Kingston's non-cyclists to utilize cycling as a primary transportation mode. The recommendations provided below address the needs of both experienced and novice cyclists. The suggestions from the focus group highlighted inadequacies in the map and the cycling infrastructure. Consequently, we have divided this section into:

- Improving the content of the map
- Improving the cycling infrastructure

5.2.1 Improving the Content of the Map

Members of the Kingston Wheelers Cycling Club participated in our focus group and helped us assess the types of features that cyclists desire in a journey planner. Their reaction to the concept of a multimodal transportation map was positive. They assessed our map and provided valuable input about its weaknesses and strengths. Although they found our map's display of Kingston's cycling routes appealing, they believed that the map did not provide cyclists with enough information to plan their journey efficiently. To this aim we recommend:

1. Utilizing various colours and dotted lines to indicate differences in the type of cycling routes.

An example includes using a blue line to show routes that have cyclists as well as vehicular traffic and a yellow line to show routes that are specifically for cyclists. We believe that this will enable persons to plan their journeys more efficiently, since an inexperienced cyclist may not want to use a route that has a lot of vehicular traffic.

2. Indicating one-way streets with a symbol such as an arrow.

This will provide cyclists with information so they can plan a safer journey.

3. Including the location roundabouts

A participant of our focus group conducted with members of the cycling club, Kingston Wheelers stated that "*roundabouts [are a] really big hazard for cyclists they are the worst.*" Another participant expressed his agreement stating that "*...especially if you got children, you have to worry about them behind you since cars*

are not looking for you they are looking to get in and out.” These statements suggest that it is very important that cyclists know the location of roundabouts so they can plan their journeys more safely and efficiently.

4. Providing the location of cycle shops when the cycle route layer is visible.

Providing the locations of cycle shops may be a feature particularly useful to new cyclists, since they may be unaware of the location of this cycling resource.

5. Organize and display cycle routes by:

- a) Proximity to traffic and traffic amount (similar to current Kingston Council cycling map)
- b) Exertion level
- c) Recreational and quiet vs. shortest distance and shortest time

OR

- d) Experienced rider
- e) New rider
- f) Travelling With family

By categorizing routes we enable riders to identify routes based on their personal level of comfort.

6. Indicate the changes in elevation using one of the following methods:

- a) Include faint topographical contours
- b) Display a symbol alerting cyclists that the grade is greater than 5%
- c) Indicate sections of paths which have significant uphill and downhill slopes

7. Make cycle routes blue.

The cyclists from Kingston Wheelers believe that this would make it easy to identify cycle routes since that is the standard cartographic colour for cycle routes on London's cycle maps.

The cyclists expressed their concern that the map alone will not increase cycling within The Borough. They believe it will be the combined influence of the multimodal transportation map and changes to cycling infrastructure that will get more persons cycling. The following section provides some recommendations that could assist in improving the cycling infrastructure.

5.2.2 Recommendations for Cycling Infrastructure

One of the unexpected but noteworthy discussion topics initiated by the focus group was their concern with Kingston's cycling infrastructure. The participants spent a notable amount of time critiquing Kingston's cycling network. Although the cyclists were pleased with Kingston's commitment to improving cycle resources, in particular the creation of this multimodal transportation map, they strongly recommended that The Kingston Council review its cycling infrastructure. When prompted for factors that would encourage more residents to use cycling as a means of transportation, the focus group participants unanimously suggested that Kingston improve the layout of its cycle network.

"The car is king," was a resounding theme in their dialogue, as they felt that automobiles are unfairly prioritized in transportation planning. They stated that if the cycling infrastructure were more prioritized, cycling would become more accepted in The Borough as a means of standard transportation. They believe that the primary reason new cyclists revert to their previous mode of transportation is because of their lack of comfort with cycle route safety and efficiency. To this aim, they stated that improved cycle infrastructure would increase the retention rate of new cyclists.

To this aim we recommend the following:

- 1. Develop more two-way cycle traffic lanes to provide greater cycle access on one-way streets.**
- 2. Investigate the possibility of a transportation imperative that drivers have to yield to cyclists on busy roads which tend to be dangerous for cyclists.**

Participants of the focus group with Kingston Wheelers believe that if cyclists received a higher priority on the road it would be an incentive that could get more persons cycling.

3. Audit cycle routes for efficiency, especially in congested areas.

Members of our focus group stated that a large amount of traffic lights creates abrupt route interruptions, and consequently becomes an inconvenience.

The focus group participants preferred using routes farther away from urban areas because they contained fewer crossings and more direct routes. One participant even suggested that the map displays routes that are frequently used by cyclists, since this may be a good indicator of a cycle route's functionality.

4. Implement more cautionary signage for cyclists that indicate imminent inclines, dips, and roundabouts.

Based on feedback received this would enable cyclists to plan their journeys more efficiently and help them feel more secure. Also if these signs are displayed at an appropriate distance they will have enough time to change their route if necessary.

5. Provide more innovative forms of cycle parking, such as highly protective pay-per-use cycle parking schemes with attendants.

Participants from the focus group expressed that a general concern of cyclist is the safety of their bicycles when they leave them parked. They also stated that they think an appropriate cost would be £1.00 per day.

6. Increase the frequency of cycle path maintenance to clear paths of glass, stones, sand, and other debris.

The participants stated that sometimes cycle routes have debris, or are not salted regularly in the winter. This creates a hazard and can reduce a person's willingness to utilize this method of transportation.

In summation, the members of Kingston Wheelers who participated in this focus group were genuinely excited about the concept of a new multimodal transportation map. However, they do not believe that the map will be a sufficient resource to get more people cycling, since they believe there are inefficiencies in the existing cycling infrastructure within The Borough. To this aim the aforementioned recommendations should work in conjunction to enhance a cyclists experience, respond to the needs of existing cyclists, and the needs of novice cyclists. The proceeding section presents our recommendations for improving the map so it responds to the needs of the disabled community.

5.3 Improving the Map so it Responds to the Needs of the Disabled Community

The interview conducted with “Person F” identified several resources that we could include on the map so it responds to the needs of the disabled community. “Person F’s” principle concern was for the map to display the location of disabled parking bays. She stated that a significant amount of disabled persons gain access to the commercial areas in Kingston using an automobile. The inclusion of the locations of disabled parking bays could help her and other disabled persons plan their journeys more efficiently and take the hassle out of finding a car park with parking for the disabled. “Person F” also recommended that the map identifies public recreational parks with accessibility resources. A disabled person who primarily utilizes an automobile may adjust their means of transportation to a park accordingly, based upon their awareness of the recreational park’s accessibility resources and the location of accessible pedestrian crossings. Moreover, indicating the location of accessible recreational parks would be an inherently useful resource for disabled users.

To obtain the exact location of disabled parking bays “Person F” suggested contacting employees of The Kingston Council who work with highways and roads. She also suggested that contacting the Driver and Vehicle Licensing Agency (DVLA) as well as an accessibility resource database entitled DisabledGo, (available online at www.disabledgo.com), could provide additional information and resources to develop the

map for users with various disabilities. “Person F” stated that DisabledGo would also have the ability to provide accessibility feedback for map users with visual disabilities, as the organization provides services to people with many different types of disabilities. In order to disseminate the map to potential disabled users, “Person F” pointed to local and national organizations such as DisabledGo and the Kingston Centre for Independent Living (KCIL) as possibilities.

Our recommendations for improving the map so it responds to the needs of the disabled community are located below:

- 1. Indicate the location of disabled parking bays.**
- 2. Indicate the location of recreational parks with accessibility resources.**
- 3. Develop a secondary multimodal map to convey transportation options for disabled persons.**

This map could show all disabled parking bays, toilets, accessible parks, using special fonts, colours, and symbol sizes. We recommend an audit of each of these respective options, which will assist in ensuring that they are accessible and safe. Additionally we recommend indicating the accessibility status of boat services along the River Thames.

- 4. Provide the phone number of disabled assistance resource for suburban rail services.**

The entrances to many of London’s suburban trains and central subway cars are gapped and elevated. This prohibits the seamless and linear movement, which a disabled person requires to enter a rail car from the platform. Consequently, all of Kingston’s suburban rail stations need advanced notice on the arrival or departure of a disabled passenger, in order to assist a person who is disabled. By providing the phone number of the disabled assistance resource we would be make it easier for

members of the disabled community to use public transportation, or an integration of modes.

5. Develop an educational initiative for drivers such as an advertisement on courtesy and safety consideration for community members who are disabled.

Our interview suggested that drivers sometimes speed in a manner that makes it dangerous for pedestrians to cross. The danger of crossing these intersections is exacerbated for individuals who are disabled. Integrating a model of awareness for disabled pedestrians at crossings in driving schools may greatly benefit the pedestrian safety of disabled persons.

In conjunction the feedback received from each focus group and interview has enabled us to identify possible ways of enhancing user experience and increasing usefulness of the map. Once The Kingston Council has developed the map to its full potential they will then become interested in making the map available for public use. At that point The Council will have to determine how they are going to raise the public's awareness of this resource. Consequently, the following section provides some recommendations for raising public awareness about the map and its usefulness.

5.4 Providing for an Online Interactive Journey Planner

1. Develop ESRI JavaScript to provide travellers with an interactive online version of our map.

Based on our critical evaluation of the various web applications listed in Chapter 2 and Chapter 4, we have chosen to recommend the development of ESRI's JavaScript web application. We have chosen to specifically recommend this web application because of its interactive features, graphical user interface, and ease of development. The main reason for implementing an ESRI JavaScript API is that it presents users with an interactive map without sacrificing clarity and quality. Due to time constraints, as well as our limited programming expertise we were unable to develop a highly functional interactive map. However, using our developed ArcGIS 9.3.1 files, this web application will allow users to pan to different parts of the map, zoom

in, and zoom out. Every time a traveller uses one of these interactive features, the map is refreshed to display appropriate levels of detail. The attributes of these basic pan and zoom features, such as navigation arrows, slider size, pan animations, and zoom animations, can be tailored to suit the desires of The Kingston Council.

The ability to allow users to select and unselect GIS layers is another feature that can be developed in ESRI JavaScript API. This is a key development feature, as it will enable users to view attributes that they find relevant for specific journeys. This feature is similar to the visible GIS layer selection feature available in the georeferenced PDF. Although JavaScript API and the georeferenced PDF both allow users a zoom in and out option, there is a distinct difference. As aforementioned, the JavaScript web application has the advantage of allowing users to zoom and pan without sacrificing map clarity and quality. Georeferenced PDF's cannot be panned, a disadvantage that recalls the adage, "what you see is what you get." Additionally, even though zooming features can be used on PDF files, zooming either in or out on a georeferenced PDF file does not provide more or less detailed information; it simply reveals a more or less pixilated view of the same map. To support this claim we shall juxtapose a zoomed in and zoomed out screenshot of each map.

2. Develop ESRI RouteTask in order to provide for journey planning capabilities.

As we begin to evaluate the future development of the map, we have identified a possible recommendation. In particular we may suggest that The Kingston Council develop ESRI's "RouteTask" as an additional feature within the interactive map. This feature is ESRI's journey planner framework for web applications. If this RouteTask feature were developed, it would allow users to obtain detailed textual and graphical travel directions as well as estimated journey times. Supplementary programming would also allow users to calculate journeys using single and multimodal transportation, estimate travel costs, and determine the number of transfers for single or multimodal journeys. Developing and troubleshooting the RouteTask feature however requires a significant amount of time and complex programming. Additionally, providing users with the option to filter by mode desired, and type of journey will further complicate the programming.

5.5 Developing a Website Template

It is intended for our multimodal transportation map to be made available on the internet. Therefore, it was necessary to develop an initial website template to explore how it would function with our mapping concepts. After designing a template, we found it necessary to solicit feedback and identify the weaknesses and strengths of our devised website template. Respectively, the informal follow-up interviews which assessed our initial website template have generated several recommendations. These recommendations can be utilized at The Kingston Council's discretion when designing a final website template. With regards to designing a website template for Kingston's multimodal journey map, we recommend that The Kingston Council:

- 1. Offer users the option to journey plan from one page and simply explore the map on another page.** This would differentiate website use, allowing users to choose which map function they wish to operate.
- 2. Provide concise descriptions of journey planning options and avoid ambiguity.** For example, effectively define "safe" journey option in order to make it less ambiguous.
- 3. Set the default journey planning option as "quickest route" but allow users to change this default.**
- 4. Include on the website a resource that enables users to provide further feedback about the transportation map and corresponding website.** While conducting the informal interviews, participants appreciated the opportunity to provide comments and suggestions that would work towards improving our map. This suggests that some persons would like the option to provide feedback.

5.6 Raising Awareness

In order to promote sustainable travel options and raise awareness about alternative travel options it is imperative that we garner public support. Raising

awareness is therefore a very important objective because The Kingston Council aims to reduce the public's reliance on cars and increase the use of alternative forms of transportation through the public's use of the map. In order to raise awareness we have identified the following advertising and marketing strategies. It should be noted that the majority of these options do not have a high capital cost. Listed below are some of our recommendations for raising the public's awareness about the multimodal transportation map.

1. Social Networks:

- a) Twitter
- b) Facebook

The use of social networks is a common advertising strategy of many businesses since it is free and reaches a large audience. It should be noted however that this method will require frequent updates and posts.

2. Public Entities

- a) Schools
- b) Public Libraries

3. Distribute map to the disabled community either through The Kingston Council or with organizations such as DisabledGo.

4. Media

- a) Local newspapers
- b) Radio announcements

5. Events

- a) Host a treasure hunt in association with Kingston First.

We recommend that Kingston Council provides participants with a copy of the map to use. Participants will have to use this map to locate the hidden prizes. Businesses that are associated with Kingston First could donate prizes for the

Treasure Hunt and therefore benefit from the influx of persons within The Borough, and the free advertising. Similarly The Kingston Council would benefit because the map would be advertised and the public's awareness of its existence would be increased.

5.7 Chapter Summary

Our findings and corresponding recommendations have presented the most significant outcomes of our map research and design. These findings and recommendations have been the result of a dynamic progression of objectives and their respective tasks. Although the extent of our compiled background information and work has been recorded in the previous chapters of this report, we now find it appropriate to provide an executive summary of our work. The executive summary is located on the following page and provides a synopsis of each chapter within this document.

CHAPTER 6

6.0 EXECUTIVE SUMMARY

Transportation in Western Europe has developed a lot in the last several decades. Accordingly, the United Kingdom's goals in developing transportation infrastructure have been an exceptional priority. Home to the world's first rapid light rail system, London has especially continued to uphold its achievements in improving transportation infrastructure well into the 21st century. In concurrence with guidelines developed by the European Union and the UK's Department for Transport, the Greater London Authority has developed strategic transportation planning documents on behalf of the city's civic and environmental assets.

One of London's boroughs, The Royal Borough of Kingston, is located in the southwest boundary of Greater London. The Borough's governing body, The Kingston Council, is responsible for administering strategic planning documents developed by the Greater London Authority. Recent planning concerns include how and why transportation usage affects the environment. Accordingly, The Climate Change and Sustainable Travel Group, primary goals are concerned with reducing CO₂ emissions, decreasing road congestion, maintaining public health, and improving overall travel safety.

In order to assist this group with their environmentally focused transportation development goals, we were asked to create a multimodal transportation map and design a website template. Before approaching these objectives, we focused on understanding Kingston's demographics and transportation modes to better orient ourselves. With this, we found that Kingston maintains a relatively large range of transportation options despite its mostly suburban layout. After improving our understanding of Kingston, we found it necessary to look at elements of effective map design to incorporate on our map. Reviewing books by professional cartographers helped us integrate aspects of successful map design and improve our map. Finally, we investigated a range of website application options that are compatible with The Kingston Council's GIS department. This expanded our knowledge of website applications, providing us with the final pieces of background information required to move onto our methodological approach.

Before developing the map, we conducted a ground truth in which we observed The Borough's various urban, suburban, and light industrial areas. Through this experience, we became more aware of the layout of The Borough from a traveller's perspective. After the completion of this task, we were equipped began to design a multimodal transportation map of The Borough. The software with which we imported, edited, modified, and exported spatial data was ArcGIS 9.3.1, a geospatial analysis program developed by ESRI. We acquired relevant map data from The Kingston Council's GIS department, customized its arrangement and appearance, and began to critically analyze and modify our map's design. We referred to background literature and consulted other transportation maps in order to improve our map's layout, symbols, colour scheme, and content.

Through two focus groups and one interview, we obtained the feedback of potential users who require general journey planning resources, disabled access resources, and cycling resources. This feedback enabled us to develop our findings, which were then sorted and evaluated in order to develop a compilation of recommendations. These recommendations address work which has been completed, such as the creation of the multimodal map and the design of a website template.

Additionally, the recommendations include propositions that require further consideration by The Climate Change and Sustainable Travel Group, such as developing interactive website applications and additional map features.

GLOSSARY

A

Adobe: an international software company that produces a range of computer programs that handle data and workflow (Adobe Systems Incorporated. 2010).

(ArcGIS) Arc Global Information Systems: an integrated collection of GIS software products that provides a standards-based platform for spatial analysis, data management, and mapping (ArcGIS Overview, 2010).

B

C

D

(DfT) Department for Transportation: leader of the transport sector aiming to provide a transport system which balances the needs of the economy, the environment and society (About DfT, 2010).

E

(EST) Environmentally Sustainable Transport: an international project founded within the framework of the OECD working group Transport and Environment. The approach central to the project is the basis of health quality goals. It relies on the backcasting approach providing alternate perspectives of sustainable transport systems which are examined with respect to their feasibility and impacts (Thaler, 2010).

(EU) European Union: a union of European nations created by treaty and put into effect in 1993 for the purpose of working gradually toward an

economic and political unification of Europe by means of a united monetary policy, a common currency, standardized laws of commerce and trade, etc. (European Union definition, 2010).

F

G

(GLA) Greater London Authority: a strategic authority with a role to design a better future for the city and its environs (Working for a better London, 2010).

H

I

J

JavaScript: A computer programming language that can be used to create interactive features on websites (Cozzens, 1998).

K

L

(LATS) London Area Travel Survey: a survey of travel and transport in London conducted in 1991 consisting of interviews to 60,000 households, roadside interviews and traffic counts, and on-mode surveys of public transport users (London Area Travel Survey (LATS) 1991, 2010).

(LIP) Local Implementation Plan: a Borough wide transport strategy outlining how to achieve the proposals set out by the Greater London Authority. It builds on and is consistent with strategies in both the Unitary Development Plan (UDP) and the Community Plan (Royal Borough of Kingston upon Thames, 2006).

M

(MTS) Mayor's Transport Strategy: outlines the Mayor's vision for transport in London over the next twenty years. It prepares for London's predicted growth of 1.3 million more people and 0.75 million more jobs by 2031 and supports sustainable growth across central, inner and outer London (Mayor's Transport Strategy, 2010).

N

O

(OECD) Organisation For Economic Co-Operation And Development: brings together the governments of countries committed to democracy and the market economy from around the world to support sustainable economic growth, boost employment, raise living standards, maintain financial stability, assist other countries' economic development, and contribute to growth in world trade. It provides a setting where governments compare policy experiences, seek answers to common problems, identify good practice and coordinate domestic and international policies (About OECD, 2010).

P

Q

R

S

(SEA) Strategic Environmental Assessment: the process of appraisal through which environmental protection and sustainable development may be considered, and factored into national and local decisions regarding government plans and programmes (What is the SEA Process?, 2004).

Sustainability: development that meets the needs of the present without comprising the ability of future generations to meet their own needs (Sustainability, 2010).

T

(TfL) Transport for London: is a local government body responsible for most aspects of the transport system throughout greater London in England. Its role is to implement the transport strategy and to manage transport services across London (Farlex, 2010).

(TLP) The London Plan: the strategic spatial planning document for London (The London Plan , 2010).

U

(UK) United Kingdom: a country in Western Europe comprising of England, Scotland, Wales, and Northern Ireland (United Kingdom, 2010).

V

W

X

Y

Z

AAPPENDICES

APPENDIX A: FOCUS GROUPS AND INTERVIEWS

Focus Group Conducted with Employees of The Kingston Council: Notes

Topic: How Do You Plan Your Journey?

Conducted: June 3rd, 2010

Facilitated by: Professor Robert Krueger

Project Team: Maria Gioules, Lauren Hannmann, Jodi-Lee Smith, and Evan Sullivan

Slide 1



Notes From Focus Group:

- Introductions
- Working with Leslie
- Discuss how you plan your journey and discuss alternative transportation options

Slide 2

Motivation for this session

- Walking and cycling can:
 - Work toward CO₂ emission reduction targets
 - Reduce traffic congestion
 - Promote sustainable, healthy travel options
 - Walking and cycling can be quicker and enjoyable

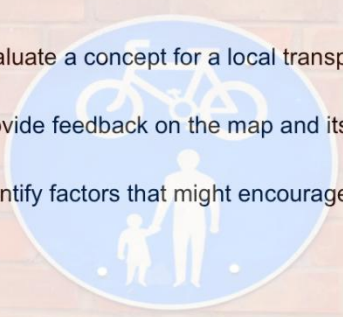
Notes From Focus Group:

- Reduce climate gas
- Reduce traffic congestion
- Promote healthy and sustainable travel options
- Highlight that cycling is quicker and more enjoyable

Slide 3

Why are you here?

- To evaluate a concept for a local transportation map
- To provide feedback on the map and its features
- To identify factors that might encourage map usage



Facilitator's Comments

- We have been working diligently to develop a sustainable transportation map
- We will present a concept map
- We would like to solicit your feedback
- We are asking for insight on the local transportation map and how we can encourage people to use the map.

Slide 4

Journey planners

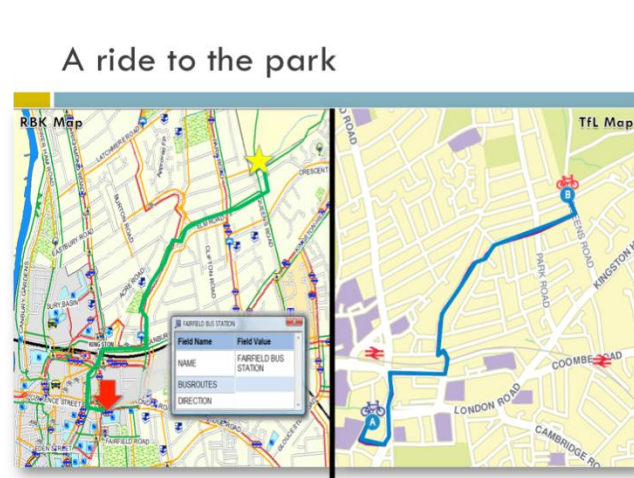
TfL map:	RBK map:
<ul style="list-style-type: none">Fastest travel timeFewest changesLeast walkingDesired transport mode	<ul style="list-style-type: none">Safe routesDesignated routesAccessibility<ul style="list-style-type: none">DisabilitiesCar chargingCar clubs'Park and Ride'Bicycle parkingOther amenities

Facilitator's Comments

- TfL Journey Planner:
 - Best for use if travelling to central London
 - Not specific for visits inside community or around this area
 - Several characteristics include:
 - Select fastest route
 - Select route with least travel
 - Ability to choose mode of transportation
- RBK Journey Planner
 - Use for localized mapping

- Use when planning for shorter journeys
- Use this map for safe routes, designated routes
- Map is accessible
 - Disabilities
 - Car charging
 - 'Park and Ride'
- Purpose of the map is to compliment the TfL map providing more detailed, localized journey planning

Slide 5



Notes From Focus Group

RBK map uses cycle routes that The Council has approved while, TfL usually reroutes cyclists onto trafficked roads.

Slide 6



Notes From Focus Group

TfL provides long-distance routes, stop for gelato, Italian ice cream specific to commuter needs.

Slide 7

Discussion topics

- What are your general impression of the concept?
 - ▣ How would you improve it?
 - ▣ Legend feedback
- What additional features would make it more useful to you?
- What would motivate you to use the map?
- What type of journeys would you use this map to plan?
- Where would you like to see the map posted on the web?
- What would prompt you walk or cycle more to local destinations?

We asked participants to provide:

1. The distinction between two maps
2. General impressions of idea

The following text is an outline of the discussion

RESPONSE 1: WHY A GOOD IDEA, WHO MAY USE IT

Map is definitely a good idea for people who would like to go on leisurely walks. Her mom visits from out of The Borough, and likes to take walks. She believes that her mom would like to identify alternate routes, having safe routes is good for women, late in the evening leaving from the pub.

RESPONSE 2: AMBIGIOUS

Definition of safe: least traffic

RESPONSE 3: WHY A GOOD IDEA; SUGGESTIONS

Prefers to cycle around The Borough. She cycles from Ealing to Kingston. She believes it is better than taking two buses because it is relaxing, takes less time. Also, believes that RBK provides travellers with another option. She thinks TfL is difficult to use. One must scroll through several pages to locate information. She thinks it is great that the RBK map shows cycle paths. This could be particularly helpful for cyclists since she herself gets confused at busy roundabouts.

RESPONSE 4: SUGGESTION WHY COULD BE GOOD

This map can be helpful because in an emergency or in the case of gasworks, they commonly close certain routes. If a map is available that identifies these alternate routes it could be helpful.

RESPONSE 5: CONCERN ABOUT UTILITY, AND PURPOSENESS PLUS SUGGESTION

A concern about the usefulness of this map is that there are a limited number of journeys that people will utilize a journey planner for within The Borough. Travellers will mostly use a journey planner for cross borough journeys, persons who live within The Borough

are already familiar with the area. He believes that in order for it to be useful to more people it needs to cover more distance. In sum, widen the scope of the map. Suggests that the map includes attributes located within surrounding boroughs since most people actually reside outside of The Borough.

RESPONSE 6: WHO WILL USE THE MAP?

Believes that persons would primarily use the map for planning journeys; using public transportation when interested in the time or if they are unaware where they are going. Believes that potential users for this map could be persons who are planning first time journeys within The Borough.

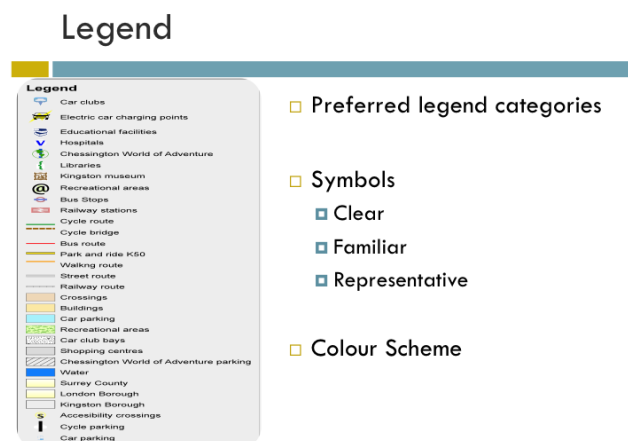
RESPONSE 7: Not as useful as the TfL Journey planner

QUESTION FROM THE FACILITATOR: Do you think people within The Borough know enough about their environs and would not find it useful at all?

RESPONSE 8: Not that the map would not be useful

QUESTION FROM THE FACILITATOR: Is there a value?

Slide 8



RESPONSE 9: Good for disabled persons

RESPONSE 10: ROADWORKS, ALTERNATE ROUTES

1. A possible additional feature to include is mapping roadworks.
2. While gas works and roadworks are being conducted commuter's typical routes may be rerouted. This is particularly important for disabled persons because they need to have access to designated alternate routes.
3. Suggests that this could be a good feature because by providing alternative street routes for street works, then people, especially, drivers may use it.

RESPONSE 12: COPYRIGHT ISSUES

1. Copyright issues because base map is owned by Ordnance Survey.
2. Cycle map is issued as hardcopy because of copy right restrictions.

RESPONSE 13: ACCESSIBILITY

Accessibility: TfL does not provide a wheel chair option

FACILLITATOR QUESTION: Do they have a website that travellers can use to check for traffic delays and Roadworks?

RESPONSE: ROADWORKS ON MAPS

1. Yes they have smart routes. In particular, for highways not for travel within The Borough.
2. Everyone must notify The Council in advance for roadworks.
3. Suggests if we place a feature that identifies roadworks, then persons can use the map to effectively plan their journey's to avoid such routes.

FACILLITATOR QUESTION:

Could you require Roadwork companies to submit GIS locations?

RESPONSE 14: LEGAL ISSUES REGARDING MAPPING ROADWORK

1. They are legally required.
2. The GIS department does not have to map the spatial data.

FACILLITATOR QUESTION:

What other features would you like made available on a map?

PARTICIPANTS QUESTION: MANIPULATION OF FEATURES TO JOURNEY PLAN

Can we manipulate these features to create a journey planner?

PARICIPANT ANSWER: MANIPULATION OF FEATURES TO JOURNEY PLAN MORE EFFECTIVELY

1. Features need to be points of interest.
2. Features need to be selectable it is not useful to just have these features on the map.
3. Points of interest are already on website so then we have a duplication, if the map development continues. There is already a similar online map, we cannot create confusion therefore, what is the difference between these two applications?

RESPONSE 15: MANIPULATION OF FEATURES TO JOURNEY PLAN MORE EFFECTIVELY

1. Layer each feature, provide the option to turn on and off each layer. For example, cyclists do not want to think about buses, or other layers they are mainly interested in cycle parking, cycle routes, and bridges.
2. Make it possible to select features, based on your preferred mode.

RESPONSE 16: CYCLISTS AND CONTOUR OF THE LAND

For cycle routes show grade. This is important so persons can plan their journey in order to use steeper inclines or avoid them. For example, one can travel via Berrylands to avoid Surbiton Hill. Over and down the top of Surbiton Hill, is the shorter and more direct route, while Berrylands on the other hand provides a longer, slower, but easier route.

FACILITATOR QUESTION: What would be a good location for this map on the Kingston Website?

RESPONSE 17: PLACEMENT OF MAP ON WEBSITE

1. The website is about to be completely redeveloped; we cannot answer that question at the moment.
2. Unaware of map design, it is going to be Web 2.0 so users can customize it and make it their home page.

RESPONSE 18: LEGEND AND SYMBOLS

1. Simplify symbols
2. The Ordnance Map Survey, contains universal symbols
 - Use standard symbols since Ordnance Survey is used on maps, if people know that X is represented by the symbol £ then they will use it.

FACILITATOR QUESTION:

Are there any copyright issues?

RESPONSE 19: ORDNANCE SURVEY COPYRIGHT ISSUES

No copy right issues, we have rights for use.

RESPONSE 20: SUGGESTION

Correct the two recreational areas, both are confusing.

RESPONSE 21: ACCESSIBILITY; AMBIGUOUS; CONTACT FOR FOLLOW UP

1. Accessibility, what does this mean? Drop curbs and bollards.

RESPONSE 22: CYCLE CLUBS

1. Cycle clubs, there are a few: Kingston Cycle Club, Cycle Kingston
2. Cycle Kingston has a link on Kingston.gov.uk

RESPONSE 23: RUNNERS OR JOGGERS

What about features or layers for runners or joggers?

FACILITATOR QUESTION:

What kind of journey planners do you normally use?

RESPONSE 24: JOUREY PLANNER'S TYPICALLY USED

Journey planners frequently used:

1. GPS
2. National Rail website (never displays the correct information or time)
3. TfL
4. Google Maps (not always correct) got lost. However, Google Maps does a great job with its features despite her getting lost.

RESPONES 25: SUGGESTION MERGE WITH GOOGLE MAPS

Suggests that we overlay on Google Maps, more approachable. It is a better option since people are more familiar with it. Also, the proposed map in conjunction with Google Maps has the potential, to be developed into a mobile application.

RESPONSE 26: LEGEND ADIVCE

1. Take hospitals off the legend, everyone is familiar with an H symbol
2. Libraries and Museums use the same symbol
3. Bus stops look like tube signs, but there are no tubes in Kingston
 - Bus is red and white
4. Electric Car Club is too big, change size
5. Need to differentiate between Surrey county and London boundary on the legend, just add boundary line
6. Car Parks

FACILITATOR QUESTION:

What is the best way to advertise or market the map?

RESPONSE 27: ADVERTISING AND MARKETING SUGGESTIONS

Best approach to advertise or market the map:

1. Tweet
2. Facebook
3. Schools, get children using it
4. If we had traffic caused by roadworks we could ask our friends at radio jockey.
DJ states “roadworks, route diversion, problems on this road “check out the TfL Map

5. Local newspapers
6. Libraries
7. Treasure hunt or some type of competition that necessitates participants to use the map
 - a. Try to get Kingston First to sponsor a treasure hunt, (Kingston First the partnership with The Council and local shops and businesses)
 - b. Treasure hunt attracts people into borough and into their shops, that is how Kingston First benefits
 - c. Market it to those persons outside The Borough, because residents are already with the town centre

Closing Remarks

- a. If working on a mashup of a website, a design, we might contact all participants
- b. Get names and extensions
- c. Email, first name last name at RBK

The general idea of the treasure hunt is to partner with Kingston First. Kingston Council will provide participants with a copy of the map to use. They will have to use this map in order to locate the prizes. With respect to the Treasure Hunt idea “Person A” suggests that businesses which are associated with Kingston First could sponsor prizes for the Treasure Hunt and therefore benefit from the influx of persons, and the free advertising. Similarly The Kingston Council would benefit because the map would be advertised, and thus bolster public support.

Table 6: Sorting Focus Group Data

General Impressions	Motivation to use the map at current stage of development	Motivation to use sustainable transport	Dislikes	Suggestions	Comments
<ul style="list-style-type: none"> Limited scope of use: Limited number of journeys that people will utilize a journey planner for. This idea is best for cross borough journeys . Reason: “Persons who live in The 	<p><u>RECREATIONAL</u></p> <ul style="list-style-type: none"> Good idea for persons who would like to go on walks. Esp. Family walks Locate alternate routes 	<ul style="list-style-type: none"> It is relaxing Takes less time “Better than taking two buses” 		<p><u>FEATURE: ROADWORKS</u></p> <ul style="list-style-type: none"> Identify roadworks Reason for identifying roadworks: good idea because people especially drivers may use it If there is a feature that identifies roadworks then persons can use the map to effectively plan their journey to avoid those routes 	<p><u>CONCERNS:</u></p> <ul style="list-style-type: none"> Copyright issue base map is owned by Ordnance Survey Cycle map only issued as a hardcopy because of copyright issues Since the Ordnance Survey is the standard use it. People are familiar with

Borough are already familiar with getting around					
<ul style="list-style-type: none"> Not as useful as the TfL map 	<u>ACCESSIBILITY</u> <ul style="list-style-type: none"> Good for disabled persons 			<u>FEATURE:</u> <u>ROADWORKS/</u> <u>ACCESSIBILITY</u> <ul style="list-style-type: none"> Reason for identifying roadworks: Important for disabled persons who need to have access to designated alternate routes 	<u>ROADWORKS</u> <ul style="list-style-type: none"> Companies are legally required to notify the council about Roadwork GIS department does not have to go and map spatial data for roadworks since companies provide spatial data

	<p><u>UNFAMILIARITY WITH AREA</u></p> <ul style="list-style-type: none"> Interested in time or if traveller does not know where they are going, or if they are planning their first journey. 			<p><u>FEATURE: ROUNDABOUTS</u></p> <ul style="list-style-type: none"> Include roundabouts. “She gets confused at busy roundabouts” 	<p><u>PLACEMENT OF MAP ON WEBSITE</u></p> <ul style="list-style-type: none"> Website about to be completely redeveloped so we cannot answer that question now No idea what the design will be It will be web 2.0 so users can use it as their home page
	<ul style="list-style-type: none"> TfL is difficult to use RBK map already shows cycle paths 			<p><u>FEATURE: CONTOURS</u></p> <ul style="list-style-type: none"> For cycle routes show the grade Important so persons can 	<p><u>AMBIGUITY:</u></p> <ul style="list-style-type: none"> Use of word Safe Routes

				plan their journeys to avoid or include steep inclines	
	<ul style="list-style-type: none"> Displays alternate routes that travellers can use when roads are closed due to roadworks or due to emergencies 			<p><u>MANIPULATION OF FEATURES TO JOURNEY PLAN:</u></p> <ul style="list-style-type: none"> Layer each feature Turn on and on each layer. Cyclists do not want to think about buses or other things.* Make it possible to select features, so you only show things based on your preferred mode 	<p><u>CYCLE CLUBS:</u></p> <ul style="list-style-type: none"> Cycle Clubs there are a few: Kingston Cycle Club, Cycle Kingston Cycle Kingston has a link on Kingston.gov.uk
				<p><u>AREA COVERED</u></p> <ul style="list-style-type: none"> Believes that “ in order for it to be more useful to people it needs to cover 	<p><u>QUESTION:</u></p> <p>What about runners and joggers?</p>

				<p>more distance”</p> <ul style="list-style-type: none"> • Suggests that the map includes attributes located within neighbouring boroughs since most people reside outside the borough 	
				<p><u>LEGEND AND SYMBOLS</u></p> <ul style="list-style-type: none"> • Simplify the symbols • Use the Ordnance Map Survey Symbols they have universal symbols • No copy right issue because we have the rights to use it • Correct the two 	<p><u>WHAT JOURNEY PLANNER DO THEY USE:</u></p> <ul style="list-style-type: none"> • GPS • National Railway

				<div>recreational areas they are confusing</div> <ul style="list-style-type: none">• Accessibility, what does this mean	
--	--	--	--	---	--

Accessibility Interview: Notes

Topic: Accessibility in Transportation Mapping

Conducted: June 11th, 2010

Interviewer: Evan Sullivan

Project Team: Maria Gioules, Lauren Hannmann, Jodi-Lee Smith, and Evan Sullivan

Person F:

Introduction

- a. Student group designing a local multimodal transportation map for The Borough of Kingston
- b. Solicit feedback on the map's resources

Accessibility in Transportation

- a. Do you have routine travel habits?
Drives a car to and from work every day
- b. What forms of transportation do you use? (bus, train, pedestrian routes: sidewalks)
In the evening she will get the bus (routes 2 & 3) to get home because there is "wheelchair assistance".
The wheelchair bus:
 - Frequently arrives every 7 to 8 minutes.
 - "Sometimes ramps do not work so have to wait another 7 minutes. If they do not work they should not be in service, just my opinion."
- c. Where in Kingston (and/or Greater London) do you recommend additional accessibility resources?
 - Guildhall offers the least accessible resources, people must go around the corner without even looking.

- St. James's Road: needs additional accessibility resources because "there is constant traffic", a challenging intersection.
- d. How do you plan a journey for an unknown destination?
- "Bought a Tom Tom or I use the A to Z map and then get lost."
 - "I look it up on ISIS."
 - Google Maps
- e. What types of accessibility information is crucial before travel?
- Disabled parking
 - National system for disabled toilets: (national key, "radar key", puppet toilet in businesses, cafes, etc.)
 - Ramps or lifts
 - LIP systems for other disabled persons (hearing impairment—deaf)

Accessibility in Maps

- a. Do you use interactive journey planners? (such as TfL Google Maps)
- TfL
- "I tend to check roadworks specifically for traffic updates on major roads, and whether or not bus routes are in commission."
- b. In its advanced search options, Transport for London offers a user to plan a journey with specific mobility requirements.

My mobility requirements

☐ I cannot use stairs
☐ I cannot use escalators
☐ I cannot use lifts
☐ I use wheelchair accessible vehicles

Select any of the above statements that apply to you.
 For station access details [click here](#)

Cycling options

Select any which apply:

☐ I want a cycle only route
☐ I want to leave my bicycle at the station
☐ I want to take my bicycle on public transport

I don't want to cycle for longer than minutes

Walking options

I don't want to walk for longer than minutes

My walking speed is:

☐ I'd rather walk if it makes my journey quicker

Journey Planner

From the TfL shop

I'M GOING UNDERGROUND

Have you ever used this feature?

- “No I do not, mainly that is for the tubes and trains; I have not used them for approximately 25 years.”
- Majority of tubes need to be notified in advance, especially the suburban tubes.
- Assistance required on the tube: “there is a lot of hassle and I prefer to travel in more comfort. Also, I might miss the train, it is not worth it.”

Present Our Map

- a. Suggestion: make the crossings polygon the same blue as the symbol
 - This feature is not available on ISIS

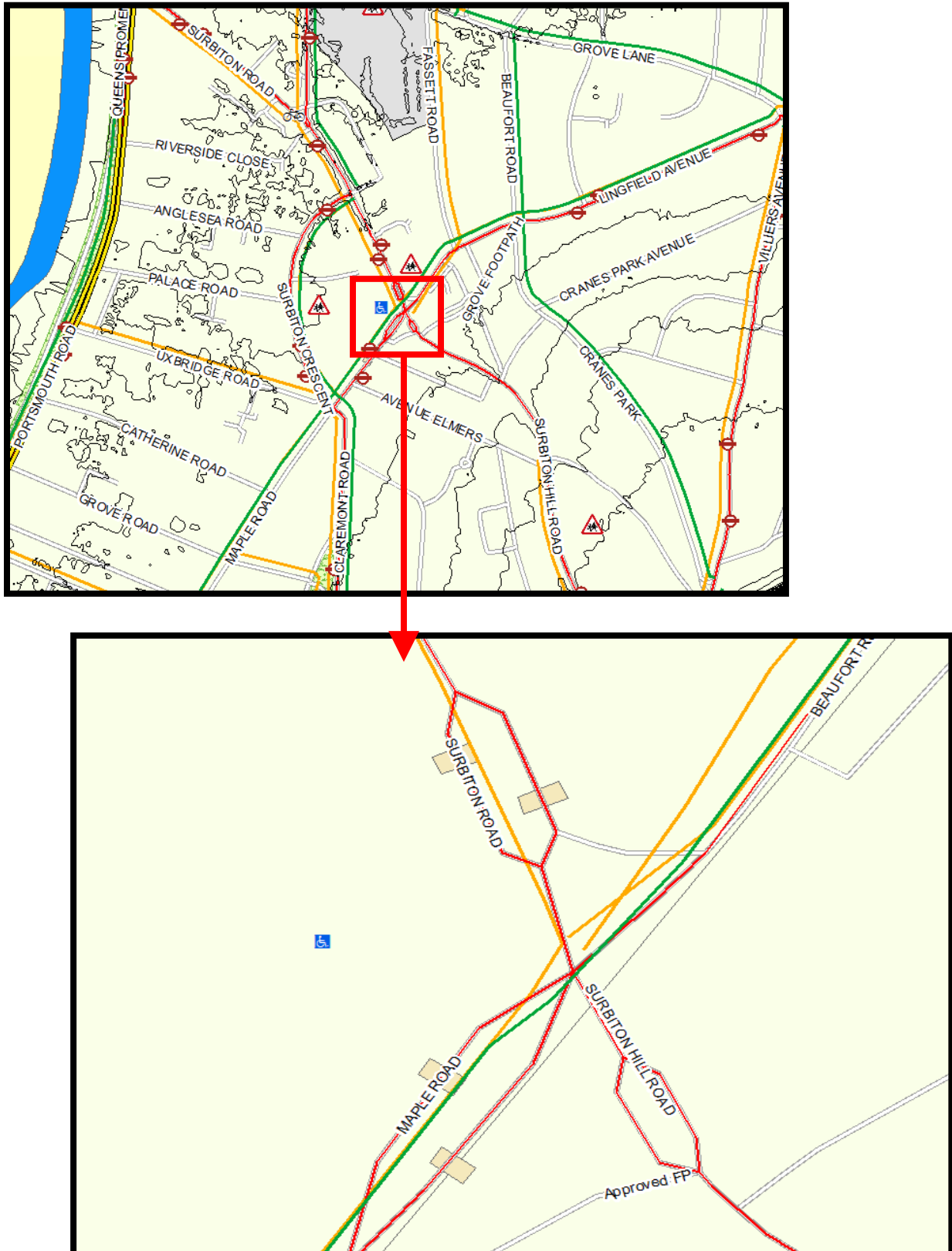


Figure 26: RBK Map: Accessibility Crossings

Can you think of additional features that make the map more useful to you? (Location of anything specific? cinemas, shopping, restaurants...)

The figure below identifies three features suggested to include on the map including the reason and approach.

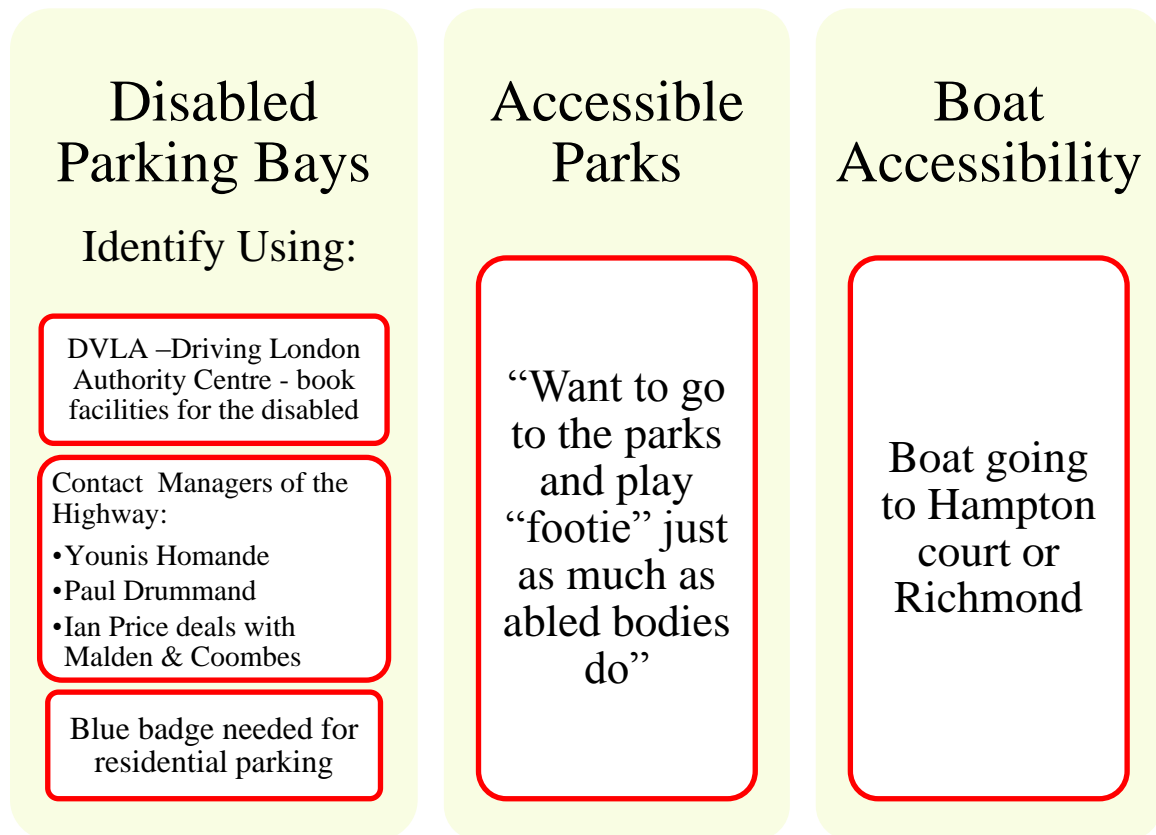


Figure 27: Suggested Features

b. How can we contact accessible resources?

- Local authority deal with Kingston Centre for Accessibility Living (KCAL) which consists of hiring, purchasing, adaptations, giving direct payments for people, “one of the first places I would suggest.”
- KAB (for the blind) McNally: has resources and contacts for the local businesses

- Tourist information centre, local libraries, doctor surgeries, elderly
- MS society
- Local authorities surrounding Kingston
- Disabled GO: accessible in and around London “tap them, their very good”

Concluding Remarks:

- “This would be something spectacular if Kingston were able to supply this.”
- “When the disabled, the blind, have to cross the streets, they are unable to see the visuals. Therefore, a “dolly”, a person’s hand is placed underneath the mechanical box and tells when a safe cross-location, these would be idealful for the blind.”
- A potential feature on the journey planner that allows you to hear the route.
- “I am impressed I really am, that would be really ideal.”

Focus Group Conducted with Members of a Cycling Club: Notes
Topic: Cycling In and Around Kingston

Conducted: June 14th, 2010

Facilitated by: Evan Sullivan

Project Team: Maria Gioules, Lauren Hannmann, Jodi-Lee Smith, and Evan Sullivan

Introduction:

1) Introductions

- a) RBK Climate Change and Sustainable Travel Group wants to reduce reliance on automobiles (road congestion, air pollution)
- b) Student group is helping develop a multimodal transportation map for RBK
- c) The prototype map exists to compliment, not replace, pre-existing journey planners
- d) Asked to conduct focus group to help gain insight on how to adapt features of the map specifically for cyclist usage

Notes From Focus Group:

- Student group assigned to help Kingston Council Develop a multimodal transportation map
- The multimodal transportation map will be developed into a journey planner eventually
- Solicit feedback in order to gain insight on how we can adapt features for cyclist usage
- Borough aims to increase cycling and reduce automobile use in The Borough

Question 1 & 2:

What is your opinion about cycling maps and journey planners available to the Royal Borough of Kingston?

What do you typically use to plan your journeys?

GENERAL RESPONSE:

Have never used maps

Person I:

We live around here, we are familiar where places are located. However, cycling maps are not super useful especially when I want to get from A to B. To find a better route or a main street cross however, I go on Google maps or use Open Street Maps which is a “geeky map” overlay that is comparable to Google maps.

Person G:

I use a map to plan a journey with my children.

Question 3:

What additional features/resources do you think the map should include?

Person G:

Roads are not ideal for cyclists, major traffic avoidance would be useful. If you have children, you do not mind travelling the distance.

Person H:

It would be helpful if you had a map of the area showing traffic free routes or quiet routes.

Person I:

The cycling routes are not always clear on the map. Sometimes there is a path beside the road and this is not apparent unless you try it.

Question 4:

Are there any particular ways you would like the routes categorized?

e) cycling routes with traffic (generally quicker)

- f) cycling routes with walking (safer)
- g) cycling routes near particular destinations (parks, libraries, schools, cycle parking, etc.)
- h) cycling routes with less elevation

Person G:

When cycling from Kingston to Richmond Park with children, the main cycle routes are too dangerous. Cycling routes are clearly an afterthought. It would be ideal if the map suggested an alternate way to travel when routes are narrow.

Person H:

When you have children, you consider travelling, the traffic free route.

Person I:

Indication of traffic on the route would be helpful. When travelling to Berrylands, there are tiny roads. It is ridiculous the obstacles cyclists encounter when they follow the bike path symbols. It also would be helpful to provide the alternative routes and discard of the non-useful ones.

General Complaints:

Person G:

The major problem with Kingston is the one way system, three lanes. Instead of travelling through the town centre where it is difficult to travel, I use the cycle path and footpath travelling up the river, before Hamm and across to Kingston Gate to reach Richmond Park. Persons should avoid going through the trafficked town centre “like the plague”.

Person H:

In front of Bentalls, there is a no cycling sign however, there is cycle parking. TfL does not provide options such as the shortest route, travelling with children, new cyclist, confident cyclist, etc.

Person I:

Near Kingston station there are pedestrians crossing the street, swarming the bike lane creating half a bike path and half a sidewalk. Instead of “messaging” with the busy roads and traffic, an alternate way to reach Richmond Park includes travelling the Kingston near the River. The lights for cyclists are also a concern because they are specifically tailored for cars. In Holland, there are scenic routes labelled with green signs and faster, uglier routes labelled with red signs.

Question 5:

2) Are there any potential modifications that could enhance the map?

Person H:

The symbols should be similar to the TfL map or the A to Z map since they are more recognizable. In terms of the contours, it would be helpful to design routes based on athletic ability for example, for those quite fit, (seek doctors before travelling up hill). It is a good idea to note hills because when travelling with children, you will want to avoid any major hills. However, contours may be interpreted as a weather map.

Person I:

Use the same symbols as TfL map because it is confusing creating a new map. The signage should be the same too. The official signage for bike paths is blue. Ordnance Survey Symbols may also be used. If contours are added, they must be faint; contours may be indicated with uphill and downhill as well as the level of difficulty. Statistically, “over 5% is considered challenging for a cyclist”.

Question 6:

3) Do you think it would be useful to identify busy roundabouts?

Person G:

“Roundabouts are a really big hazard for cyclists.”

Person H:

“Roundabouts are the worst with your children, not fun. You follow the designated cycle paths and are unable to see what is coming around the bend.” A warning triangle symbol may be used to indicate roundabouts.

Person I:

Cars are not aware of cyclists. The College roundabout is a big hazard. The buses compose $\frac{3}{4}$ of the lanes. The exit from the roundabout is not visible. It would be advisable to avoid the busy roundabouts.

Table 7: Sorting Focus Group Two Data

	Person G	Person H	Person I
Question 1 & 2	Use them with the children	TfL	<p>-“Never used it, there is one in London”</p> <p>-“We live around here so we get used to knowing where things are located”</p> <p>-“Move with a purpose, know cycle routes but only use half of them”</p> <p>To find a better route or main street:</p> <ul style="list-style-type: none"> • Google Maps • Open street maps (geeky thing, map overlay, more build up, the more bike shops etc., works like Google maps) <p>“a lot of bike paths not super useful”</p>
Question 3	<p>-Major traffic; roads not ideal for cyclists</p> <p>-“if you have children do not mind going the extra way”</p>	<p>-Traffic free, quiet</p> <p>-Map area to show traffic free routes</p>	<p>-Not always clear on a map</p> <p>-“Sometimes the path beside a road is not ideal for me, and I adjust the route next time”</p>
Question 4	<p>-From Kingston to Richmond Park, main cycle routes with the children are unsafe</p> <p>-Cycle routes are clearly an afterthought</p> <p>-When it gets narrow, suggest better route</p>	<p>-Travelling with children, do not mind the traffic free route</p>	<p>-Indication of traffic on the route</p> <p>-Berrylands, has tiny roads, ridiculous obstacles for a cyclist to travel especially when they follow the bike path symbols</p> <p>-Provide an alternative routes if not useful routes, disregard them on the map</p>
General	<p>-A cycle path and a foot path up the river has less traffic</p> <p>-Travel by the river before Hamm to go from Kingston Gate to Richmond Park. Otherwise, the other route is:</p> <p>A- Impossible to cross</p> <p>B- Inexperienced cyclists should avoid it</p> <p>C- “Avoid it like the plague”</p> <p>-Huge issue for Kingston</p>	<p>-Secure your bike (Bentalls centre sign, no cycling but there is a cycle parking)</p> <p>-TfL does not provide options for shortest route, travelling with children, inexperienced, new cyclist, confident cyclist etc.</p>	<p>-Travel in an “L” to Richmond instead of “messaging” with the busy roads and traffic</p> <p>-The cyclist lights are more or less primarily for cars</p> <p>-In Holland: green signs- leisure routes while, red signs- travel from point A to B; ugly approach</p>

Question 5	is the one way system with three lane race track; impossible to travel		
		<ul style="list-style-type: none"> -Should be similar to the TfL map -Instead of providing an option for an experienced cyclist, provide routes for those quite fit, (seek doctors position for going up the hill -Show a symbol indicating a hill -Contours will be distinguished as a weather map 	<ul style="list-style-type: none"> -Use the same symbols as on the TfL map -The signage should be the same too -“When I road Coombe Lane there was quite a bit of a hill. More ideal to travel through the park.” -Indication of uphill or downhill -Contours must be faint - A recognizable signage feature is blue for an official bike path
	Exploring		<ul style="list-style-type: none"> -To make the map efficient, ground truth The Borough.
	Question 6: busy roundabout with a sign	<ul style="list-style-type: none"> “Roundabouts are a big hazard for cyclists” <ul style="list-style-type: none"> Designated cycle paths cannot see what is coming around, warning triangle 	<ul style="list-style-type: none"> -Cars do not pay attention to cyclists -College roundabout is another big hazard, buses are constantly coming through -“college roundabout consists of the $\frac{3}{4}$ lanes wide buses” -Avoid the busy roundabouts
	Background Information & Input		<ul style="list-style-type: none"> -Kingston Wheelers are persons from southwest London -People come from all over London; a general club with mountain cyclists, cyclists that train for Tour de France, or leisure cyclists

Follow-up interview with Employees of The Kingston Council: Notes
Topic: Website Design Feedback

Conducted: June 18th, 2010

Facilitated by: Lauren Hannmann

Project Team: Maria Gioules, Lauren Hannmann, Jodi-Lee Smith, and Evan Sullivan

Person E:

In the journey planner, Person E highlights there is no available bus route timetable. “If times were unavailable, then I would use another resource.” Overall, Person E thinks map is well done.

Person B:

Person B highlights that separate tabs would be ideal because the Journey Planning option is distinct from the different town centres tabs. Also, Person B states that the default could be the quickest route. Other suggestions included that items of interest such as Hospitals and schools, should be displayed as available options. Also, instead of displaying cycle parking and car parking options, create an option like “show nearest cycle parking to destination”, change The River Thames option to also include the Hogsmill River, and change Car Blub Bays to Car Club Bays. Additionally, Person B adds that including a fifth option for zooming into a location is best. Person B liked the potential of the website template.

Person D:

Person D likes the layout of the website template, particularly the town centre tabs which included the zoom in and out options as well as turning on and off layers. TfL thinks they know how to do things so they do not ask for local feedback. They think

they know all but they do not.” Eventually, Person D suggests one way roads be denoted.

Person C:

Person C states the map looked too similar to TfL, and to make it more unique. All persons discussed a dislike for the safety option featured because it would mislead users.

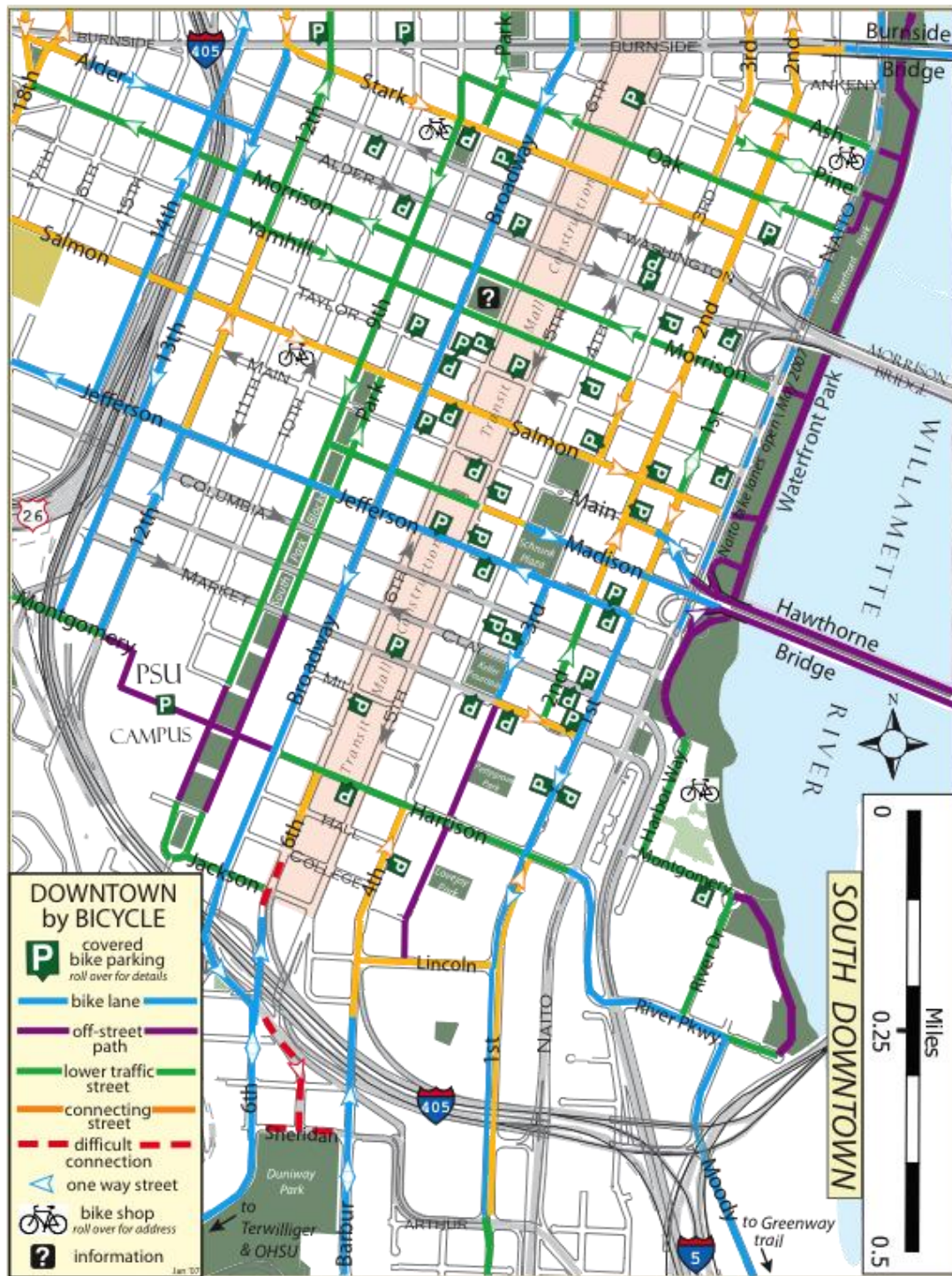


Figure 29: Portland, Oregon, USA Cycle Map
(City of Portland, Oregon , 2010)

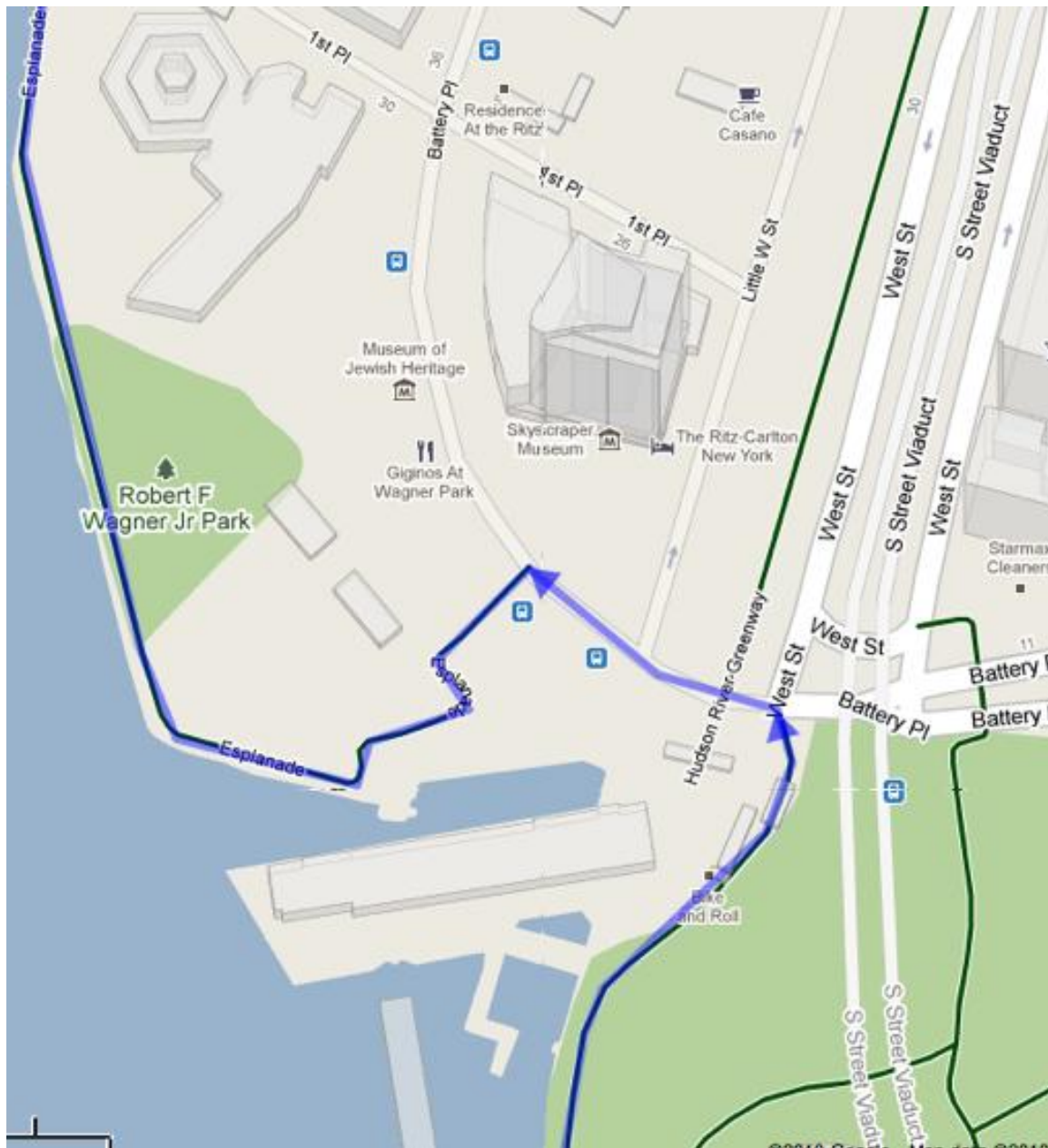


Figure 30: Journey Planned using Google Maps
(Google, 2010)

Table 8: Evaluation of Layout

	Advantages	Reason	Disadvantages	Reason
Cambridge Cycle Map	<ul style="list-style-type: none"> Legend located at bottom of page below content of map 	<ul style="list-style-type: none"> Does not obstruct information on the map 	<ul style="list-style-type: none"> Lacks a title Names of colleges place on map 	<ul style="list-style-type: none"> Uninformative Overwhelming
Portland Cycle Map	<ul style="list-style-type: none"> Provides a map scale 	<ul style="list-style-type: none"> Allows users to account for their distance and time effectively 	<ul style="list-style-type: none"> Legend located at bottom left of map Title located, “sideways” on bottom right of map 	<ul style="list-style-type: none"> Obstructs view of the entire map Inconveniently placed for users
New York Google Transit Cycle Map	<ul style="list-style-type: none"> No legend 	<ul style="list-style-type: none"> Users are familiar with symbols; unnecessary to create a legend 		

Table 9: Evaluation on Use of Symbols

	Advantages	Reason	Disadvantages	Reason
Cambridge Cycle Map	<ul style="list-style-type: none"> Legend located at bottom of page below content of map 	<ul style="list-style-type: none"> Does not obstruct information on the map 	<ul style="list-style-type: none"> Lacks a title Names of colleges place on map 	<ul style="list-style-type: none"> Uninformative Overwhelming
Portland Cycle Map	<ul style="list-style-type: none"> Provides a map scale 	<ul style="list-style-type: none"> Allows users to account for their distance and time effectively 	<ul style="list-style-type: none"> Legend located at bottom left of map Title located, “sideways” on bottom right of map 	<ul style="list-style-type: none"> Obstructs view of the entire map Inconveniently placed for users
New York Google Transit Cycle Map	<ul style="list-style-type: none"> No legend 	<ul style="list-style-type: none"> Users are familiar with symbols; unnecessary to create a legend 		

Table 10: Evaluation of Use of Colour

	Advantages	Reason	Disadvantages	Reason
Cambridge Cycle Map	<ul style="list-style-type: none"> Each route is coloured with hues and tones that complement each other Base land layer uses subtle multi-faceted colour scheme Multiple route colours indicate type of cycle lane; e.g. off street path or lower traffic street 	<ul style="list-style-type: none"> Makes map visually appealing and effective Suburban areas, parks, and less populated areas discernable Information allows users to make the best decisions when planning their cycle routes 	<ul style="list-style-type: none"> Base colour scheme not explained in legend 	<ul style="list-style-type: none"> Forces user to determine the meaning of colour scheme
Portland Cycle Map	<ul style="list-style-type: none"> Cycle lanes displayed with relatively bright colours Multiple route colours indicate type of cycle lane; e.g. off street path or lower traffic street 	<ul style="list-style-type: none"> Cycle lanes easy to distinguish from other map layers Information allows users to make the best decisions when planning their cycle routes 	<ul style="list-style-type: none"> Provides solid lines for mostly all available routes Blue cycle lane colour is not apparent; looks too similar to the river colour 	<ul style="list-style-type: none"> No variety in use of symbols Users must be able to distinguish between two colours
New York Google Cycle Map	<ul style="list-style-type: none"> Utilizes “soft” colours; easily comprehensible 	<ul style="list-style-type: none"> Informative 	<ul style="list-style-type: none"> Colour of cycle paths, the most crucial piece of information, blends in with colour of parks 	<ul style="list-style-type: none"> May be harder for certain users to distinguish

Table 11: Evaluation of Content Presented

	Advantages	Reason	Disadvantages	Reason
Cambridge Cycle Map	<ul style="list-style-type: none"> Includes a separate zoomed in map for downtown 	<ul style="list-style-type: none"> Helps users discern cycle routes where there is higher street density 	<ul style="list-style-type: none"> Did not identify other surrounding physical attributes 	<ul style="list-style-type: none"> Users are unable to plan their journey based on points of interest
Portland Cycle Map	<ul style="list-style-type: none"> Pinpoints the location of bike shops 	<ul style="list-style-type: none"> Provides the location of a highly relevant resource 	<ul style="list-style-type: none"> Did not identify side street names 	<ul style="list-style-type: none"> Persons unlikely to use an uninformative map
New York Google Cycle Map	<ul style="list-style-type: none"> Identifies surrounding areas and select building shapes 	<ul style="list-style-type: none"> Informative; broader use among public 	<ul style="list-style-type: none"> Arbitrary points of interest visible at high zoom Some cycle routes terminate confusingly 	<ul style="list-style-type: none"> Some points of interest are perhaps irrelevant Map lacks connecting route suggestions

APPENDIX C: Summative Team Assessment

0	3	5	7	10
No Effort	Little Effort	Average Attempt	Good	Outstanding

Table: Team member's evaluation of the extent to which each individual followed through on the actions identified in the Week 2 formative assessments.

	Self Improvement	Maria G	Lauren H	Jodi-Lee S	Evan Sullivan
Maria G	I will try to improve my writing skills by reading over my work and checking my errors.	7	9	8	6
	I will remember that work will go on even if I am sick so I must learn to take a break when it is necessary.	10	10	9	7
	I will continue to control my stress and directness in order to not overwhelm the group.	8	9	9	7
Lauren H	I will be more confident with my work by defending it and speaking loud with my head held high.	10	10	10	8
	I will continue to strive to do my best and improve my writing format.	9 for doing best 5 for writing	9	10- for striving for best 5- improving writing	7

Sustainable Transportation Mapping-Appendix C

	I will continue to provide excitement and a positive attitude.	10	9	10	7
Jodi-Lee S	I will continue to work on not being perceived as being overwhelming.	8	10	7	7
	I will try to be a team player with a softer tone as maybe my personality is a bit strong.	10	10	8	9
	As I did yesterday, I will continue to give more praises and compliments so as to encourage better performance in a more relaxed environment.	6	9	6	8
Evan S	I will communicate more clearly with group members.	5	10	6	7
	I will improve work pace and establish more personal goals in order to carry the team along.	10	9	10	7
	I will contribute suggestions for work distribution and provide input and reasoning behind suggestions for work distribution.	8	9	9	6

Key Contributions

For the summative team assessment, each team member will identify 1-3 key contributions from each member, including him or herself, that are not evident from the authorship page.

Maria Gioules Contributions:

Maria Gioules

- Contacted necessary persons in order to progress the project.
- Provided excessive editing and formatting to the overall document.

Lauren Hannmann

- Provided enthusiasm and motivated all group members.
- Put her best effort into every assignment, particularly ArcGIS.

Jodi-Lee Smith

- Provided leadership to the group and encouraged group discussions.
- Demonstrated an esteemed work ethic that helped foster a successful work environment.

Evan Sullivan

- Took on more tasks; facilitating a focus group.
- Improved presentation skills and quality of work.

Lauren Hannmann Contributions:

Maria Gioules

- Provided email contact to necessary persons in order to complete the project.

- Provided outstanding editing and formatting to the overall document.

Lauren Hannmann

- Provided the group with a positive attitude and insightful advice.
- Contributed in formatting the overall document and designing the website template.

Jodi-Lee Smith

- Provided excellent leadership to the group and willingness to adapt to the groups needs.
- Wrote abundantly, quickly, and eloquently with a determined drive to move on to the next objective.

Evan Sullivan

- Provided an understanding while making suggestions calmly.
- Provided decent writing, superb speaking, and listening for the group.

Jodi-Lee Smith Contributions:

Maria Gioules

- Has been an exceptional editor. She edits thoroughly and quickly. This contribution has enabled us to submit a professional document. Takes pride in delivering quality results.
- Worked consistently and effectively throughout the entire project while displaying good interpersonal & organizational skills

Lauren Hannmann

- Provided a level of excitement and enthusiasm from the beginning to the end regarding the work assigned. Displayed large amounts of team spirit.

-A very determined individual who is willing to go the extra mile regarding project work. Despite having to complete multimodal transportation map she still found the time to assist others to complete their sections.

Jodi-Lee Smith

- Consistently presented a professional level of writing
- Displayed good time management skills and thus completed tasks quickly and efficiently

Evan Sullivan

- Displayed good research skills. He has been instrumental in assisting the project team to understand the various web applications, and their limitations as they concern The Kingston Council's available resources.
- A very thoughtful person who is a good conflict mediator. In addition his calm persona contributed to maintaining a calm atmosphere in a work setting.

Evan Sullivan Contributions:

Maria

-Maria took on the responsibility of contacting a majority of the individuals that were involved in our project. She often emailed professors, liaisons, and individuals involved with our focus groups with relevant information and questions. This established our project team as communicative and productive, further enhancing external perceptions of our project team.

-Maria often formatted the vexing things that comprise a large document, such as monitoring and modifying in-text citations and references. This is not the most glamorous aspect of the IQP report yet she was willing to do it numerous times.

Lauren

-Beyond teaching herself how to use ArcGIS and working extensively on our map, Lauren worked closely with the Kingston Council's GIS department and

developed a working relationship with them. This relationship was utilized often and ultimately benefitted our project greatly.

-Lauren presented during our first focus group and discussed our map's features during the group's final presentation. Lauren was responsible for being conversant not only with ArcGIS but also with the rest of our project's aspects, which would often quickly expand.

Jodi

-Acted as group leader and contributed greatly to planning, attending to the needs of the group dynamic issues when necessary, and encouraging other group members to contribute ideas.

-Provided summary booklet for liaison, making particular effort to ensure that our liaison fully understood the progress and future development of our project.

Evan Sullivan

-Attempted to research potential website applications to the fullest extent, considering how a GIS server would work with each web application and understanding the development software required to develop certain applications as well.

-Facilitated the focus group with the local cycling club and the interview with a disabled member of the community in assessing the map's features. I took on a leadership role that involved a significant amount of responsibility, as the findings from these feedback sessions contributed to many of our findings and recommendations.

Summative Team Assessment Paragraph:

The team actions and comments provided in each of the two formative team assessments have encouraged areas of overall growth. This growth has contributed positively to the outcome of our project. The team actions and comments from the first formative team assessment helped us initially identify personal characteristics

and distinguish their influence on overall group dynamic. The first team actions required us to collectively slip from comfort zones as individuals and realize the nature of everyone's weaknesses and strengths. This helped us recognize our commitment not only to the project but also to the needs of other group members. This additionally motivated continuous effort towards different aspects of the IQP process. The second formative team assessment helped the group applaud group dynamic improvements and concentrate focus as the final outcome of our project approached. Although some features of our group dynamic were challenging to discuss, we feel that outlining areas for team improvement have maximized the effectiveness of our proposal.

REFERENCES

About DfT. (2010). Retrieved 2010 24-April from Department for Transport:
<http://www.dft.gov.uk/about/>

About OECD. (2010). Retrieved 2010 24-April from Organisation for Economic Co-Operation and Development:
http://www.oecd.org/pages/0,3417,en_36734052_36734103_1_1_1_1_1,00.html

Aditjandra, P. T., Nelson, J. D., & Wright, S. D. (2008 1-MONTH). *WISETRIP : Centre for Transport Research*. Retrieved 2010 31-March from University of Aberdeen:
http://www.abdn.ac.uk/ctr/wp-content/uploads/2009/10/3132_its-wc09_wisetrrip.pdf

Adobe Systems Incorporated. (2010). *Corporate Fact Sheet*. Retrieved June 23, 2010, from About Adobe: <http://www.adobe.com/uk/aboutadobe/pressroom/pdfs/fastfacts.pdf>

Agrawala, M., & Stolte, C. (2000 1-January). *A Design and Implementation for Effective Computer-Generated Route Maps*. Retrieved 2010 17-May from Association for the Advancement of Artificial Intelligence: <http://www.aaai.org/Papers/Symposia/Spring/2000/SS-00-04/SS00-04-010.pdf>

ArcGIS Overview. (2010). Retrieved 2010 24-April from ESRI:
<http://www.esri.com/software/arcgis/index.html>

City of Portland, Oregon . (2010 1-January). *Bike Parking Maps*. Retrieved 2010 20-May from City of Portland, Oregon: <http://www.portlandonline.com/shared/cfm/image.cfm?id=143776>

Deakin. (2003). *University of California at Berkeley Institute of Urban and Regional Development* . Retrieved 2010 31-March from Sustainable Development and Sustainable Transportation : <http://www.uctc.net/papers/519.pdf>

Dran, P. Z. (2000, December). *A Two-Factor Model for Website Design and Evaluation*. Retrieved June 2, 2010, from Dr. Ping Zhang:
http://melody.syr.edu/pzhang/publications/JASIS_00_Zhang_vonDran.pdf

Environmental Systems Research Institute, Inc. (2009 12-February). *An overview of map projections*. Retrieved 2010 17-April from ArcGIS Desktop 9.3 Help:
http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=An_overview_of_map_projections

European Union definition. (2010). Retrieved 2010 24-April from Your Dictionary.com: <http://www.yourdictionary.com/european-union>

European Union. (2001). *European transport policy for 2010: time to decide*. Retrieved 2010 8-April from European Commission of Mobility & Transport: http://ec.europa.eu/transport/strategies/doc/2001_white_paper/lb_com_2001_0370_en.pdf

European Union Transport Research. (2009 29-January). *EU Transport Research- A European Vision For Sustainable Transport*. Retrieved 2010 31-March from European Commission: http://ec.europa.eu/research/transport/news/article_8727_en.html

Farlex. (2010). *Transport for London*. Retrieved 2010 24-April from The Free Dictionary: <http://encyclopedia.thefreedictionary.com/Transport+for+London>

FLEISHMAN, G. (2009 9-October). *Wi-Fi Networking News: Roaming Archives*. Retrieved 2010 25-May from Wi-Fi Networking News: <http://wifinetnews.com/archives/vertical-markets/hot-spot/roaming/>

Fujimoto, H. (2008 May). *Science & Technology Trends* . Retrieved 2010 26-March from The Modal Shift to Environmentally Sustainable Transport:: <http://www.nistep.go.jp/achiev/ftx/eng/stfc/stt029e/qr29pdf/STTqr2903.pdf>

Google. (2010 1-January). *Statue of Liberty Ellis Island to Columbia University*. Retrieved 2010 21-May from Google Maps: <http://www.google.com/maps>

Greater London Authority. (2009). *Mayor's Transport Strategy*. Retrieved 2010 27-March from Transport for London: <http://www.tfl.gov.uk/corporate/11610.aspx>

Greater London Authority. (2009). *Mayor's Transport Strategy*. Retrieved 2010 26-March from Transport for London: <http://www.tfl.gov.uk/assets/downloads/corporate/mts09-complete.pdf>

Greater London Authority. (2009). *The Mayor's London Plan*. Retrieved 2010 26-March from Greater London Authority: <http://www.london.gov.uk/shaping-london/london-plan/docs/london-plan.pdf>

Greater London Authority. (2009). *The Mayor's London Plan*. Retrieved 2010 26-March from The draft replacement London Plan: <http://www.london.gov.uk/shaping-london/london-plan/strategy/index.jsp>

Harrower, M., & Brewer, C. (2003 1-June). *University of Albany*. Retrieved 2010 18-May from University of Albany: <http://www.albany.edu/faculty/fboscoe/papers/harrower2003.pdf>

Harvard College . (2009 1-June). *Harvard GIS Tutorials and Exercises*. Retrieved 2010 17-April from Harvard College Library: <http://hcl.harvard.edu/libraries/maps/gis/IntroToGISmovie-part3.htm>

Kenyon, S., & Lyons, G. (2002 6-June). *Science Direct*. Retrieved 2010 7-April from Science Direct: http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VN8-473MFR4-1&_user=74021&_coverDate=03%2F31%2F2003&_rdoc=1&_fmt=high&_orig=search&_sort=d&_docanchor=&view=c&_acct=C000005878&_version=1&_urlVersion=0&_userid=74021&md5=f8f3ea77b8ee57e94559cb10e800ac79

Kingston Council. (2009). *The Royal Borough of Kingston*. Retrieved 2010 28-April from http://www.kingston.gov.uk/borough_profile_2009_final_v12.pdf

Kingston Council. (2009). *The Royal Borough of Kingston*. Retrieved 2010 28-April from http://www.kingston.gov.uk/borough_profile_2009_final_v12.pdf

Krygier, J., & Wood, D. (2005 01-Janauary). *Making Maps: A Visual Guide to Map Design For GIS*. Retrieved 2010 17-May from Making Maps: A Visual Guide to Map Design For GIS: <http://makingmaps.owu.edu>

Lisa Cozzens, A. K. (1998). *JavaScript Tutorial*. Retrieved June 23, 2010, from A Bridge to Computer Science: <http://www.cs.brown.edu/courses/bridge/1998/res/javascript/javascript-tutorial.html>

London Area Travel Survey (LATS) 1991. (2010). Retrieved 2010 24-April from Office for National Statistics: <http://www.statistics.gov.uk/STATBASE/Source.asp?vlnk=375>

Lucas-Smith, M. (2009 29-Novemeber). *Cambridge Cycle Campaign-Cambridge cycle map*. Retrieved 2010 20-May from Cambridge Cycle Campaign: <http://www.cambridge.gov.uk/public/docs/Cambridge%20cycling%20map.pdf>

Massachusetts Bay Transportation Authority. (2010 1-January). *MBTA Subway the 'T' Maps, Schedules, And Fare Information for the Boston Area Subway System*. Retrieved 2010 7-April from Massachusetts Bay Transportation Authority: http://www.mbta.com/schedules_and_maps/subway/

Mayor's Transport Strategy. (2010). Retrieved 2010 24-April from Transport for London: <http://www.tfl.gov.uk/corporate/11610.aspx>

Merlin Entertainments Group. (2010 1-January). *Chessington World of Adventures: Offical Website*. Retrieved 2010 26-May from Chessington World of Adventures: <http://www.chessington.com>

Organisation For Economic Co-Operation And Development. (2001 May). Retrieved 2010 31-March from Environmentally Sustainable Transport Guidelines: <http://www.oecd.org/dataoecd/53/21/2346679.pdf>

Ormsby, T., Napoleon, E., Burke, R., Groessl, C., & Feaster, L. (2004). *Getting to Know ArcGIS desktop Basics of ArcView®, ArcEditor™, and ArcInfo®*. Redlands, California, United States: ESRI Press.

Palmer, J. W. (2002, June). *Usability Performance*. Retrieved June 2, 2010, from <http://tao.nuk.edu.tw/hci/usabilityperformance.pdf>

Pamuk, A. (2006). *Mapping Gloabl Cities: GIS Methods in Urban Analysis*. Redlands, California, United States Of America: ESRI Press.

Parramatta Park Trust. (2009 1-Janauary). *Park Map- Parramatta Park Trust Website*. Retrieved 2010 25-May from Parramatta Park Trust Website: <http://www.ppt.nsw.gov.au/hours-and-info/park-map>

Royal Borough of Kingston. (2009). *Borough Profile 2009*.

Royal Borough of Kingston. (2010 1-January). *Car Parks*. Retrieved 2010 23-April from Kingston Council: http://www.kingston.gov.uk/browse/transport_and_streets/parking/car_parks.htm

Royal Borough of Kingston. (2006). *Local Implementation Plan*. Retrieved 2010 26-March from The Royal Borough of Kingston: http://www.kingston.gov.uk/browse/transport_and_streets/local_implementation_plans/lip.htm

Scheurer, D. J., & Curtis, P. C. (2008 2-June). *The University of Melbourne The University of Melbourne*. Retrieved 2010 23-March from The University of Melbourne : <http://www.abp.unimelb.edu.au/gamut/pdf/perth-snamuts-report.pdf>

Scheurer, D. J., & Porta, D. S. (2006 13-June). *Human Space Lab Published Articles*. Retrieved 2010 5-April from Human Space Lab: http://www.humanspacelab.com/UploadedFiles/2006_01.pdf

Sustainability. (2010). Retrieved 2010 24-April from The Dictionary of Sustainable Management: <http://sustainabilitydictionary.com/>

Thaler, R. (2010). *OECD Project «Environmentally Sustainable Transport» (EST) – Case Study Environmentally Sustainable Transport for Austria*. Retrieved 2010 24-April from EST goes East!: http://est-east.unep.ch/default.asp?community=est-east&page_id=58535754-415A-4DE2-AC71-F6963F14ED76

The London Plan . (2010). Retrieved 2010 24-April from The London Plan: <http://www.london.gov.uk/thelondonplan/index.jsp>

The Royal Borough of Kingston. (2010). Retrieved 2010 26-March from Local Implementation Plan: http://www.kingston.gov.uk/mykingston/contact_us.htm

The Royal Borough of Kingston. (2010 1-January). *Car Clubs in the Royal Borough of Kingston*. Retrieved 2010 16-April from Kingston Council:
http://www.kingston.gov.uk/browse/transport_and_streets/car_clubs.htm

The Royal Borough of Kingston. (2010). *Planning Your Route*. Retrieved 2010 20-April from Kingston Council:
http://www.kingston.gov.uk/browse/transport_and_streets/cycling/route_planning.htm

The Royal Borough of Kingston. (2010 1-January). *Public Transport Links*. Retrieved 2010 13-April from Kingston Council:
http://www.kingston.gov.uk/browse/transport_and_streets/public_transport/transportlinks.htm

The Royal Borough of Kingston. (2010). *Surrounding Areas of Kingston*. Retrieved 2010 25-March from Royal Kingston:
http://www.kingston.gov.uk/mykingston/find_it/greater_london_map/surrounding_areas_of_kingston.htm

The Royal Borough of Kingston. (2010 1-January). *Trains*. Retrieved 2010 13-April from The Royal Borough of Kingston upon Thames:
http://www.kingston.gov.uk/browse/transport_and_streets/travel_awareness/goodgoing_trains.htm

The Royal Borough of Kingston. (2010 1-January). *Travel in Kingston*. Retrieved 2010 13-April from The Royal Borough of Kingston:
http://www.kingston.gov.uk/browse/leisure/tourism/travel_in_kingston.htm#road

Tomorrow Bulletin of Singapore Bloggers. (2005 7-July). Retrieved May 2010-25 from Updated Mrt Map: <http://www.mkc-properties.com/images/livinginjapan/tokyometromapbig.jpg>

Transport for London. (2010 1-January). *Transport for London- Standard Tube Map*. Retrieved 2010 15-April from Transport for London: Transport for London

Turban, D. G. (1999). *Determinants of Successful Website Design: Relative Importance and Recommendations for Effective*. Retrieved June 3, 2010, from CiteSeerx :
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.97.460&rep=rep1&type=pdf>

United Kingdom. (2010). Retrieved 2010 24-April from Answers.com:
<http://www.answers.com/topic/united-kingdom>

United Kingdom Department for Transport. (1998). *A new deal for transport: better for everyone - white paper*. Retrieved 2010 8-April from Department for Transport:
http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/adobepdf/187604/A_new_deal_for_transport_bel.pdf

Sustainable Transportation Mapping- References

What is the SEA Process? (2004). Retrieved 2010 24-April from Strategic Environmental Assessment: http://www.offshore-sea.org.uk/site/scripts/documents_info.php?categoryID=39&documentID=5

Working for a better London. (2010). Retrieved 2010 24-April from london.gov.uk: <http://www.london.gov.uk/who-runs-london/greater-london-authority>