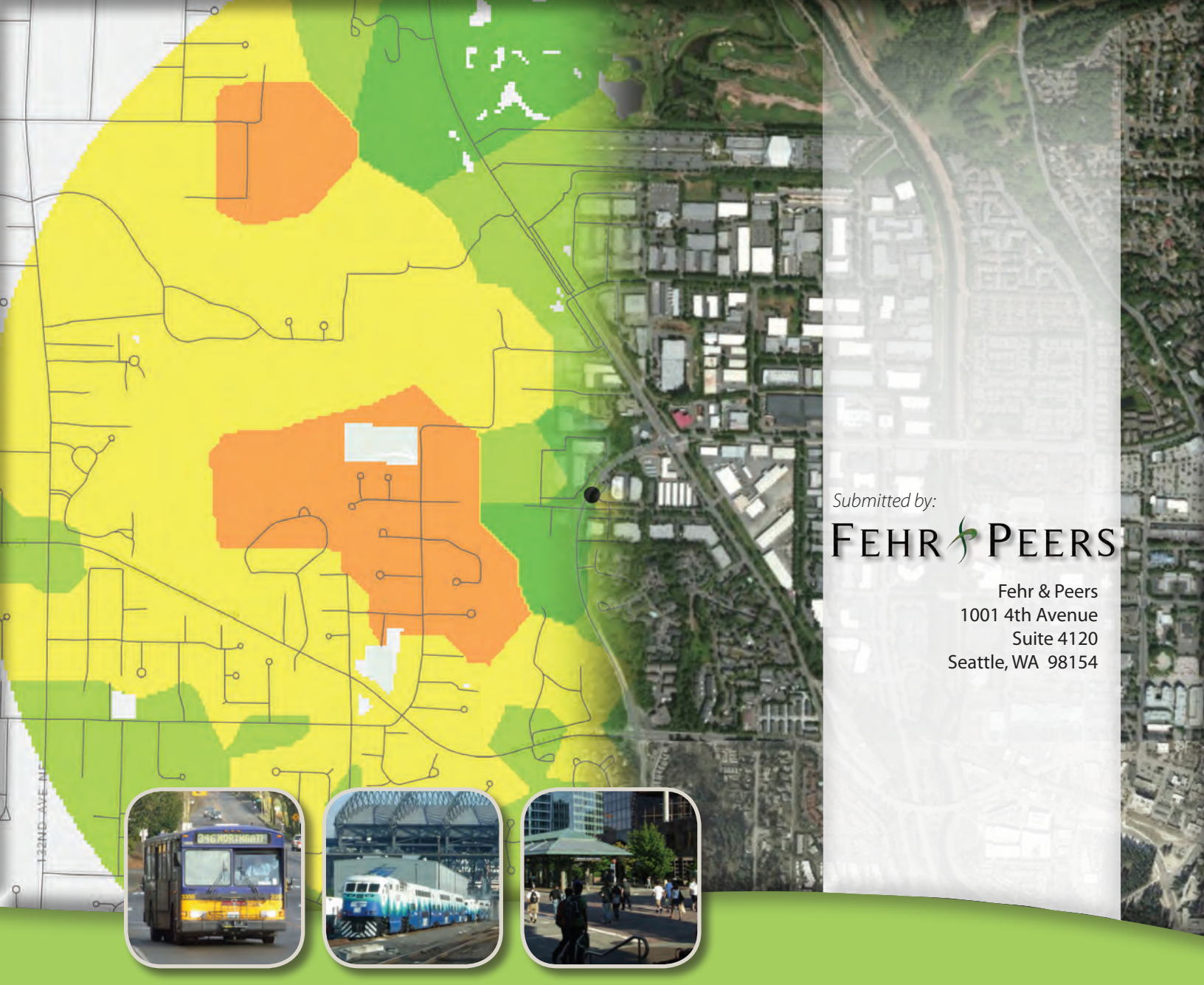

Submitted by:

FEHR & PEERS

Fehr & Peers
1001 4th Avenue
Suite 4120
Seattle, WA 98154

Prepared for:

King County METRO

SOUNDTRANSIT

Non-Motorized Connectivity Study

September 2014

TABLE OF CONTENTS

1. Introduction 1

2. Literature Review Findings – Non-Motorized Access and Transit Ridership 4

3. Data Collection 11

4. Data Preparation 13

5. Connectivity Analysis and Tools 20

6. Regression Modeling 32

7. Existing Conditions Connectivity Analysis Results 42

8. Future Projects Dataset 51

9. Future Projects Connectivity Analysis Results 54

10. Project Prioritization 79

11. Market Analysis 91

12. Case Studies 99

13. Model Limitations and Thoughts on Future Improvements 147

APPENDICES

Appendix A: Connectivity User Guide
Appendix B. Project Type Rankings by Percent Change in Ridership
Appendix C: Project Type Rankings by Potential New Riders
Appendix D: Demographic and Ranking Tables
Appendix E: Project Type Prioritization by Aggregate Method
Appendix F: Example Plans for Future Projects

LIST OF TABLES

Table 1: Summary of Influential Access to Transit Factors 4

Table 2: Regression Model Variables 11

Table 3: Bike/Level of Stress Calculation Matrix 18

Table 4: RDI Scoring Categories 22

Table 5: Bike Stress Scoring Categories 24

Table 6: Intersection and Sidewalk/Walkway Density Scoring 26

Table 7: Arterial Signalized Crossing Scoring 28

Table 8. Regression Model Variables 34

Table 9: Base Model Coefficients 36

Table 10: Connectivity Coefficients 38

Table 11: Final Regression Results 40

Table 12: Top 15 and Bottom 15 Station Locations for Composite Connectivity Index Scores 42

Table 13: Stop Locations with the Largest Change in RDI 54

Table 14: Stop Locations with the Largest Change in Signalized Arterial Crossing Index 57

Table 15: Stop Locations with the Largest Change in the Sidewalk Density Score 59

Table 16: Stop Locations with the Largest Change in the Intersection Density Score 61

Table 17: Stop Locations with the Largest Reduction in the Bike Stress Average 63

Table 18: Top 15 locations in Walk Shed and Bike shed Area Increase 65

Table 19: Stations with the Largest Change in the Connectivity Composite Score 68

Table 20: Top 40 Project Types with the Largest Percent Change in Daily Ridership 83

Table 21: Top 30 Project Types with the Largest Change in Net Daily Ridership 85

Table 22: Demographic and Transit Service Scoring Metric 86

Table 23: Aggregate Stop-Area Project Rankings 88

Table 24: Demographic and Transit Service Scoring Metric 89

Table 25: Station Areas with High Potential for Marketing Efforts 93

Table 26: Station Areas with High Potential for Infrastructure Investment 95

Table 27: Station Areas with High Potential Return from Zoning Changes 97

Table 28: 2035 Employment and Population in Case Study Locations 127

Table 29: Daily Ridership Estimates 133

Table 30: Daily Ridership Estimates Based on Sound Transit Model Forecasts 134

Table 31: Case Study Project Evaluation 141

Table 32: Case Study Project Evaluation 145

LIST OF FIGURES

Figure 1: Study Area 3

Figure 2: Issaquah (left) and Burien (right) Sidewalk GIS Files 14

Figure 3: Examples of Network Gaps and Discontinuities 16

Figure 4: Example Attributes of a Minor Arterial (left) and an Off-street Path (right) from the final 19

Figure 5: Example Connectivity Surfaces 21

Figure 6: Examples of Route Directness in Northgate Transit Center and Capitol Hill 23

Figure 7: Example of Bike Stress routing and the Bike Stress Index 25

Figure 8: Examples of Sidewalk/Walkway Density and Intersection Density 27

Figure 9: Examples of Signalized Arterial Index 29

Figure 10: Examples of 15-Minute Travel Sheds Areas in Seattle and Redmond 31

Figure 11. Connectivity Modeling Process 32

Figure 12. Scatter plot of Actual vs. Prediction for Daily Boardings 41

Figure 13: Composite Connectivity Scores - West Seattle and Downtown Seattle 44

Figure 14: Composite Connectivity Scores - Othello and Mt. Baker LRT Stations 45

Figure 15: Composite Connectivity Scores - Northgate Transit Center and Overlake Village 46

Figure 16: Composite Connectivity Scores - Edmonds Sounder Station and Tukwila International Boulevard Light Rail Station 48

Figure 17: Composite Connectivity Scores - Kent-Des Moines Rd and in Federal Way Transit Center 49

Figure 18: Gaps in Seattle Bike Plan and the Existing Street Network (left) and Discrepancies between the Network and the Bellevue Bike Plan GIS Data (right) 52

Figure 19: Existing and Future RDI Scores for Overlake Village 56

Figure 20: Existing and Future Signalized Arterial Crossing Score for North Seattle 58

Figure 21: Existing and Future Sidewalk Density Scores for Tukwila Urban Center 60

Figure 22: Existing and Future Intersection Density Scores for SeaTac 62

Figure 23: Existing and Future Bike Stress Scores for Overlake Village 64

Figure 24: Existing and Future 15-minute Walk Shed for the Northgate Transit Center Area 66

Figure 25: Existing and Future 15-minute Bike Sheds for the Northgate Transit Center Area 67

Figure 26: Existing and Future Connectivity in SeaTac 70

Figure 27: Existing and Future Connectivity in Burien 72

Figure 28: Existing and Future Connectivity in West Seattle 74

Figure 29: Existing and Future Connectivity in Lynnwood 76

Figure 30: Existing and Future Connectivity in in Overlake Village 78

Figure 31: Station Areas with High Marketing Potential 94

Figure 32: Station Areas with High Investment Potential 96

Figure 33: Station Areas with High Zoning Potential 98

Figure 34: Northgate Transit Center RDI and Signalized Arterial Crossing Index 101

Figure 35: Northgate Transit Center Bike Stress and Bike Shed 102

Figure 36: Northgate Transit Center Arterial Sidewalk/Walkway Density and Intersection Density 103

Figure 37: Northgate Transit Center Composite Connectivity Scores 104

Figure 38: Pedestrian Underpass of I-5 and Unsignalized Crossing of Roosevelt Ave 105

Figure 39: Bicyclist along Northgate Way and Urban Form near Transit Center 106

Figure 40: Overlake Village RDI and Signalized Arterial Crossing Index 107

Figure 41: Overlake Village Bike Stress and Bike Shed 108

Figure 42: Overlake Village Arterial Sidewalk/Walkway Density and Intersection Density 109

Figure 43: Overlake Village Composite Connectivity Scores 110

Figure 44: Narrow Sidewalk along 148th Ave and Wide Sidewalks with Signalized Crossings along 156th Ave 111

Figure 45: Bicyclist along NE 24th St and New Bike Lanes along 152nd Ave 111

Figure 46: Mt. Baker LRT Station RDI and Signalized Arterial Crossing Index 113

Figure 47: Mt. Baker LRT Station Bike Stress and Bike shed 114

Figure 48: Mt. Baker Arterial Sidewalk/Walkway Density and Intersection Density 115

Figure 49: Mt. Baker LRT Station Composite Connectivity Scores 116

Figure 50: Pedestrians along MLK Jr. Way and Poor Sidewalk Quality 117

Figure 51: Bicyclist along Rainier Avenue and Steep Terrain West of the Station 117

Figure 52: Federal Way Transit Center RDI and Signalized Arterial Crossing Index 119

Figure 53: Federal Way Transit Center Bike Stress and Bike shed 120

Figure 54: Federal Way Transit Center Arterial Sidewalk/Walkway Density and Intersection Density 121

Figure 55: Federal Way TC Composite Connectivity Score 122

Figure 56: Buffered Sidewalks with Strip Commercial and Flashing Pedestrian Crossing 123

Figure 57: Bike Lane on S 316th Street and Bike Parking at the Transit Center 124

Figure 58: Northgate Transit Center New Transportation Projects 128

Figure 59: Overlake Village New Transportation Projects 129

Figure 60: Mt. Baker Transit Center New Transportation Projects 130

Figure 61: Federal Way Transit Center New Transportation Projects 131

Figure 62: Northgate Transit Center Future Connectivity Map and 15-minute Travel Sheds 136

Figure 63: Overlake Village Future Connectivity Map and 15-minute Travel Sheds 137

Figure 64: Mt. Baker LRT Station Future Connectivity Map and 15-minute Travel Sheds 138

Figure 65: Federal Way Transit Center Future Connectivity Map and 15-minute Travel Sheds 139

1. INTRODUCTION

Increasing the availability of transportation options is a primary goal of *Transportation 2040*, the Puget Sound region's long-range transportation blueprint. Transit plays a key role in providing for local and regional mobility, but in many areas, transit access is limited by a lack of non-motorized infrastructure. There has been an increasing amount of research on how non-motorized access can improve walking/biking mode share, but research on non-motorized access to transit is still a relatively new field.

This study works to fill this gap in the research using data and modeling techniques developed specifically for the Puget Sound region. The timing for this work is right, with continued advancement in non-motorized connectivity research, improved non-motorized data from local jurisdictions, and better analysis techniques being incorporated into common GIS software. The intent of this study is to develop a suite of GIS tools to analyze and visualize non-motorized transit access and to develop a model to understand how non-motorized connectivity affects transit ridership. Using these tools, King County Metro (KC) and Sound Transit (ST) can assess non-motorized access projects, prioritize transit service and investments, and partner with local agencies on obtaining grant and other funds to support transit access projects. The tools and research described in this report are part of an ongoing evaluation of non-motorized transit access by both agencies. This report was informed by earlier access studies and may be incorporated into future evaluations.

The non-motorized transit access study involved a major collaboration with local jurisdictions to collect GIS pedestrian, bicycle, and roadway data from more than 20 local jurisdictions. Using this data, the model team developed a set of GIS analysis tools to summarize connectivity data such as route directness, bike stress, intersection/sidewalk density, and arterial crossing density at more than 500 transit stops across a three-county study area. These connectivity variables were then used to develop a model that can measure the potential change in transit ridership when non-motorized connectivity to transit stops improves.

Also included in this report are several examples of potential uses of the connectivity tools and ridership model. The applications described in the report include:

- A framework for transit agencies to prioritize non-motorized projects included in local jurisdiction active transportation plans

- An evaluation of "market areas" where areas with high/low non-motorized connectivity, transit supportive land use densities, and transit supportive demographics are presented
- A set of detailed case study applications where the model was used to evaluate existing and 2035 conditions at four transit stop areas in the region. Through these case studies, the team evaluated specific non-motorized access projects and identified some strategies to enhance the non-motorized evaluation with additional station area planning.

The project study area consists of approximately 400 square miles of KC and ST coverage area, shown in **Figure 1**.

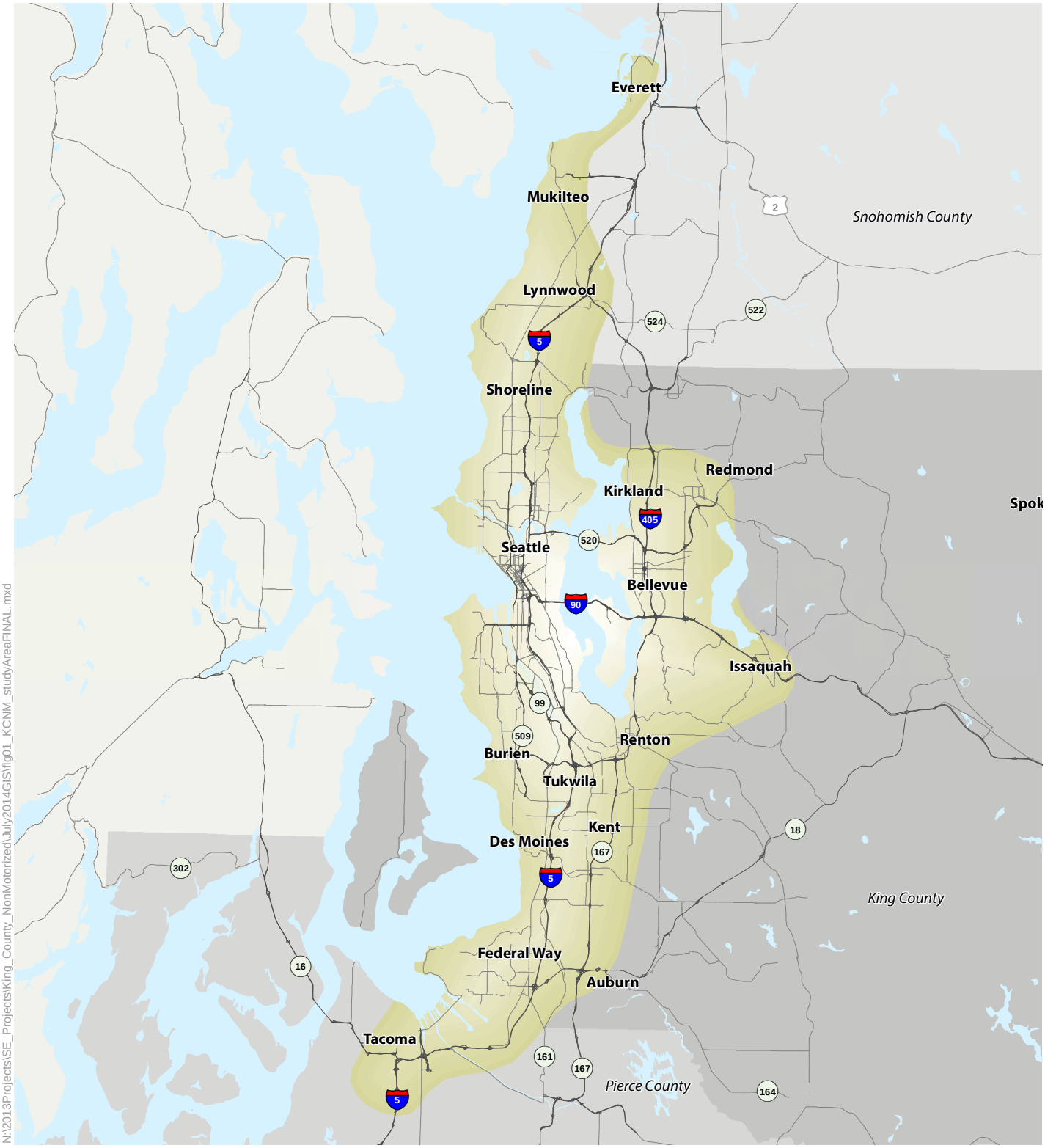

Figure 1

Study Area