**DRAFT PROPOSAL**

# *Tracking Land Use Changes that Support Sustainable Communities*

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Check if applicable:
Animal subjects _____
Human subjects _____

# Table of Contents

# 1. Abstract

With the 2008 passage of The Sustainable Communities and Climate Protection Act (SB 375), Metropolitan Planning Organizations (MPOs) throughout California have been engaged in the development of Sustainable Communities Strategies (SCS). These plans are meant to help the state meet greenhouse (GHG) emissions related land use and transportation. The relationship between land use and transportation is a product of the complex interactions between a variety of urban factors and forces. These interactions are often difficult to model using traditional agent based models (Pinjari, Pendyala, Bhat, & Waddell, 2011; Waddell, 2002) , often resulting in unexpected or emergent outcomes. In this reality, past ways of organizing, designing, and measuring no longer match the complexity of local systems. New methods are needed to evaluate and benchmark these connected and overlapping systems given the nature of emergent phenomena in these complex urban systems (Alberti, 2014; Alberti et al., 2003; Berke, 2002; Cretney, 2014; Dooling, Graybill, & Greve, 2007; Grimm & Redman, 2004; Liu et al., 2007; Oleyar, Greve, Withey, & Bjorn, 2008; Vitousek, Mooney, Lubchenco, & Melillo, 1997; B. H. Walker, Anderies, Kinzig, & Ryan, 2006; B. Walker, Holling, Carpenter, & Kinzig, 2004).

Given this construct, this project proposes to work with the California Air Resources Board (ARB) to develop a replicable framework for benchmarking changes in land use and transportation impacts in order to assess the contribution of SB 375 on development patterns in the state. To do this, a simple process of data gathering and refinement, modeling and evaluation, and finally dissemination will be used to weigh the nexus between land use conversion/change and the impact on ecological resources in select locations throughout California. In doing so we have 4 objectives:

O1. Establish a consistent suite use of change indicators that can be used for varying MPOs to better quantify progress toward the goals of SB 375.
O2. Outline simple, replicable methods for use of these indicators.
O3. Develop a GIS-based pilot to benchmark land use change.
O4. Build a working web platform to disseminate this information.

To achieve these objectives, we propose to engage in 4 tasks. First we will conduct a review of what existing MPOs are doing, including an inventory of existing data and the methods being used to assess changes in land form (Objective 1 and 2). We will use this inventory to make a recommendation to ARB on potential land use change indicators. Secondly, we will test these data using a geo-spatial modeling framework, evaluating change in land use and land cover over time. We propose to pilot the efficacy of the indicators in this framework on 2 MPOs of varying size / type / resources, selected in coordination with ARB. We will test the effectiveness of modeling using quantitative methods alongside qualitative interviews with local planners on how they might use such a tool.

Based on this feedback we will then develop a digital output tool using existing application program interfaces (APIs) from data sources. Aligning directly with Objective 4, the tool will provide a template for other MPOs to clearly communicate the impact of SB 375 and illustrate / gauge local government performance in meeting SCS goals. The code for this tool will be open source and available for modification and improvements to meet future needs. Ultimately, the data and digital output will move both the ARB and MPOs toward the ability to simulate and model future growth alternatives for communities, not only benchmarking performance but serving as an advanced planning tool for local land and transportation planning.

## 2. Introduction

The purpose of this study is to assist the California Air Resources Board (ARB) in developing a simple, consistent and replicable framework for benchmarking the land use and transportation impacts of the Sustainable Communities and Climate Protection Act (SB 375) Sustainable Community Strategies (SCS) on development patterns in California. While the State of California continues to invest a considerable amount of funding in creating a safer, more bikable, walkable and livable environments throughout priority development areas (PDAs) in its' jurisdictions, little work has been done to evaluate the longitudinal performance of SB 375. Given this we propose to embark in a study of how SCS are impacting land and transportation form, and to develop consistent methods for benchmarking these across the State.

To accomplish this task, California Polytechnic State University (CalPoly), San Luis Obispo, City & Regional Planning (CRP) faculty and graduate students will provide their expertise in transportation, land use, climate change policy and geo-design to assist ARB in defining these methods. CalPoly, CRP faculty and students offer specific expertise in the area of land use, transportation, greenhouse gas (GHG) emissions reduction, and climate change adaptation. The department is currently ranked the #2 small planning program in the country and offers a focus in transportation and environmental methods. Co-PI Greve co-authored one of the primary texts on local government planning for climate change (Boswell, Greve, & Seale, 2012), has engaged in many of the statewide discussion on the planning and modeling of climate impacts, and has authored research examining the impacts of land use change (Oleyar et al., 2008). Co-PI Riggs has developed a research focus that evaluates the environmental impact of land use and transportation patterns using geographic information systems (GIS) modeling (Gilderbloom, Meares, & Riggs, 2014; Riggs, 2014; Sethi, Riggs, & Knapp, 2014). In his GIS course he uses longitudinal models to evaluate change in landform over time – a critical evaluator factor to benchmark the success of SB 375. These provide a platform for engaging in work with ARB.

While many of these research platforms are framed in the context of California State law, they also reflect the broader discussion of coupled human-natural systems that is increasingly viewed as the critical to addressing the consequences of global urbanization. Literature shows many benefits of integrating the natural environment in urban areas -- from the macro scale influences on local heat and climate conditions to the micro scale with a connection with active lifestyles, health and biophelia (Jonker, Lenthe, Donkers, Mackenbach, & Burdorf, 2014; Takano, Nakamura, & Watanabe, 2002; Ulrich, 1984; Ulrich et al., 1991; Wolch, Byrne, & Newell, 2014; Wolch et al., 2011). These studies illustrate the overlap of human and natural systems that comes into play in urban areas. Green space and human interactions are sometimes dealt with separately, however in urban spaces the lines between the two become more blurred – one clearly impacting the other and illustrating the importance of better understanding the impacts of SB 375 and the regionally produced SCS.

Given this framework, we propose to engage in 4 tasks to develop methods of measuring the impact of SCS policies at the local level. They include:

- Task 2: Assess and select land use change indicators (Objectives 1 and 2)
- Task 3: Develop GIS Base, Quantitative & Qualitative Pilot (Objective 3)
- Task 4: Draft Report, Publication & Output Tool (Objective 4)
- Task 5: Final Document, Tool & Publication (Objectives 1-4)

The objectives and technical plan that follows, describes these tasks in greater depth.

# 3. Objectives

The principle goal of this project is to devise a replicable way for California Metropolitan Planning Organizations (MPOs) to assess land use changes that support sustainable communities in the context of SB 375. The key objectives to achieve this goal are:

O1. Establish a consistent suite use of change indicators that can be used for varying MPOs to better quantify progress toward the goals of SB 375.
O2. Outline simple, replicable methods for measurement and tracking of these indicators.
O3. Develop a GIS-based pilot to benchmark land use change
O4. Build a working web platform to disseminate this information.

The benefit of this work will be the development of a framework for benchmarking change in landform. This will allow for the spatial representation of this information and assist in facilitating greater levels of discourse between the ARC and MPOs in implementing SB 375.

# 4. Technical Plan

## 4.1 Task 1: Project Management, progress reports, and administration

As a part of Task 1, the CalPoly team will participate in meetings and project implementation to facilitate the effective administration and completion of the project. Dr. William Riggs, PhD, ACIP and Dr. Adrienne Greve, PhD, professors of City & Regional Planning, will lead the project. Both have published widely in the areas of land use transportation, environmental planning and climate change. Two dedicated graduate assistants (GAs) will assist during the entire tenure of the project.

*Deliverables:*

- Revision of scope, schedule and management plan

## 4.2 Task 2: Assess and select land use change indicators

To begin Task 2, the PIs will lead a full literature review on the measurement of land use and climate change, and benchmarking of sustainable communities. This analysis will use a meta-analysis approach that gathers the best cases across the literature and conduct an inventory of existing data and methods being used assess how MPOs are currently measuring the performance of SB 375 policies (Objective 1 and 2). The goal of this review will be to look for common correlates that can be used in modeling and benchmarking land use change.

We will then move to an evaluation of other existing data sets that can potentially be used for benchmarking efforts. The goal of this will be to move toward a common data-dictionary that MPOs in California can use as performance indicators. Potential indicators that will be evaluated include: land use entropy / mix; new housing starts / unit mix; greenfield vs. infill development; street grid density; vegetative land cover. These will be sourced from local, easily accessed data sources including: local parcel / building permit data; U.S. Census data; and U.S. Geological Survey National Land Cover data. A preliminary list is provided in Table 1.

In addition to this data, we anticipate using student teams to do online data scraping of other pertinent online data using basic computer coding skills and publically available APIs. This will allow us to take advantage of data from online vendors such as Walkscore, Zillow and Strava that can provide data to assist in better quantifying land use and transportation changes in areas where national data sets do not have appropriate coverage or are not as frequently updated. We anticipate hosting a student technology competition as a part of the project where we intend to take advantage of public APIs for popular web-based or mobile health tools to develop a repeatable method for collecting quantitative active planning data for California (MPOs). This would be a research advancement in the field that could be co-published for the Transportation Research Board (TRB) and could lead to follow-on work in this area.

From these inventory efforts a data dictionary will be developed. The project team will refine and extend this data using the data and approach listed in the table below. This will be complimented by a limited number of field audits and interviews with key MPO stakeholders. This may include an assessment of certain segments of regional networks and infrastructure (including sidewalks, bicycle lanes, and paths citywide, parking facilities and connectivity to transit) along with land use patterns in our pilot MPOs (see Task 3 for more on pilot MPO unit of analysis). This may also result in a replicable way for municipalities to identify system gaps and opportunities.

**Table 1: Data Collection Strategy**

| Data Source / Input | Format | Collection Strategy | Anticipated Analysis |
|---|---|---|---|
| US Census, NLCDB, NHTS, LandSat | DBF | Online Download | Evaluation of land take, coverage and growth concentration / density |
| Local parcel data | Geodatabase / DBF | MPO / Regional Contacts<br><br>Some onsite validation | Entropy / land use diversity |
| Local roads / traffic model | Geodatabase | Development of web-scraping meta analysis | Street grid density |
| Businesses Density | Geodatabase / Online | Development of web-scraping meta analysis & cross reference with CA-EDD<br><br>Some onsite validation | Economic activity / opportunities |
| Real Estate Property Values (non-commercial) | CSV | Development of web-scraping meta analysis; Assessor's data complimented by Zillow data | Compare valuation and adjacency to infrastructure by proximity |
| Local Stated Preference Mode Surveys | CSV | Online Data Sources | Evaluate travel cost by mode |
| Walkability / Bikeability Index | CSV | Development of web-scraping meta analysis Online Data Sources | Correlation with stated preference surveys |
| Strava / Other Online | Geodatabase / Online | Purchase / API / Data Scraping | Coordinate to determine inputs to modeling process on current travel patters |
| CalEEMod and systems related to air quality | Application / Online | TBD | Determine the impacts of land use / transportation on air quality and emissions |

*Deliverables:*

- Literature review and bibliography
- Technical memorandum summarizing data-dictionary / database

- Data dictionary

## 4.3 Task 3: Develop GIS Base, Quantitative & Qualitative Pilot

After assembling a relatively fluid dataset and data dictionary, we will model the baseline indicator data with GIS and other statistical packages (Objective 3). We propose to pilot our work using the unit of analysis of 2 MPOs of varying size, scale, culture and environment in consultation with ARB. The rationale for this is based on the different issues that small and mid-sized cities must address as opposed to those of large mega-cities and to account for embedded system complexity and difference. (Appelbaum, Bigelow, Kramer, Molotch, & Relis, 1976; Appelbaum, 1978; Batty, 2013). Given our geographic situation and past research experience we would propose to pilot our work on the Bay Area (ABAG / MTC) and the San Luis Obispo Region (SLOCOG). We propose to test indicators at the Census Block-group level, which allows for a high degree of resolution with some degree of aggregation for data smoothing, but also provides for less propensity for aggregation error than the Census Tract level.

### 4.3.1 Experimental Techniques & Research Methods

***Given this unit of analysis, we will first employ our geo-informatics framework using a cross-sectional lens***, testing the correlation between land changes and our preliminary list of indicators in the form of multiple regression frameworks. While some of this serves as a literature validation, the primary rationale for this is to validate that appropriate metrics are being used. Our work in comparable urban ecology has revealed multi-collinearity between many urban indicators (see Sethi et al., 2014) thus only the most appropriate will be applied to the subsequent longitudinal analysis.

This modeling will be based on Akaike's information criterion (AIC) which has been used more widely in the ecological sciences but rarely taken advantage of in cross disciplinary work that spans social and natural sciences (Burnham, Anderson, & Huyvaert, 2011; Symonds & Moussalli, 2011). This will use a series of metric tests to judge how well candidate measures perform in terms of explaining increases or decreases in land use change factors (Whittier et al., 2007). It also helps guard against redundancy in data (e.g., for variables or metrics that contained similar information to others.) This method is appropriate given recent arguments about complexity in urban systems and how 'less is more' may be appropriate from a predictive modeling standpoint (Batty, 2000, 2007). This relates back to the concept of complex systems behavior and emergent phenomena (as mentioned in our introduction) and will be the baseline for our strategy in model building and testing.

***After validating indicators, we will begin testing the broader association of potential indicators with longitudinal trends in land cover and growth.*** Again, we intend to use GIS software to evaluate spatial attributes correlated with user dynamics as well as to control for spatial autocorrelation. We will use the suite of tools from ESRI , Community Viz, R and more recent technology and visualization tools from Synthicity (see recently released UrbanCanvas™ and GeoCanvas™ tools developed by Synthicity; http://www.synthicity.com/). We have been in touch with them about using the tool for our work and then developing a curriculum and a shareable geo-database as a part of that work.

### 4.3.2 Output / Visualization

The outcome of this will be a model specification that provides a roadmap for application statewide. We will conduct qualitative outreach with our target MPOs to critique the tool and inquire about how they might use it to both benchmark and model growth based on SB 375. In addition to interviews with key stakeholders this will also involve some level of data truthing. To that aspect we will actively explore local General Plan / zoning updates, specific plans and other plans to evaluate how they relate to and inform our potential indicators. Based on this feedback we will then develop a report and digital output tool using existing applications.

*Deliverable:*

- Draft manuscript & model specifications

## 4.4 Task 4: Draft Report, Publication & Output Tool

Based on the results of Task 3, we will produce an open source tool that can be used by MPOs to clearly communicate the impact of SB 375 and illustrate / gauge local government performance in meeting SCS goals. We will provide an open source template that can extend beyond the pilot implementation phase and be applied as a way of benchmarking statewide.

While our results, data and evaluation will be documented in our draft report, we anticipate that our digital tool will be more future forward, providing the most capacity to both MPOs and local government. It is our intention to work in partnership with Urban Insights, Inc. as a sub consultant on this task. As the moderators of Planetizen.com with experience in design of web interfaces for planning and local government, we have already begun preliminary discussions with them as a partner to help organization and display mapping scenarios online. It is our intent that together we can develop a digital output that will provide both ARB and respective MPOs with the ability to visualize future growth alternatives for communities, using the interface as an advanced planning tool for local land and transportation decisions.

*Deliverables:*

- Draft report
- Meeting on results
- Beta web-based visualization tool

## 4.5 Task 5: Final Document, Tool & Publication

As a final task we will bring together all work and comments produce a final report. The report will be presented along with the visualization tool in a meeting with ARB.

*Deliverables:*

- Final report / presentation
- Web-based visualization tool

## 4.6 Data Management Plan

Both Co-PI Riggs and Co-PI Greve have professional and academic experience in the natural, social and behavioral sciences that will enable them to successfully manage and complete this project.

**Co-PI William (Billy) Riggs**, Assistant Professor of City and Regional Planning, will lead the socio-economic, use and geo-spatial components of the project. He will work closely with Co-PI Greve in quantitative modeling, and evaluating and producing policy suggestions stemming from the evaluation. Dr. Riggs is well-published in the area of the resource accessibility and human and built environment factors. He evaluated the relationship of socio-economic factors with local environmental quality. He is a GIS expert, teaching a focused curriculum on geospatial modeling at CalPoly. He has professional experience as a land use and environmental planner that informs his research.

**Co-PI Adrienne Greve**, Associate Professor of City and Regional Planning, will lead the ecological assessment and analysis conducted as a part of the project. She will work closely with Co-PI Riggs in the quantitative modeling, and evaluating and producing policy suggestions stemming from the evaluation. Dr. Greve is an expert in the interface between biological and human systems. Her recent work is focused on local climate planning, adaption and resilience. She has professional experience in applied biological and habitat assessment that inform her work in resilient systems.

### Lead Management Responsibility

The PIs will be responsible for the overall management and integrity of project objectives. The PIs will assemble the research team and engage in monthly coordination meetings organize and coordinate progress toward research, education, and policy goals. Key team members to be involved in these activities include graduate students and research assistants. The PI will generate a bi-annual progress report and after action review to be used by the External Advisory Committee (EAC) and in annual planning sessions.

### Project Analyst

The project analyst will assist in support the PIs in managing graduate students, and conducting both GIS and statistical analysis. S/he will also help in the coordination of multi-data sources into the central data warehouse for this project and ensure proper data security protocols are taken.

### Accounting and Contracts

The Sponsored Programs office in the Cal Poly Corporation will be the fiscal agent for the project and deal with any purchases or service contracts under direction of the PIs.

### Monthly Coordination Meetings

Monthly management meetings will address key operational issues concerning research design, implementation and strategic direction. They will involve the PIs, analyst, graduate students and the local Natural Resources Manager who will be engaged for coordination purposes.

### Expected Data, Format, Archival and Dissemination

The primary form of data generated as a part of this project will be aggregated and simulated public information on changes in urban form. These will be in tabular form readable in ArcGIS

Shapefiles and geo-databases. Data will be retained and archived indefinitely on CalPoly's digital archive, the DigitalCommons@CalPoly.

As referenced in the Technical Plan, it is anticipated that data and metadata will be available online in downloadable format. This website will serve as a technical appendix for any documents and publications stemming from the work.

Data delivery will require the requester to register prior to delivery and to read and consent to a disclosure that the data is to be used for research and not-for-profit use only with full citation of the data source and intellectual property rights.

The project will use public data and not require IRB approval.

### Data Storage and Preservation of Access

During the course of the project CalPoly servers and a jointly held Dropbox account will be used for data storage. The long-term archival strategy will be web-based – deposited into a repository on the project web site. The data will be preserved indefinitely and backed up at either a discipline-specific data repository or archive or on Cal Poly's digital archive, the DigitalCommons@CalPoly.

# 5. References and Similar Work Completed

## 5.1 PI-Authored Publications and Work

Boswell, M. R., Greve, A. I., & Seale, T. L. (2012). Local Climate Action Planning. Island Press.

Oleyar, M. D., Greve, A. I., Withey, J. C., & Bjorn, A. M. (2008). An integrated approach to evaluating urban forest functionality. Urban Ecosystems, 11(3), 289–308.

Dooling, S., Graybill, J., & Greve, A. (2007). Response to Young and Wolf: goal attainment in urban ecology research. Urban Ecosystems, 10(3), 339–347.

Gilderbloom, J. I., Meares, W. L., & Riggs, W. (2014). How brownfield sites kill places and people: an examination of neighborhood housing values, foreclosures, and lifespan. Journal of Urbanism: International Research on Placemaking and Urban Sustainability, 0(0), 1–18. doi:10.1080/17549175.2014.905488

Knight, L. & Riggs, W. (2010). Nourishing Urbanism. The Case for a New Urban Paradigm. International Journal of Agricultural Sustainability, 8 (1), 116–126.

Riggs, W. (2014). Inclusively Walkable: Exploring the Equity of Walkable Neighborhoods in the San Francisco Bay Area. Local Environment. doi:10.1080/13549839.2014.982080

Riggs, W. & Pontarelli, H. (2014). Community Sustainability Planning as a Tool for Increased Environmental Sustainability: The Case of Two California Cities. Focus, 11, 99-105.

Sethi, S. A., Riggs, W., & Knapp, G. (2014). Metrics to monitor the status of fishing communities: An Alaska state of the state retrospective 1980–2010. Ocean & Coastal Management, 88, 21–30. doi:10.1016/j.ocecoaman.2013.11.007

## 5.2 Other Publications

Alberti, M. (2014). Eco-evolutionary dynamics in an urbanizing planet. Trends in Ecology & Evolution. Retrieved from http://www.sciencedirect.com/science/article/pii/S0169534714002493

Alberti, M., Marzluff, J. M., Shulenberger, E., Bradley, G., Ryan, C., & Zumbrunnen, C. (2003). Integrating humans into ecology: opportunities and challenges for studying urban ecosystems. BioScience, 53(12), 1169–1179.

Appelbaum, R. P. (1978). Size, growth, and US cities. Praeger. Retrieved from http://www.getcited.org/pub/101887418

Appelbaum, R. P., Bigelow, J., Kramer, H. P., Molotch, H., & Relis, P. M. (1976). The Effects of Urban Growth: A Population Impact Analysis. Praeger New York. Retrieved from http://www.getcited.org/pub/101590044

Batty, M. (2000). Less is more, more is different: complexity, morphology, cities, and emergence. Environment and Planning B: Planning and Design, 27(2), 167–168.

Batty, M. (2007). Cities and complexity: understanding cities with cellular automata, agent-based models, and fractals. The MIT press. Retrieved from http://dl.acm.org/citation.cfm?id=1543541

Batty, M. (2013). A Theory of City Size. Science, 340(6139), 1418–1419. doi:10.1126/science.1239870

Berke, P. R. (2002). Does sustainable development offer a new direction for planning? Challenges for the twenty-first century. Journal of Planning Literature, 17(1), 21–36.

Burnham, K. P., Anderson, D. R., & Huyvaert, K. P. (2011). AIC model selection and multimodel inference in behavioral ecology: some background, observations, and comparisons. Behavioral Ecology and Sociobiology, 65(1), 23–35.

Cretney, R. (2014). Resilience for Whom? Emerging Critical Geographies of Socio-ecological Resilience. Geography Compass, 8(9), 627–640. doi:10.1111/gec3.12154

Grimm, N. B., & Redman, C. L. (2004). Approaches to the study of urban ecosystems: the case of Central Arizona—Phoenix. Urban Ecosystems, 7(3), 199–213.

Jonker, M. F., Lenthe, F. J. van, Donkers, B., Mackenbach, J. P., & Burdorf, A. (2014). The effect of urban green on small-area (healthy) life expectancy. Journal of Epidemiology and Community Health, jech–2014–203847. doi:10.1136/jech-2014-203847

Liu, J., Dietz, T., Carpenter, S. R., Alberti, M., Folke, C., Moran, E., … others. (2007). Complexity of coupled human and natural systems. Science, 317(5844), 1513–1516.

Pinjari, A. R., Pendyala, R. M., Bhat, C. R., & Waddell, P. A. (2011). Modeling the choice continuum: an integrated model of residential location, auto ownership, bicycle ownership, and commute tour mode choice decisions. Transportation, 38(6), 933–958. doi:http://dx.doi.org.ezproxy.lib.calpoly.edu/10.1007/s11116-011-9360-y

Symonds, M. R. E., & Moussalli, A. (2011). A brief guide to model selection, multimodel inference and model averaging in behavioural ecology using Akaike's information criterion. Behavioral Ecology and Sociobiology, 65(1), 13–21.

Takano, T., Nakamura, K., & Watanabe, M. (2002). Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces. Journal of Epidemiology and Community Health, 56(12), 913.

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. Science, 224(4647), 420.

Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments1. Journal of Environmental Psychology, 11(3), 201–230.

Vitousek, P. M., Mooney, H. A., Lubchenco, J., & Melillo, J. M. (1997). Human domination of Earth's ecosystems. Science, 277(5325), 494–499.

Waddell, P. (2002). Modeling urban development for land use, transportation, and environmental planning. Journal of the American Planning Association, 68(3), 297–314.

Walker, B. H., Anderies, J. M., Kinzig, A. P., & Ryan, P. (2006). Exploring resilience in social-ecological systems through comparative studies and theory development: introduction to the special issue. Ecology and Society, 11(1), 12.

Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, Adaptability and Transformability in Social–ecological Systems. Ecology and Society, 9(2), 5.

Whittier, T. R., Hughes, R. M., Stoddard, J. L., Lomnicky, G. A., Peck, D. V., & Herlihy, A. T. (2007). A structured approach for developing indices of biotic integrity: three examples from streams and rivers in the western USA. Transactions of the American Fisheries Society, 136(3), 718–735.

Wolch, J., Jerrett, M., Reynolds, K., McConnell, R., Chang, R., Dahmann, N., … Berhane, K. (2011). Childhood obesity and proximity to urban parks and recreational resources: A longitudinal cohort study. Health & Place, 17(1), 207–214. doi:10.1016/j.healthplace.2010.10.001

Wolch, J. R., Byrne, J., & Newell, J. P. (2014). Urban green space, public health, and environmental justice: The challenge of making cities "just green enough." Landscape and Urban Planning, 125, 234–244. doi:10.1016/j.landurbplan.2014.01.017

# 6. Project schedule

The work plan for this proposed project aligns with the project tasks and work objectives referenced previously. As indicated in the table below Task 2 will focus on database inventory assemblage, inventory. A preliminary peer-reviewed manuscript will likely be completed during this timeframe. Task 3 will focus on analysis and development of geo-spatial modeling framework. Tasks 4 will develop the data pilot and be completed mid-2016 with Task 5 being complete by December 2016.

- Task 1: General Project Management
- Task 2: Assess and select land use change indicators (Objective 1 and 2)
- Task 3: Develop GIS Base, Quantitative & Qualitative Pilot (Objective 3)
- Task 4: Draft Report, Publication & Output Tool (Objective 4)
- Task 5: Final Document, Tool & Publication (Objective 1-4)

**Table 2: Estimated completion timeline.**

| | 2015 | | 2016 | | | | | | 2017 | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Task / Objective** | **Sep-Oct** | **Nov-Dec** | **Jan-Feb** | **Mar-Apr** | **May-Jun** | **Jul-Aug** | **Sep-Oct** | **Nov-Dec** | **Jan-Feb** | **Mar-Apr** |
| ***Task 1*** Project Management | | | p | | p | | | p | | |
| ***Task 2*** *Objectives 1-2*: Indicators | | | m | | | | | | | |
| ***Task 3*** *Objective 3:* Analyze / GIS | | | | | | | | | | |
| ***Task 4*** *Objective 4:* Model / Draft Report | | | | | | m | | d | | |
| ***Task 5*** *Objectives 1-4:* Final Report | | | | | | | | | m | f |

p = Quarterly progress report
d = Deliver draft final report (to be submitted 6 months prior to contract expiration)
f = Deliver final report
m = Meeting with ARB staff

# 7. Curricula vitae / resumes

**WILLIAM RIGGS**

City & Regional Planning
California Polytechnic State University
1 Grand Ave., San Luis Obispo, CA 93407
Email: wriggs@calpoly.edu
Web: http://www.williamriggs.com

**PROFESSIONAL PREPARATION**

Bachelor of Arts, Art and Architecture History, Ball State University, 2001
Master of Urban Planning, University of Louisville, 2003
Ph.D., City and Regional Planning, University of California, Berkeley, 2011

**APPOINTMENTS**

Assistant Professor, California Polytechnic State University, San Luis Obispo, 2013 – Present.
Principal, Sustinere Consulting, San Luis Obispo, 2012 – Present.
Principal Planner, Lecturer & Visiting School, University of California, Berkeley, 2008 – 2014.
Senior Research Associate, University of Louisville, 2011– 2013.
Adjunct Professor, San Jose State University, San Jose, 2012.
Senior Land Use Planner, Arup, San Francisco, 2007 – 2008.
Land Use and Economic Planner, United States Coast Guard, 2003 – 2007.
Associate, Bay Area Economics, 2006.
Planner, Robert Doughty Consultancy, Ltd., 2002.
Research Assistant, University of Louisville, Urban Studies Institute, 2001-2003.
Program Coordinator, Foundation for Teaching Economics, 1999-2001.

**FIVE RELATED PUBLICATIONS**

2014. Riggs, W. Inclusively walkable: exploring the equity of walkable housing in the San Francisco Bay Area. *Local Environment.*

2014. Riggs, W., J. Gilderbloom, and W. Meares. Does Walkability Matter? An Examination of Walkability's Impact on Housing Values, Foreclosures and Crime. *Cities.*

2014. Sethi, S.A., W. Riggs, and G. Knaap. Metrics to monitor the status of fishing communities: an Alaska state of the State retrospective 1980-2010. *Ocean and Coastal Management.*

2014. Meares, W. J. Gilderbloom, and W. Riggs. How Toxic Waste Sites Kill Places and People: A Case Study of a Mid-Sized City on the Impact of EPA Superfund Sites on Neighborhood Housing Values, Foreclosures, Crime, and Premature Deaths. *Journal of Urbanism*.

2010. Knight, L., and Riggs, W. Nourishing urbanism: a case for a new urban paradigm. *International Journal of Agricultural Sustainability*, 8(1-2), 116–126.

**FIVE OTHER PUBLICATIONS**

2014. Riggs, W. and Pontarelli, H. Community Sustainability Planning as a Tool for Increased Environmental Sustainability: The Case of Two California Cities. *Focus.*

2014. Riggs W. Steps Toward Validity in Active Living Research: Research Design that Limits Accusations of Physical Determinism. *Health & Place.*

2014. Riggs, W. Kuo, J. Parking Reform on a Sustainable Campus: Permit Pricing and Rebalancing. *Proceedings of the 93rd Transportation Research Board.*

2013. Reflections on Campus Planning: Lessons for Practice. *Focus.*

2011. Riggs, W. Going Home Again. *Berkeley Planning Journal*, 23(1).

**SYNERGISTIC ACTIVITIES**

2014. San Luis Obispo, Open Space Study. San Luis Obispo, CA.

2014. Complete Streets Accessibility and Educational Projects. City of Concord, CA. http://www.bikepedaction.org

2010 – 2014. Researcher on FHWA Value Pricing Pilot Program Grant ($1.8M) evaluating parking pricing, economic norms and social norms.

2013 – 2014. PI on grant investigating Walkability Metrics and the Connection with Housing Value, Return on Investment for Streetscape Investments and Neighborhood Socio-Economic Resilience. CalPoly External Funds Initiative (EFI).

City of San Luis Obispo, Planning Commissioner and Certified Planner (AICP), American Planning Association

**COLLABORATORS**

David Levine, UC Berkeley; John Gilderbloom, University of Louisville; Wesley Meares, Georgia Regents University; David Simpson, Univ. of Louisville; Paavo Monkonnen, UCLA; J. Michael Oakes, University of Minnesota; Zachary Peterson, CalPoly; Megyn Rugh, UCLA; Chris Steins, Planetizen; Menka Sethi, CalPoly; Suresh Sethi, Univ. of Alaska; Jessica Kuo, San Francisco MTA; Lewis Knight, Gensler.

**THESIS ADVISING**

John (Forrest) Chamberlain, CalPoly; Kelly Cheung, CalPoly; Charlie Coles, CalPoly; Kayla Gordon, CalPoly; Sam Gross, CalPoly; Jessica Kuo, UC Berkeley; Elissa McDade, CalPoly; Kelsey Steffen, CalPoly.

**Adrienne I. Greve**
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## PROFESSIONAL PREPARATION

Cornell University (Ithaca, NY), B.S., Biological and Agricultural Engineering (1996)

Colorado State University (Fort Collins), M.S., Bioresource Engineering (1999)

University of Washington (Seattle), Ph.D., Interdisciplinary Ph.D. Program in Urban Design and Planning (2007)

## APPOINTMENTS

*Associate Professor, City and Regional Planning Department, California Polytechnic State University, San Luis Obispo, CA, 2012 – present, Assistant Professor 2006-2012*

*Visiting Professor, Research Center for Disaster Reduction Systems, Disaster Prevention Research Institute, Kyoto University (Uji, Kyoto, Japan), 2013 – 2014.*

*Doctoral Fellow, Interdisciplinary PhD Program in Urban Design and Planning, Urban Ecology IGERT (NSF), University of Washington, Seattle, WA, 2002 –2005.*

*Surface-Water Hydrologist, U.S. Geological Survey, Denver, CO, 1999-2002*

## FIVE RELATED PRODUCTS

Greve, AI, and Boswell, MR. (2014). Climate Change Adaptation. In Blanco, H and Mazmanian, D. (eds.). *The Elgar Companion to Sustainable Cities: Strategies, Methods and Outlook*. Northampton, MA: Edward Elgar Publishing Ltd.

Greve, AI. (2012). Linking urban form, land cover pattern, and hydrologic flow regime in the Puget Sound Lowland. *Urban Ecosystems*, 15: 437-450.

Boswell, MR, Greve, AI, and Seale, TL. (2012). *Local Climate Action Planning*. Washington DC: Island Press, 304 p.

Oleyar MD, Greve AI, Withey JC, and Bjorn AM. (2008). Evaluating Urban Forest Functionality: An Interdisciplinary Approach. *Urban Ecosystems* 11: 289-308.

Dooling, S., Graybill J.K., Greve, A.I. (2007). Response to Young and Wolf: Goal attainment in urban ecology research 1975-2000. *Urban Ecosystems* 10: 339-347.

**FIVE OTHER PRODUCTS**

Boswell, MR, Greve, AI, and Seale, TL. (2014). Climate Action Planning. In Blanco, H and Mazmanian, D. (eds.). *The Elgar Companion to Sustainable Cities: Strategies, Methods and Outlook*. Northampton, MA: Edward Elgar Publishing Ltd.

Boswell, MR, Greve, AI, and Seale, TL. (2010). An Assessment of the Link Between Greenhouse Gas Emissions Inventories and Climate Action Plans. *Journal of the American Planning Association*, 76(4): 451-462.

Greve, A.I., Loftis, J.C., Brown, J.B., Buirgy, R.R., Alexander, B. (2003). Design and Implementation of a Cooperative Water Quality Monitoring Program in Colorado's Big Thompson Watershed. *Journal of the American Water Resources Association* 39: 1409-1418.

Sprague, L.A., & Greve, A.I. (2003). Changes in Nutrient and Pesticide Concentrations in Urban and Agricultural Areas of the South Platte River Basin, Colorado, Wyoming, and Nebraska, 1994–2000: *U.S. Geological Survey Water-Resources Investigations Report* 02-4270, 12 p.

Greve, A.I. (2002). Data-Quality Measures for Stakeholder-Implemented Watershed-Monitoring Programs. *U.S. Geological Survey Open File Report* 02-141, 19 p.

**SYNERGISTIC ACTIVITIES**

Co-Principle Investigator, Local Policy Scan for Climate Change Adaptation and Food Systems, October 2013 – January 2014, ChangeLab Solutions.

Co-Principal Investigator, Rapid Climate Action Planning Process and Pilot Program, September 2012 – December 2013, Navigant Consulting and Southern California Gas Company.

Co-Principle Investigator, Project Manager, State of California Local Climate Change Adaptation Planning Guide, January 2011 – August 2012, California Emergency Management Agency and California Natural Resources Agency.

Project Director, City of San Luis Obispo Climate Action Plan, August 2009-April 2010, City of San Luis Obispo, CA.

Project Director, City of Benicia Climate Action Plan, August 2008 – May 2009, City of Benicia, CA, http://www.ca-ilg.org/sites/main/files/file-attachments/resources__finalcap.pdf.

**COLLABORATORS**

Michael Boswell, CalPoly; William Riggs, CalPoly; Tammy Seal, CalPoly; William Siembieda, Calpoly.

## 8. Preliminary cost proposal

**Estimated Cost by Task**

| Task | Labor | Fringe Benefits and Employer Payroll Taxes | Consultants | Equipment | Travel Subsist | Supplies | Data Storage | Data Acquisition | Coding Support | Copy Editing | Publication Fees | Indirect Costs | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | $ 34,244 | $ 17,538 | $ - | $ - | $ 5,528 | $ 1,000 | $ 1,000 | $ - | $ - | $ - | $ - | $ 5,931 | **$ 65,241** |
| 2 | $ 4,252 | $ 334 | | | $ - | | | $ 10,000 | $ 2,000 | | | $ 1,659 | **$ 18,245** |
| 3 | $ 6,439 | $ 572 | $ 30,000 | $ 5,000 | $ 5,328 | $ - | $ - | $ - | $ - | $ - | $ - | $ 4,234 | **$ 51,573** |
| 4 | $ 5,453 | $ 530 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ 598 | **$ 6,581** |
| 5 | $ 3,267 | $ 291 | | | $ - | | | | | $ 1,000 | $ 3,000 | $ 756 | **$ 8,314** |
| | | | | | | | | | | | | | |
| | **$ 53,655** | **$ 19,265** | **$ 30,000** | **$ 5,000** | **$ 10,856** | **$ 1,000** | **$ 1,000** | **$ 10,000** | **$ 2,000** | **$ 1,000** | **$ 3,000** | **$ 13,178** | **$ 149,954** |

**Estimated Cost by Task**

| Task | Labor | Fringe Benefits and Employer Payroll Taxes | Consultants | Equipment | Travel Subsist | Supplies | Data Storage | Data Acquisition | Coding Support | Copy Editing | Publication Fees | Indirect Costs | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | $ 34,244 | $ 17,538 | $ - | $ - | $ 5,528 | $ 1,000 | $ 1,000 | $ - | $ - | $ - | $ - | $ 5,931 | **$ 65,241** |
| 2 | $ 4,252 | $ 334 | | | $ - | | | $ 10,000 | $ 2,000 | | | $ 1,659 | **$ 18,245** |
| 3 | $ 6,439 | $ 572 | $ 30,000 | $ 5,000 | $ 5,328 | $ - | $ - | $ - | $ - | $ - | $ - | $ 4,234 | **$ 51,573** |
| 4 | $ 5,453 | $ 530 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ 598 | **$ 6,581** |
| 5 | $ 3,267 | $ 291 | | | $ - | | | | | $ 1,000 | $ 3,000 | $ 756 | **$ 8,314** |
| | | | | | | | | | | | | | |
| **TOTAL ARB FUNDING** | **$ 53,655** | **$ 19,265** | **$ 30,000** | **$ 5,000** | **$ 10,856** | **$ 1,000** | **$ 1,000** | **$ 10,000** | **$ 2,000** | **$ 1,000** | **$ 3,000** | **$ 13,178** | **$ 149,954** |

| | |
|---|---|
| **Co-Funding (unrecovered indirect costs)** | **$ 37,556** |
| **TOTAL PROJECT COSTS** | **$ 187,510** |

SALARIES AND WAGES: The salary rates are based on the California State University and Cal Poly Corporation established salary rate paid during the 2014-2015 Academic year (July 1 – June 30). Faculty in the California State University system's duties consists of a full fifteen units each of three Academic quarters per nine month Academic year. The salary and wage rates for all employees include a

projected 4.5% salary increase per year. The rates shown are for budgetary purposes; the actual rates in effect at the time the work is performed will be charged to the project.

FRINGE BENEFITS AND EMPLOYER PAYROLL TAXES: Full time benefits for Release time include a benefit package consisting of FICA, State Unemployment Insurance (SUI), Worker's Compensation, non-industrial leave including vacation and sick leave, medical, dental, and life insurance benefits, and retirement benefits (PERS) and are calculated at 48.03%. Benefits for Faculty summer and overload work and Intermittent employees include FICA, SUI and Workers Compensation and are calculated at 10.9%. Student benefits include FICA (when applicable), SUI, and Worker's Compensation and are calculated at 4.9%. Only rates in effect for each individual at the time the work is performed will be charged to the sponsor.

DOMESTIC TRAVEL: Funds in the amount of $10,856 for ~~the project~~Task 1 are requested for roundtrip travel to
Sacramento (1 trip per year for 3 key personnel) for meetings with the sponsor
San Francisco Bay Area (1 trip per year for 3 key personnel) for data collection

EQUIPMENT: $5,000 will be used in Year 1 (Task 3) to acquire a computer suitable to perform advanced GIS simulations.

MATERIALS AND SUPPLIES:
Printing: funds in the amount of $500 each year (Task 1) will be used to purchase miscellaneous printing and data organization supplies.

OTHER DIRECT COSTS:
Cloud-based data services: $500 will be used each year (Task 1) for secure data storage

Data Acquisition: $10,000 will be used in Year 1 (Task 2) for to procure parcel level data, U.S. Census data, building permit data, satellite and aerial imagery.

Web Scraping: $5,000 will be used in Year 1 (Task 2) to support incentives for student teams to do online data scraping.

Copy editing: $1,000 will be used in Year 2 (Task 5) to provide editorial support for publications and draft and final reports.

Publication fees: $3,000 will be used in Year 3 (Task 5) to cover the cost of open access fees for publications stemming from this project.

Consultant Services: Web-based mapping: $5,000 will be used in Year 1 and $15,000 in Year 2 for Task 3 to develop web platform to disseminate this information. Urban Insights, will assist in this work for 200 hours at $100 / hr. Statistical/coding support: $5,000 will be used each year for Task 3 for statistical support at an estimate of 200 hours at $50 / hour.

INDIRECT COSTS: Cal Poly State University's Federal negotiated indirect rate is 38.5% of modified total direct costs, effective July 1, 2015. Modified total direct costs exclude equipment, capital expenditures, charges for patient care, tuition remission, rental costs of off-site facilities, scholarships, and fellowships as well as that portion of each subgrant and subcontract in excess of $25,000. However, the sponsor limits indirect costs to 10% of Modified Total Direct Costs. Unrecovered indirect costs are contributed to the project by the University.

CO-FUNDING: Unrecovered indirect costs in the amount of $37,556 are shown as co-funding. Co-funding for this project is limited to the unrecovered indirect costs.