

CIP Benchmarking Study

# California Multi-Agency CIP Benchmarking Study

Annual Report - Update 2018



Department of  
**PUBLICWORKS**  
CITY OF SACRAMENTO



**OAKLAND**  
PUBLIC WORKS AGENCY

CITY OF  
**SAN JOSE**  
CAPITAL OF SILICON VALLEY



# December 2018



# Table of Contents

## CHAPTER 1 EXECUTIVE SUMMARY

---

<b>A. Introduction .....</b>	<b>1</b>
<b>B. Performance Benchmarking.....</b>	<b>1</b>
<b>C. Best Management Practices.....</b>	<b>3</b>
<b>D. Acknowledgements .....</b>	<b>4</b>

## CHAPTER 2 INTRODUCTION

---

<b>A. Background .....</b>	<b>5</b>
<b>B. Benefits of Participation .....</b>	<b>6</b>
<b>C. Study Focus.....</b>	<b>7</b>
<b>D. Study Goals .....</b>	<b>7</b>

## CHAPTER 3 PERFORMANCE BENCHMARKING

---

<b>A. Study Criteria.....</b>	<b>9</b>
<b>B. Data Collection and Confirmation.....</b>	<b>11</b>
<b>C. Performance Database .....</b>	<b>14</b>
<b>D. Regression Analysis Results .....</b>	<b>17</b>
<b>E. Characteristics of Data Analyzed.....</b>	<b>17</b>
<b>F. Other Considerations.....</b>	<b>21</b>
<b>G. Smaller Project Analysis.....</b>	<b>22</b>

## CHAPTER 4 BEST MANAGEMENT PRACTICES

---

<b>A. Progress on Best Management Practice Implementation .....</b>	<b>25</b>
---------------------------------------------------------------------	-----------

## CHAPTER 5 ACKNOWLEDGEMENTS

---

<b>Acknowledgements.....</b>	<b>45</b>
------------------------------	-----------

## APPENDICES

**APPENDIX A**      **PERFORMANCE QUESTIONNAIRE**      **A-1**

---

**APPENDIX B**      **PERFORMANCE CURVES**      **B-1**

---

**APPENDIX C**      **INDIRECT RATES**      **C-1**

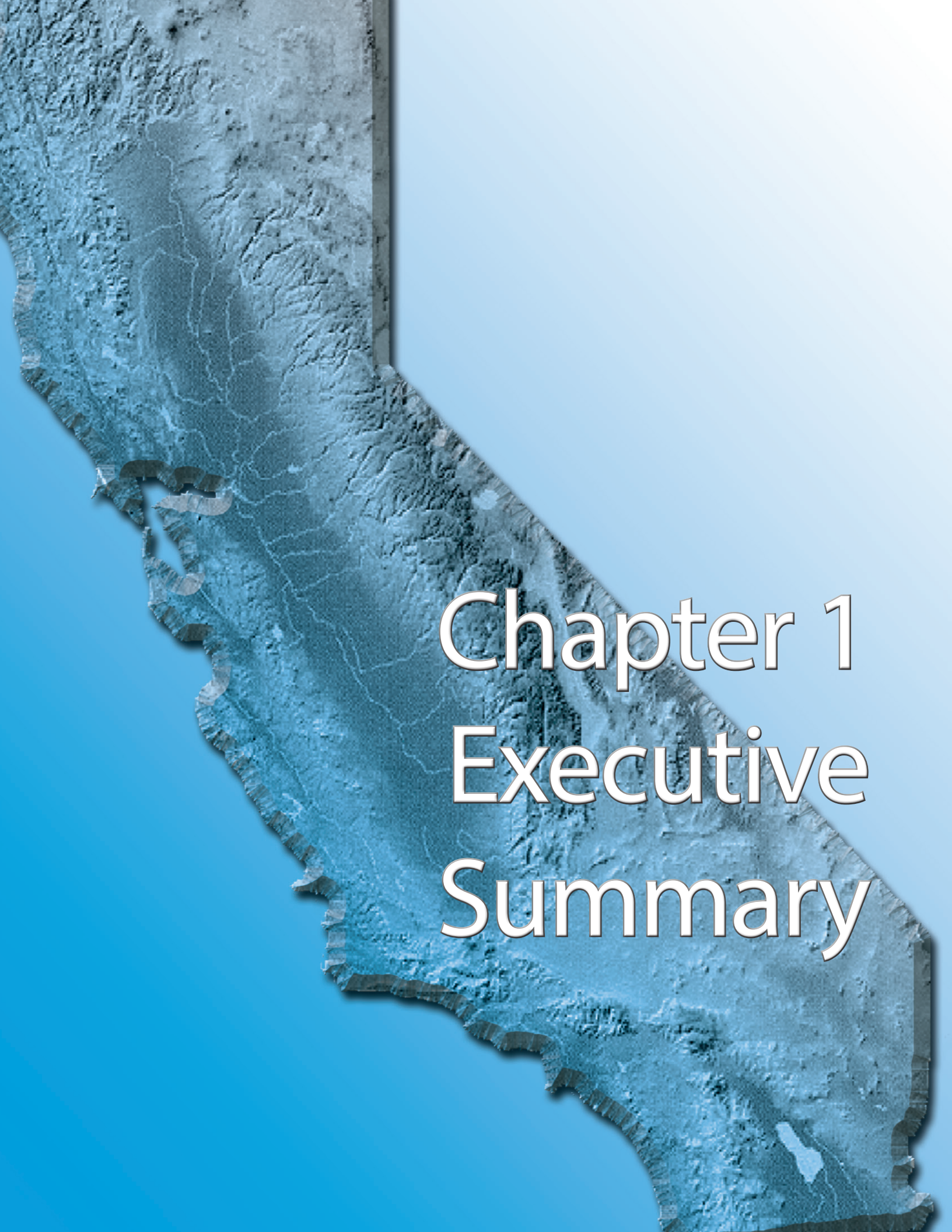
---

## TABLES

<b>Table 1-1</b>	<b>Average Project Delivery Costs by Project Type (% of TCC) (Full Range of TCC)</b>	<b>2</b>
<b>Table 1-2</b>	<b>Average Project Delivery Costs by Project Type (% of TCC) (80th Percentile Range of TCC)</b>	<b>2</b>
<b>Table 2-1</b>	<b>Participating Agency General Information</b>	<b>6</b>
<b>Table 3-1</b>	<b>Project Types and Classifications</b>	<b>11</b>
<b>Table 3-2</b>	<b>Project Cost Categories</b>	<b>14</b>
<b>Table 3-3</b>	<b>Growth of Database</b>	<b>15</b>
<b>Table 3-4</b>	<b>Projects Distribution Matrix</b>	<b>16</b>
<b>Table 3-5</b>	<b>Project Count and Project Delivery by Completion Year</b>	<b>18</b>
<b>Table 3-6</b>	<b>Average Project Delivery Costs by Project Type (% of TCC) (Full Range of TCC )</b>	<b>19</b>
<b>Table 3-7</b>	<b>Average Project Delivery Costs by Project Type (% of TCC) (80th Percentile Subset of TCC )</b>	<b>20</b>
<b>Table 3-8</b>	<b>Project Delivery Performance and Consultant Usage by Agency (2012-2016)</b>	<b>21</b>
<b>Table 3-9</b>	<b>Municipal Facilities Project Delivery Percentage based on Cost Ranges of TCC</b>	<b>23</b>
<b>Table 3-10</b>	<b>Streets Project Delivery Percentage based on Cost Ranges of TCC</b>	<b>23</b>
<b>Table 3-11</b>	<b>Pipes Project Delivery Percentage based on Cost Ranges of TCC</b>	<b>23</b>
<b>Table 3-12</b>	<b>Parks Project Delivery Percentage based on Cost Ranges of TCC</b>	<b>23</b>
<b>Table 4-1</b>	<b>Implementation of BMPs</b>	<b>27</b>



Page Intentionally Left Blank



# Chapter 1 Executive Summary

# CHAPTER 1 Executive Summary

## A. INTRODUCTION

The *California Multi-Agency CIP Benchmarking Study (Study)* is a collaborative effort that involves the sharing of ideas and data between several of the largest cities in California. This report presents the findings of several key components of the study including performance benchmarking and best management practices (BMPs).

**Performance benchmarking** is conducted to establish relationships between project delivery costs and total construction cost (TCC). The *Study* examines how these relationships change over a five-year trailing period. This is a core concept of the *Study* that provides a meaningful benchmark by which participating agencies can assess their project delivery performance and identify potential reasons for differences between them and peers.

**Best management practices** are discussed between agencies and tracked to provide participating agencies a living archive of practices being implemented by peers, lessons learned through their implementation, and potential benefits to be derived if implemented.

A brief overview of these *Study* components is presented in this executive summary.

## B. PERFORMANCE BENCHMARKING

The project data submitted by the agencies are compiled in a customized Microsoft Access® database. This database serves as a repository for the data collected since the inception of the *Study*. Each year, the project database is updated with the inclusion of project data submitted for that *Study* year and updated project data submitted for previous years. The Update 2018 database includes a total of 581 projects, 464 of which belong in the 80th percentile subset by TCC.

### Project Delivery Costs by Project Type

**Table 1-1** summarizes project delivery cost as a percentage of TCC by each of the four project types in the *Study* for the full range of TCC. **Table 1-2** similarly summarizes project delivery cost as a percentage of TCC for the smaller 80th percentile projects based on TCC. The project delivery percentage for a category is the arithmetic average of the project delivery percentages of the individual projects grouped under that category.



**Table 1-1 Average Project Delivery Costs by Project Type (% of TCC)  
(Full Range of TCC)**

Type	Design <sup>1,2</sup>	Construction Management <sup>1,2</sup>	Total Project Delivery <sup>1,2</sup>	Median Total Construction Cost (\$MM)	Number of Projects <sup>3</sup>
Municipal Facilities	26%	22%	48%	2.45	54
Parks	28%	21%	49%	0.69	43
Pipe Systems	24%	21%	45%	1.31	274
Streets	30%	19%	49%	0.77	180
Water/Wastewater Treatment Plants	23%	20%	43%	4.89	30
<b>All Types</b>	<b>26%</b>	<b>20%</b>	<b>47%</b>	<b>1.24</b>	<b>581</b>

## Notes:

1. Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
2. Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
3. Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the projects selected for analysis in the *Study*.

**Table 1-2 Average Project Delivery Costs by Project Type (% of TCC)  
(80th Percentile Range of TCC)**

Type	Design <sup>1,2</sup>	Construction Management <sup>1,2</sup>	Total Project Delivery <sup>1,2</sup>	Median Total Construction Cost (\$MM)	Number of Projects <sup>3</sup>
Municipal Facilities	28%	23%	52%	1.50	43
Parks	31%	23%	54%	0.62	34
Pipe Systems	26%	22%	48%	0.90	219
Streets	33%	20%	52%	0.53	144
Water/Wastewater Treatment Plants	26%	22%	48%	4.19	24
<b>All Types</b>	<b>28%</b>	<b>21%</b>	<b>49%</b>	<b>0.85</b>	<b>464</b>

## Notes:

1. Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
2. Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
3. Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the projects selected for analysis in the *Study*.

## Regression Analysis

A regression analysis was performed to understand the relationship between project delivery as a percent of TCC. This analysis is important to establish statistical significance related to the performance benchmarking. The results reflect the agencies' experience with the delivery of capital projects; on a percentage basis projects with lower TCCs are more expensive to deliver than projects with higher TCCs. Results from the regression analysis methodology are discussed in **Appendix B**. **Appendix B** calculates the project delivery percentages differently than observed in **Table 1-1** and **Table 1-2**, as described in detail in **Appendix B**.

## Project Delivery Percentages as Ranges of TCC

In addition to evaluating a subset of projects defined by the lower 80th percentile subset, the project team evaluated the project delivery percentages on further subsets. An analysis was performed on how the project delivery percentage would change if the projects were categorized by TCC cost ranges.

The results show how the project delivery percentage changes for different ranges of TCC of projects. Projects with higher TCC typically have lower project delivery percentages of TCC and projects with lower TCC typically have a higher project delivery percentage of TCC. The results are further discussed in **Chapter 3**.

## C. BEST MANAGEMENT PRACTICES

At the start of this *Study* in 2002, the agencies examined over 100 practices used in project delivery. Many practices included those the participants did not commonly use at the time, but believed could add value if ultimately implemented as Best Management Practices (BMPs). Each year the agencies look at industry changes in order to identify new BMPs. Each Agency's implementation of these selected practices will continue to be tracked. No new BMPs have been developed in Update 2018, although the agencies are continuing to track their performance on the already developed BMPs.

While a BMP may be developed to address a specific issue, its implementation may affect other elements of project delivery. The participating agencies judged that each of the BMPs favorably impact one of the following categories:

- Cost
- Schedule
- Quality
- Communication
- Environment
- Customer Service

These BMPs continue to be an important element of the *Study* by providing a reference for participating agencies to identify additional BMPs that may be beneficial to implement or to understand challenges associated with their implementation. The discussion on BMPs is found in **Chapter 4** of this report.

## D. ACKNOWLEDGEMENTS

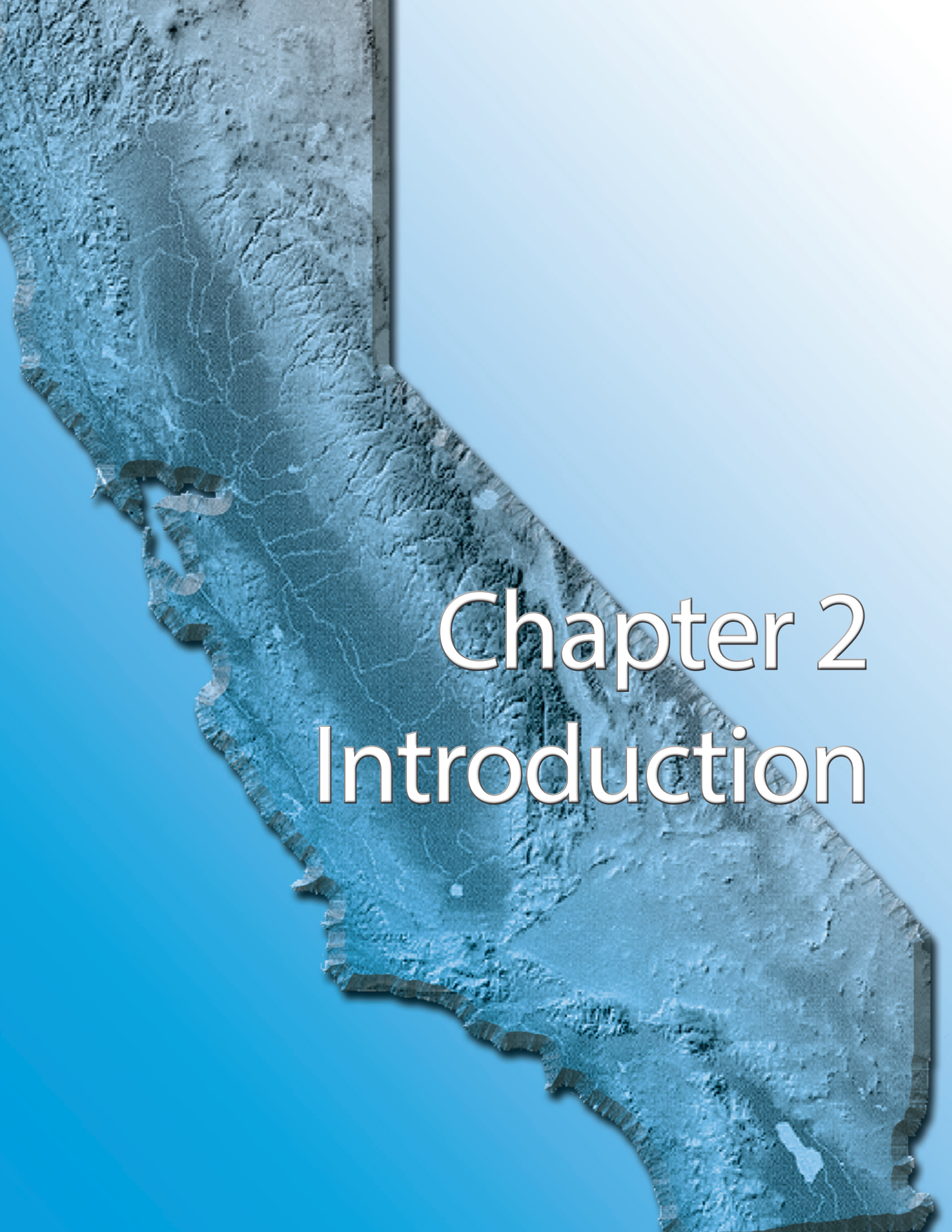
---

This *Study* is made possible through the generous contributions of each participating agency, city staff, and consultants. Contributors include:

- City of Long Beach/Port of Long Beach
- City of Los Angeles
- City of Sacramento
- City of San Diego
- City of San Francisco
- City of San José
- City of Oakland
- Stantec, Inc.
- Roebbelen Contracting, Inc.

A full list of acknowledgements is presented in **Chapter 5**. The City of Oakland took a temporary break from participating in the *Study*. However, previously submitted projects from the City of Oakland are still maintained in the *Study*.



A topographic map of the state of Maryland, rendered in shades of blue and grey, showing terrain features like mountains and valleys. The map is positioned on the left side of the page, with the rest of the background being a solid light blue gradient.

# Chapter 2

## Introduction

# 2 Introduction

The *California Multi-Agency CIP Benchmarking Study (Study)* is a collaborative effort that involves the sharing of ideas and data between several of the largest cities in California. Each participating member contributes to the discussion of lessons learned out of their capital improvement program (CIP) implementation. Through this framework, members of the Study wish to: increase efficiency in delivering services, employ best management practices (BMPs), implement continuous training programs, and develop best-in-class capabilities.

The *Study* provides a forum for the agencies to share information among themselves via meetings that focus on current issues and a database that serves as both a repository of the agencies' projects and a tool for data analysis. The purpose of this collaboration is to share the best ideas of the group for the benefit of all and to gather insight on how to address challenges that might appear to be new, but which others may have already faced and addressed successfully.

## A. BACKGROUND

In October 2001, the City of Los Angeles, Department of Public Works, Bureau of Engineering initiated the *Study* with several of the largest cities in California. These cities joined together to form the Project Team for the *Study*. The Project Team acknowledges that there have been significant benefits derived from collaborating and pooling their project delivery knowledge and experience since the inception of the *Study*.

The participating agencies currently include:

- City of Long Beach, Department of Public Works and Harbor Department Port of Long Beach
- City of Los Angeles, Department of Public Works, Bureau of Engineering
- City of Oakland, Public Works Department, Bureau of Engineering and Construction. City of Oakland took a temporary leave from the Study in 2017
- City of Sacramento, Department of Public Works and Department of Utilities
- City of San Diego, Public Works Department, Engineering and Capital Projects Department
- City and County of San Francisco, Department of Public Works, Building Design and Construction, Infrastructure Design and Construction
- City of San José, Department of Public Works and City Manager's Office

While the participating agencies have many similarities in terms of function and capital program delivery, it is important to note that a number of factors create differences. Some of these include organization and cost structure. This is reflected in the "Indirect

Rates Applied to Capital Projects” table shown in **Appendix C**. Variances amongst the agency indirect rates can create measureable delivery cost differences between the agencies for similar projects. However, the large magnitude of projects in the *Study* database has normalized these differences when data is compiled for major project categories and/or across all project types.

Upon initiation of the *Study*, it was agreed that published data provided by *Study* participants should remain anonymous in order to create a positive, non-competitive team environment, conducive to meeting the *Study’s* goals.

General information on each participating agency is summarized on **Table 2-1**.

## B. BENEFITS OF PARTICIPATION

The participating agencies have been very supportive of the *Study* efforts over the years. The *Study* is possible only because the agencies believe they are benefiting from their continued participation.

The agencies have expressed many benefits of the *Study*. Ready access to performance data and BMPs of the largest cities in California helps member agencies in their decision-making process regarding policy and procedural improvements while providing training initiatives for new project

**Table 2-1  
Participating Agency General Information**

Information	Population <sup>1</sup>	Area (sq. mi.)	Website	Government Form
Long Beach	478,561	50	<a href="http://www.longbeach.gov">http://www.longbeach.gov</a> <a href="http://www.polb.com">http://www.polb.com</a>	Council-Manager-Charter(2) Commission-Mayor-Council
Los Angeles	4,054,400	469	<a href="http://eng.lacity.org">http://eng.lacity.org</a>	Mayor-Council
Oakland	428,827	66	<a href="http://www2.oaklandnet.com/">http://www2.oaklandnet.com/</a>	Mayor-Council-Administrator
Sacramento	501,344	98	<a href="http://www.cityofsacramento.org">http://www.cityofsacramento.org</a>	Council-Manager
San Diego	1,419,845	342	<a href="http://www.sandiego.gov">http://www.sandiego.gov</a>	Mayor-Council
San Francisco	883,963	49	<a href="http://www.sfdpw.org">http://www.sfdpw.org</a>	Mayor-Board of Supervisors (11 members)
San José	1,051,316	178	<a href="http://www.sanjoseca.gov">http://www.sanjoseca.gov</a>	Mayor-Council-Manager

Notes:

1. Source: California Department of Finance, E-1 Population Estimates for Cities, Counties, and the State — January 1, 2017 and 2018.
2. (1) Provisional population estimate for the city as of January 1, 2018.
3. (2) Mayor has veto power.



managers. Sharing project delivery costs provides agencies a higher level of design and construction estimate certainty and a benchmark to assess their individual CIP implementation performance. The tracking and reporting of the *Study* provides a structured framework for agencies to more seamlessly correlate performance with that of the collective.

The *Study*, through regular meetings, facilitates the discussion of how executives from each agency are managing and meeting similar challenges. Meetings involve the discussion of timely subjects that prepare agencies in addressing coming issues. The *Study* helps agency staff better communicate typical CIP challenges, e.g., needed resources with elected officials and community stakeholders.

### C. STUDY FOCUS

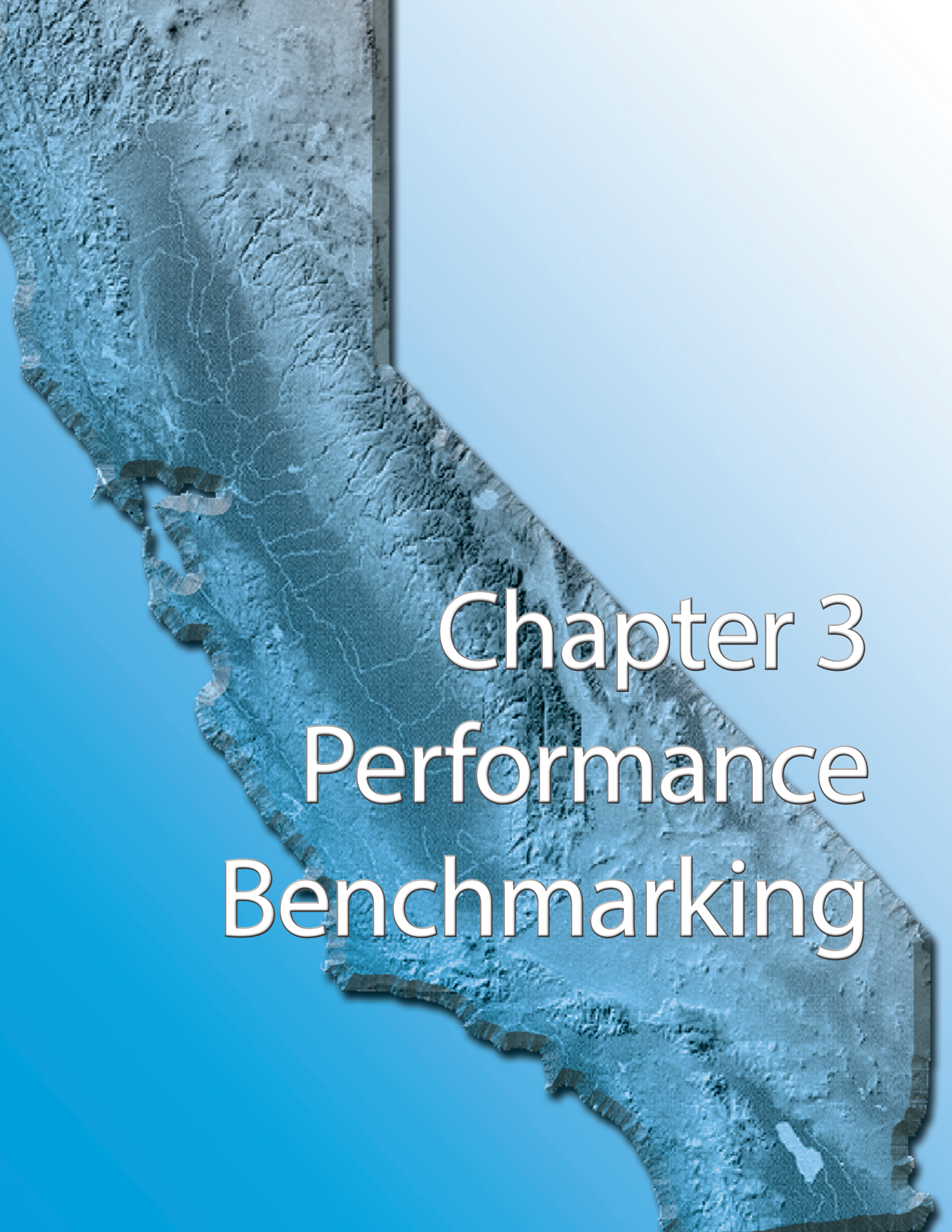
This year, the participating agencies devoted in-person meeting time to collaborating with each other on pressing issues facing all the agencies. Agency implementation of selected BMPs has been and will continue to be tracked during the *Study*. A description of the BMP along with their “Perceived Value” is presented in **Chapter 4, Best Management Practices**.

### D. STUDY GOALS

The *Study* method is described in detail in the first *Study* report (published in 2002) and modifications to it have been documented in subsequent *Study* reports. In Update 2018, the agencies made progress on several goals:

1. **Collect projects delivered by alternative delivery techniques in the performance database.** Over the years, the participating agencies have executed several projects using alternative delivery methods such as design-build and job-order-contracting yielding benefits in areas such as cost, schedule, and overall project delivery. In order to capture such projects as part of the *Study*, the agencies have decided to collect cost data for projects delivered via alternative methods. This practice was initiated in Update 2011 and continued in Update 2018. However, the agencies decided that these projects would not be analyzed until a sufficient number of projects are collected to facilitate meaningful analyses. In addition, criteria for analysis for projects delivered by alternative delivery techniques needs to be defined. The performance questionnaire was updated in Update 2017 to better categorize alternative delivery projects.
2. **Track the adoption of BMPs.** The Project Team continued to track the implementation of BMPs in order to link these practices to project delivery performance improvement over time in order to encourage their implementation. Although no new BMPs were adopted for Update 2018, agencies focused on specific challenges implementing BMPs already identified.
3. **Continue efficient information sharing with one another through in-person meetings.** In Update 2018, the Project Team participated in quarterly meetings to exchange ideas, discuss topics of mutual interest and share ideas for addressing common challenges.

Page Intentionally Left Blank



# Chapter 3

## Performance Benchmarking



# Performance Benchmarking

Performance benchmarking involves collecting documented project costs and plotting the component costs of project delivery against the total construction cost (TCC). The objective of this exercise is to develop relationships between these variables by performing regression analyses. Since Update 2009, the results of the regression analyses have yielded significantly better correlation compared to prior years of the *Study*. This is primarily due to the adoption of statistical techniques for model selection and significant improvements in the modeling methodology.

The project costs data are collected from the agencies using a Performance Questionnaire created in Microsoft Excel®. Data are then compiled from the questionnaires in Excel® using a Visual Basic for Applications (VBA) code where the data is reviewed and vetted, and then transferred into the database. A copy of the current Performance Questionnaire can be found in **Appendix A**. The Performance Questionnaire was updated in Update 2017 to better differentiate between alternative delivery projects and to gather more information to determine construction duration.

Note that the values presented in tables for previous years in this Update 2017 Benchmarking Report may have changed from prior reports due to the addition or update of past projects in Update 2017.

## A. STUDY CRITERIA

---

The following criteria applied to Update 2018 performance benchmarking analyses:

- **Total Construction Cost** – TCC is the sum of costs associated with the awarded construction contract, net change orders, utility relocation, and construction by agency forces. TCC does not include the cost of land acquisition, environmental monitoring and mitigation, design, or construction management. All projects included in the analyses have a TCC exceeding \$100,000. The participating agencies use fully-loaded (direct and indirect) costs for project delivery tasks. (See **Appendix C**).
- **Completion Date** – Projects included in the *Study* analyses were completed on or after January 1, 2013 and before December 31, 2017. Projects with earlier or later completion dates were kept in the database, but excluded from the analyses.
- **Outlier Elimination** – Statistical elimination was used to identify outliers in the performance model. The total project delivery percentage of each project in the database was evaluated against all other projects in the same classification. An outlier was identified as a project whose total



project delivery percentage was outside the range expressed by the following inequality:

$$m - 3\sigma \leq x \leq m + 3\sigma$$

where  $m$  represents the mean of the project delivery percentages,  $\sigma$  represents the standard deviation of the project delivery percentages for all projects in the same classification, and  $x$  represents the project delivery percentage of a particular project.

It should be noted that this approach, which was first adopted in Update 2008, allows for the inclusion of more data than in previous years. Previously, other methods including visual inspection were used for the elimination of outlier data points. This change was in part allowed by the improved modeling techniques that have been documented in prior *Study* reports.

Projects confirmed as outliers by this statistical technique were kept in the database but excluded from the analyses. Some of the projects classified as outliers in previous *Study* years have been included in the performance data analysis, and vice-versa.

- **Project Delivery Method** – All projects analyzed in this *Study* were delivered through the traditional design-bid-build method. In prior *Study* years, project costs data were only collected and analyzed for projects delivered using the traditional design-bid-build method. Over the years, the participating agencies have executed several projects using alternative delivery

methods such as design-build, construction management at risk, on-call engineering services, and job-order-contracting yielding benefits in areas such as cost, schedule, and overall project delivery. In order to capture such projects as part of the *Study*, the agencies have decided to collect cost data for projects delivered via alternative methods. However, the agencies decided that these projects will not be analyzed until a sufficient number of projects are collected to facilitate meaningful analyses.

- **Change Order Classification** – To support meaningful change order analyses, the Project Team reported change orders in accordance with the following classifications:
  1. Changed/Unforeseen Conditions
  2. Changes to Bid Documents
  3. Client-Initiated Changes

**Project Classifications** – Seventeen project classifications grouped into five project types are used in this *Study*. The project types and classifications are shown in **Table 3-1**. The Water/Wastewater Treatment Plant category was added for Update 2018.

**Table 3-1**  
**Project Types and Classifications**

Project Types	Classifications
<b>Municipal Facilities</b>	<ul style="list-style-type: none"> <li>• Libraries</li> <li>• Police and Fire Stations</li> <li>• Community Centers, Recreation Centers, Child Care Facilities, Gymnasiums</li> <li>• Other Municipal Facilities<sup>1</sup></li> </ul>
<b>Streets</b>	<ul style="list-style-type: none"> <li>• Widening, New, and Grade Separation</li> <li>• Bridges</li> <li>• Reconstruction</li> <li>• Bike Ways, Pedestrian Ways, and Streetscapes</li> <li>• Signals</li> </ul>
<b>Pipe Systems</b>	<ul style="list-style-type: none"> <li>• Gravity Systems</li> <li>• Pressure Systems</li> <li>• Pump Stations</li> <li>• Other Pipes</li> </ul>
<b>Parks</b>	<ul style="list-style-type: none"> <li>• Playgrounds</li> <li>• Sport fields</li> <li>• Restrooms</li> </ul>
<b>Water/Wastewater Treatment Plants</b>	<ul style="list-style-type: none"> <li>• Water/Wastewater Treatment Plants</li> </ul>

Notes:

1. Projects include design and/or construction activities for parking structures, yards, soil anchors, docks, animal shelters, reservoirs, piers, and animal services centers.

## **B. DATA COLLECTION AND CONFIRMATION**

To obtain meaningful results from the performance model, it is essential that the data collected from the agencies are accurate and conform to the *Study* criteria. The agencies recognize the importance of quality input data and are committed to providing accurate, complete project delivery cost data to support the development of performance models. Project delivery costs are defined as the sum of all agency and consultant costs associated with project planning, design, bid, award, construction management, and closeout activities. Examples of specific activities included in each phase of project delivery are presented in **Table 3-2**.

For the Update 2018 *Study*, the agencies completed the questionnaires with comparable, complete, and accurate values. The agencies also review and compare their data collection and confirmation techniques on a regular basis. For example, in the second quarterly meeting during Update 2016, each agency completed questionnaires on three previously submitted projects to compare with original submittals. The values obtained were nearly identical, with differences resulting typically from close-out costs that happen years after the project is completed. In addition, discussion among the Project Team helps clarify and resolve inconsistencies in the data collection methodologies. It also ensures that input data is vetted before projects are submitted for analysis.

**Table 3-2  
 Project Cost Categories**

Category and Phase	Description
<p><b>1) Design Costs:</b></p>	<p>The design phase (and associated costs) begins with the initial concept development, includes planning as well as design, and ends with the issuance of a construction Notice to Proceed. Design costs consist of direct labor costs, other direct agency costs such as art fees and permits, and consultant services cost associated with planning and design. Design may include the following:</p>
<p><b>Planning</b></p>	<ul style="list-style-type: none"> <li>• Complete schematic design documents</li> <li>• Review and develop scope</li> <li>• Evaluate schedule and budget</li> <li>• Review alternative approaches to design and construction</li> <li>• Obtain owner approval to proceed</li> <li>• Attend hearings and proceedings in connection with the project</li> <li>• Prepare feasibility studies</li> <li>• Prepare comparative studies of sites, buildings, or locations</li> <li>• Provide submissions for governmental approvals</li> <li>• Provide services related to future facilities, systems, or equipment</li> <li>• Provide services as related to the investigation of existing conditions of site or buildings or to prepare as-built drawings</li> <li>• Develop life cycle costs</li> <li>• Complete environmental documentation and clearances</li> <li>• Monitor and control project costs</li> </ul>
<p><b>Design</b></p>	<ul style="list-style-type: none"> <li>• Complete design development documents including outline specifications</li> <li>• Evaluate budget and schedule against updated construction cost estimate</li> <li>• Complete design and specifications</li> <li>• Develop bid documents and forms including contracts</li> <li>• Complete permit applications</li> <li>• Manage right-of-way procurement process</li> <li>• Coordinate agency reviews of documents</li> <li>• Review substitutions of materials and equipment</li> <li>• Prepare additive or deductive alternate documentation</li> <li>• Coordinate geotechnical, hazardous material, acoustic or other specialty design requirements</li> <li>• Provide interior design services</li> <li>• Monitor and control project costs</li> </ul>
<p><b>Bid and Award</b></p>	<ul style="list-style-type: none"> <li>• Prepare advertisement for bids</li> <li>• Qualify bidders</li> <li>• Manage the pre-bid conference</li> <li>• Evaluate bids</li> <li>• Prepare the recommendation for award</li> <li>• Obtain approval of contract award from Board/Council</li> <li>• Prepare the Notice to Proceed</li> <li>• Monitor and control project costs</li> </ul>

**Table 3-2  
Project Cost Categories (cont'd)**

Category and Phase	Description
<b>2) Construction Management Costs:</b>	All costs associated with construction management, including closeout costs, are included in this category. Construction management costs consist of direct labor, other agency costs, and consultant usage. Construction management may include the following:
<b>Construction</b>	<ul style="list-style-type: none"> <li>• Hold pre-construction conference</li> <li>• Review and approve schedule and schedule updates</li> <li>• Perform on-site management</li> <li>• Review shop drawings, samples, and submittals</li> <li>• Perform lab work, testing, and inspection</li> <li>• Process payment requests</li> <li>• Review and negotiate Change Orders</li> <li>• Prepare monthly reports to owner and agencies</li> <li>• Respond to Requests for Information</li> <li>• Develop and implement a project communications plan</li> <li>• Perform document control</li> <li>• Manage claims</li> <li>• Perform final inspections and develop and track punch list</li> </ul>
<b>Closeout Phase</b>	<ul style="list-style-type: none"> <li>• Commission facilities and equipment</li> <li>• Train maintenance and operation personnel</li> <li>• Document and track warranty and guarantee information</li> <li>• Plan move-in</li> <li>• File notices (occupancy, completion, etc.)</li> <li>• Check and file as-built documents</li> <li>• Monitor and control project costs</li> </ul>
<b>3) Total Project Delivery Costs:</b>	This is the total cost of delivering a capital improvement project, equal to the sum of the design cost and construction management costs indicated above.
<b>4) Change Order Cost:</b>	<p>Please see the Update 2005 Report for descriptions of the following types of change orders:</p> <ul style="list-style-type: none"> <li>• Changed/unforeseen conditions - This type of change is necessitated by discovery of actual job site conditions that differ from those shown on the contract plans or described in the specifications. These are conditions a designer could not have reasonably been expected to know about during the design of the project.</li> <li>• Changes to Bid Documents - This type of change is necessitated by a mistake or oversight in the original contract documents and is required to correct the plans and specifications.</li> <li>• Client-Initiated Changes - This type of change results from additions, deletions or revisions to the physical work.</li> </ul>



**Table 3-2  
 Project Cost Categories (cont'd)**

Category and Phase	Description
<p><b>5) Total Construction Cost (TCC):</b></p>	<p>This is the direct construction cost, including all change orders during the construction phase (from the issuance of Notice to Proceed to Notice of Completion). The following costs are associated with construction and are included in the TCC:</p> <ul style="list-style-type: none"> <li>• Direct actual construction</li> <li>• Total amount of change orders throughout construction</li> <li>• Fixtures, furnishing, and equipment (FFE)</li> <li>• Utilities relocation</li> <li>• Construction work performed by the agency's staff and other agencies' staff</li> </ul>

### C. PERFORMANCE DATABASE

The projects data submitted by the agencies are compiled in a customized Microsoft Access® database. This database serves as a repository for the data collected since the inception of the *Study*. Each year, the projects database is updated with the inclusion of projects data submitted for that *Study* year.

**Table 3-3** summarizes the number of projects included in the database and in the analyses. The 5-year database used for the current analysis contains 581 projects. This total excludes project data completed outside of January 1, 2013 to December 31, 2017, or projects identified as outliers. Projects identified as outliers are not included in the performance data analysis but are retained in the performance database. In addition, projects delivered by alternative delivery are excluded from the analysis but included in the database. The 581 projects selected for analysis do not include projects delivered by alternative delivery. As explained under subsection A *Study* Criteria of this chapter, outlier analysis was performed using statistical techniques to ensure consistency in

the selection of outlier data points. **Table 3-3** shows that as the rules for project selection were refined, the number of non-representative and projects with TCC less than \$100K have decreased. In addition, only 21 projects have been excluded as outliers in the Update 2018 *Study*.

In the *Study* 2002 report, it was recommended that at least 10 projects per classification and a minimum data set of 2,000 projects distributed evenly among classifications, ranges of TCC, and agencies are necessary to achieve statistically-significant results. While over 2,000 projects have been collected in the database, the number of projects analyzed in any *Study* phase is significantly lower due to the criteria selected for the inclusion of projects in the database. Although the requirement for the minimum number of projects per classification has been met for most project categories, more data needs to be collected to ensure an even distribution of projects amongst all classifications.

The agencies acknowledged that it is vital to the success of the *Study* to continue increasing the size of the data set, thereby increasing the confidence, consistency, and reliability of results. As previously indicated, there are five project

types (Municipal Facilities, Streets, Pipe Systems, Parks, and Water/Wastewater Treatment Plants) and 17 project classifications included in this *Study*. **Table 3-4** summarizes the distribution of projects included in the analyses.

**Table 3-3  
Growth of Database**

Study Phase <sup>1</sup>	Submitted			Deleted <sup>2</sup>		Count After Deletions <sup>3</sup>	Excluded		Net
	Traditional Projects Submitted	(a) Alternative Delivery Projects Submitted <sup>4</sup>	(b) Total	(c) TCC <\$100K	(d) Non-Representative	(e)=(b)-(a)-(c)-(d)	(f) Project Completion Date before 2012 or in 2017	(g) Outliers <sup>5</sup>	Projects in Analyses (h)= (e)-(f)-(g)
I	239	0	239	27	44	168	168	0	0
II	285	0	285	0	35	250	250	0	0
III	262	0	262	0	29	233	233	0	0
IV	173	0	173	18	24	131	131	0	0
V	182	0	182	0	4	177	177	0	0
VI	191	0	191	0	4	188	188	0	0
VII	158	0	158	2	0	157	157	0	0
VIII	149	2	151	2	0	149	149	0	0
IX	173	10	183	2	0	171	171	0	0
X	121	15	136	1	0	120	120	0	0
XI	160	15	175	0	4	160	160	0	0
XII	142	8	150	2	0	141	141	0	0
XIII	145	27	172	0	0	145	52	3	90
XIV	162	19	181	4	0	158	18	4	136
XV	124	20	144	4	0	120	14	5	101
XVI	98	35	133	1	0	97	2	1	94
XVII	172	45	217	2	0	170	2	8	160
<b>Total</b>	<b>2,936</b>	<b>196</b>	<b>3,132</b>	<b>65</b>	<b>144</b>	<b>2,735</b>	<b>2,133</b>	<b>21</b>	<b>581</b>

Notes:

1. *Study* Phase indicates action taken on the count of projects corresponding to Study Years I = 2002, II = 2003, ..., XVI = 2017, and XVII = 2018.
2. Projects that do not fit *Study* criteria for project classifications and minimum TCC of \$100K were omitted from the database.
3. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the projects selected for analysis in the *Study*.
4. These represent projects delivered by alternative project delivery techniques. These projects are kept in the database, but not analyzed. These projects will be analyzed when a sufficient number of such projects are available to facilitate meaningful analyses.
5. Outliers are identified based on statistical analysis.

Table 3-4  
Projects Distribution Matrix (2013-2017)

Agency	Long Beach	Los Angeles	Oakland	Sacramento	San Diego	San Francisco	San José	Total <sup>1</sup>
<b>Municipal Facilities</b>	1	20	3	2	11	12	5	54
Comm./Rec. Center/ Child Care/Gyms	0	9	2	0	3	3	1	18
Libraries	0	0	0	0	0	0	1	1
Police/Fire Stations	1	6	0	0	2	2	0	11
Other Municipal Facilities <sup>2</sup>	0	5	1	2	6	7	3	24
<b>Parks</b>	1	5	5	0	10	4	18	43
Playgrounds	1	3	2	0	5	2	16	29
Restrooms	0	0	1	0	2	1	0	4
Sport fields	0	2	2	0	3	1	2	10
<b>Pipe Systems</b>	9	53	18	17	110	1	66	274
Gravity Systems (Storm Drains/Sewers)	4	45	17	11	61	1	61	200
Pressure Systems	3	1	0	4	43	0	1	52
Pump Stations	1	4	1	2	3	0	3	14
Other Pipes	1	3	0	0	3	0	1	8
<b>Streets</b>	14	16	18	46	34	43	9	180
Bike/Pedestrian/ Streetscapes	0	1	11	23	15	2	5	57
Bridges (New/Retrofit)	2	6	4	2	1	0	0	15
Reconstructions	11	6	1	2	11	35	0	66
Signals	0	1	2	13	4	6	4	30
Widening/New/ Grade Separations	1	2	0	6	3	0	0	12
<b>Water/Wastewater Treatment Plants</b>	1	28	0	0	1	0	0	30
<b>Total<sup>1</sup></b>	<b>26</b>	<b>122</b>	<b>44</b>	<b>65</b>	<b>166</b>	<b>60</b>	<b>98</b>	<b>581</b>

Notes:

- Total refers to the projects included in the Update 2018 analyses only. Total excludes projects delivered by alternative delivery methods such as design-build, JOC, on-call engineering services, and CM@Risk. Projects delivered by alternative methods are retained in the database but not analyzed. These projects are not included in the projects selected for analysis in the Study.
- Projects include design and/or construction activities for parking structures, yards, soil anchors, docks, animal shelters, reservoirs, piers, and animal services centers.

## D. REGRESSION ANALYSIS RESULTS

During Update 2008, several changes were made to improve the modeling methodology. These included developing a statistically-sound method for outlier analysis, using a linear trendline regression for modeling project costs relationships, and using the upper and lower bounds of a 95 percent confidence interval to estimate the range of the project delivery percentages. Results from the regression analysis methodology are discussed in **Appendix B**.

It is important to note that the project delivery percentages developed in **Appendix B** are calculated differently than the average project delivery percentages in **Section 3**, as described in more detail in **Appendix B**. **Section 3** evaluates the arithmetic average project delivery of all projects, while **Appendix B** calculates the average slope using the least squares fit method.

This is better explained by the following example. Consider 5 projects in the Pipe category having the a1, a2, a3, a4, and a5 as their individual project delivery costs and b1, b2, b3, b4, and b5 as their individual TCC. The project delivery percentages in **Section 3** are the arithmetic average of the project delivery percentages represented as:

$$\text{Project Delivery Percentage} = \left( \frac{a1}{b1} + \frac{a2}{b2} + \frac{a3}{b3} + \frac{a4}{b4} + \frac{a5}{b5} \right) / 5$$

The project delivery percentage in **Appendix B** is calculated using the below formula which utilizes the least squares fit method:

$$\text{Project Delivery Percentage} = \left( \frac{a1 + a2 + a3 + a4 + a5}{b1 \ b2 \ b3 \ b4 \ b5} \right)$$

## E. CHARACTERISTICS OF DATA ANALYZED

Project performance data were analyzed using the custom database application at both the Project Type level and the Project Classification level (see **Table 3-1**).

### *Project Count and Project Delivery by Completion Year*

**Table 3-5** summarizes characteristics of the projects included in the analyses by project completion year and shows trends in the average TCC values, median TCC values, design costs, construction management costs, and overall project delivery costs. The median value is the value at which 50 percent of the values are above and 50 percent of the values are below.



**Table 3-5  
 Project Count and Project Delivery by Completion Year**

Project Completion Year	Count by Project Type					Project Delivery Data <sup>1,2</sup>					Project Delivery Cost (% of TCC)
	Municipal Facilities	Streets	Pipes	Parks	Water/Wastewater Treatment Plants	Total(3)	Average TCC (\$MM)	Median TCC (\$MM)	Design Cost (% of TCC)	Construction Management Cost (% of TCC)	
2013	15	35	63	8	1	122	\$2.72	\$1.25	29%	20%	49%
2014	6	50	81	10	1	148	\$2.08	\$0.97	26%	20%	46%
2015	12	30	54	7	8	111	\$2.63	\$1.35	27%	21%	48%
2016	10	31	46	11	7	105	\$3.23	\$1.22	24%	20%	44%
2017	11	34	30	7	13	95	\$3.81	\$1.65	25%	21%	45%
<b>Total</b>	<b>54</b>	<b>180</b>	<b>274</b>	<b>43</b>	<b>30</b>	<b>581</b>	<b>\$2.81</b>	<b>\$1.24</b>	<b>26%</b>	<b>20%</b>	<b>47%</b>

Notes:

1. Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
2. Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
3. Total excludes projects delivered by alternative delivery mechanisms such as design-build, on-call engineering support, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the projects selected for analysis in the *Study*.

As indicated in **Table 3-5**, median project size has fluctuated considerably since 2013. The median project size decreased approximately 22 percent between 2013 and 2014, then increased by 38 percent in 2015 and increased significantly again in 2017 by 35 percent from 2016. A similar trend is observed in the average project size. The fluctuations could be due to a combination of several factors such as the selection of projects using the five-year window, elimination of projects with high TCC values during the outlier analysis, and the addition of several new projects with high TCC values. In addition, factors such as personnel turnover in the agencies have also affected productivity, leading

to inefficiencies due to the loss of project specific knowledge.

***Project Delivery Costs by Project Type***

**Table 3-6** shows project delivery costs by each of the five project types in the *Study* for the full range of TCC. The project delivery percentage for a category is the arithmetic average of the project delivery percentages of the individual projects grouped under that category.

**Table 3-6**  
**Average Project Delivery Costs by Project Type (% of TCC)**  
**(Full Range of TCC )**

Type	Design <sup>1,2</sup>	Construction Management <sup>1,2</sup>	Total Project Delivery <sup>1,2</sup>	Median Total Construction Cost (\$MM)	Number of Projects <sup>3</sup>
Municipal Facilities	26%	22%	48%	2.45	54
Parks	28%	21%	49%	0.69	43
Pipe Systems	24%	21%	45%	1.31	274
Streets	30%	19%	49%	0.77	180
Water/Wastewater Treatment Plants	23%	20%	43%	4.89	30
<b>All Types</b>	<b>26%</b>	<b>20%</b>	<b>47%</b>	<b>1.24</b>	<b>581</b>

Notes:

1. Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
2. Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
3. Total excludes projects delivered by alternative delivery mechanisms such a design-build, on-call engineering support, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the projects selected for analysis in the *Study*.

Projects belonging to the Water/Wastewater Treatment Plants categories have the lowest average project delivery percentage. The Pipes category has the highest number of projects (274) in the Update 2018 database. The Pipe and Streets category projects combined total 78 percent of the projects in the database. The Parks category exhibits one of the highest average project delivery cost, and also has the lowest median TCC whereas the Water/Wastewater Treatment Plants category has the highest median TCC but the lowest average project delivery cost. The average project delivery percentage

for the overall dataset is 47 percent. These percentages have remained relatively stable for the original four project types (Municipal Facilities, Parks, Pipe Systems and Streets) over previous years.

Over the course of the *Study*, the agencies have observed that the relatively high average project delivery cost of Streets projects is likely due to increasing cost influences of right-of-way acquisition, community outreach requirements, environmental mitigation requirements, and the smaller median total construction cost of these projects.

**Table 3-7** shows project delivery costs by each of the five project types in the *Study* for the 80th percentile subset of TCC (Note: In Update 2009, the concept of looking at a subset of projects was introduced. This subset generally characterizes the projects in the type or classification being examined. This step was taken as it was generally believed that project delivery for the very large projects did not characterize the overall projects in the type of classification being examined.). The trends in the project delivery costs for the projects in the 80th percentile subset of TCC follow that of the projects in the full range of TCC. As expected based upon the agencies' practical experience, project delivery costs are higher for projects that fall in the 80th percentile subset of TCC.

### Consultant Usage Analysis

Project delivery performance and consultant usage by agency are presented in **Table 3-8**. The table indicates that on average, 59 percent of the design work and 81 percent of the construction management efforts are completed in-house by the participating agencies. Consultants account for approximately 31 percent of the total project delivery costs while in-house efforts by the participating agencies accounts for the remaining 69 percent of the project delivery costs. From the available data, a clear relationship between the level of in-house effort and project delivery costs cannot be established.

**Table 3-7**  
**Average Project Delivery Costs by Project Type (% of TCC)**  
**(80th Percentile Subset of TCC )**

Type	Design <sup>1,2</sup>	Construction Management <sup>1,2</sup>	Total Project Delivery <sup>1,2</sup>	Median Total Construction Cost (\$MM)	Number of Projects <sup>3</sup>
Municipal Facilities	28%	23%	52%	1.50	43
Parks	31%	23%	54%	0.62	34
Pipe Systems	26%	22%	48%	0.90	219
Streets	33%	20%	52%	0.53	144
Water/Wastewater Treatment Plants	26%	22%	48%	4.19	24
<b>All Types</b>	<b>28%</b>	<b>21%</b>	<b>49%</b>	<b>0.85</b>	<b>464</b>

Notes:

1. Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
2. Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
3. Total excludes projects delivered by alternative delivery mechanisms such a design-build, on-call engineering support, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the projects selected for analysis in the *Study*.

## F. OTHER CONSIDERATIONS

### Size of the Database

The size of the project database remains relatively the same for each *Study* update due to the 5-year rolling window criterion for project completion dates; as new projects are added, old projects are excluded from analyses based on age. The participating agencies are challenged to identify as many completed projects as possible that meet the *Study* criteria. The benefits of projects delivered via alternative delivery techniques can be quantified by including them for analysis in the project database. However, due to the significant difference in delivery mechanisms, those projects will have to be analyzed separately from the rest of the projects in the database.

### BMP Implementation and Project Delivery Costs

Although it is desirable for project delivery costs to decrease as agency efficiencies increase and BMPs are implemented, this can be confounded by other factors that change annually such as project size, construction cost fluctuations, inflation, competitive bidding environments, or additional environmental regulations. Without more detailed data gathered for each project, these factors cannot be confirmed.

**Table 3-8**  
**Project Delivery Performance and Consultant Usage by Agency (2013-2017)**

AGENCY	DESIGN					CONSTRUCTION MANAGEMENT					PROJECT DELIVERY					TCC	
	In-House		Consultants		Total % of TCC <sup>2,3</sup>	In-House		Consultants		Total % of TCC	In-House		Consultants		Total % of TCC	Average (\$MM)	Median (\$MM)
	(\$M)	% of Design <sup>1</sup>	(\$M)	% of Design		(\$M)	% of CM	(\$M)	% of CM		(\$M)	% of PD	(\$M)	% of PD			
<b>Agency A</b>	51.2	78%	14.5	22%	31%	46.7	95%	2.7	5%	20%	97.9	85%	17.2	15%	50%	1.9	1.3
<b>Agency B</b>	14.6	37%	24.7	63%	26%	13.6	43%	18.3	57%	16%	28.2	40%	43.0	60%	43%	3.2	0.5
<b>Agency C</b>	15.8	82%	3.4	18%	18%	16.7	95%	0.9	5%	14%	32.5	88%	4.3	12%	32%	2.3	1.3
<b>Agency D</b>	75.4	50%	74.3	50%	24%	119.0	82%	26.2	18%	28%	194.3	66%	100.4	34%	52%	5.7	2.9
<b>Agency E</b>	4.6	50%	4.5	50%	32%	3.4	35%	6.4	65%	25%	8.0	42%	10.9	58%	57%	1.4	0.9
<b>Agency F</b>	21.5	84%	4.0	16%	25%	21.3	96%	0.9	4%	22%	42.7	90%	4.8	10%	47%	1.2	0.7
<b>Agency G</b>	17.9	56%	14.3	44%	26%	8.2	100%	0.0	0%	12%	26.1	65%	14.3	35%	37%	2.7	0.8
<b>OVERALL</b>	<b>201.0</b>	<b>59%</b>	<b>139.6</b>	<b>41%</b>	<b>26%</b>	<b>228.8</b>	<b>81%</b>	<b>55.4</b>	<b>19%</b>	<b>20%</b>	<b>429.8</b>	<b>69%</b>	<b>195.0</b>	<b>31%</b>	<b>47%</b>	<b>2.8</b>	<b>1.2</b>

Notes:

1. In-House and Consultant costs are expressed as percentages of total agency Design, CM (Construction Management), and PD (Project Delivery) costs.
2. TCC = Total Construction Cost
3. Design, CM, and PD costs are expressed as percentages of TCC and are unweighted, arithmetic averages of projects by agency.



## G. SMALLER PROJECT ANALYSIS

In 2009, the Project Team decided to differentiate the projects based on the full set of projects and a subset of “smaller cost projects”. It was hypothesized that projects with smaller total construction cost (TCC) will have a higher project delivery percentage due to costs associated with project delivery which are independent of the size of project. These project delivery costs include:

- regulatory requirements (such as CEQA)
- public involvement and outreach
- right of way acquisition
- project alternatives and scope development
- utility agreements and relocations
- bidding costs and procurement of public contracts

In Update 2009, it was decided that the “smaller projects” cutoff limit would be the smallest 80 percent of projects ranked by the TCC for each category of projects. For example, if there were 100 street projects, the 80 least expensive TCC street projects would be included in the smaller projects cutoff. The hypothesis was confirmed, and it was found that the smaller projects typically have about a 3 to 5 percent higher project delivery percentage of TCC than the full set of projects.

In Update 2014, the Project Team reconsidered the smaller project cutoff limit, especially since the actual project delivery cost for “small projects” was felt

to be much greater than that of the 80th percentile subset of projects. Therefore, an analysis was performed to evaluate the project delivery percentage for the projects in the database based on various TCC cost ranges.

**Table 3-9** through **Table 3-12** show the project delivery percentages for a range of construction costs by project type. Since the Water/Wastewater Treatment Plant category is new for Update 2018, the Project Team decided to not include cost ranges for this category until more projects are reported. In each project type category, the projects were arranged within four to five cost ranges. More than five cost ranges were not developed because more cost ranges lead to a fewer number of projects in each category, allowing the project delivery percentage to be more easily influenced by projects with extreme (either high or low) project delivery percentages. The cost ranges for each project type were developed in Update to distribute the projects evenly amongst the cost ranges. The cost ranges in subsequent updates have been the same as the cost ranges in Update 2014 to allow for comparison between *Study* update years.

In discussing the results presented in the tables below, the Project Team felt that the project delivery percentages shown are more reflective of the actual project delivery costs for small projects and are a useful tool for determining the expected project delivery costs of smaller projects.

**Table 3-9**  
**Municipal Facilities (2013-2017)**  
**Project Delivery Percentage based on Cost Ranges of TCC**

Dollar Ranges of Projects based on TCC		Number of Projects	AVERAGE of projects between Cost X and Cost Y, % TCC		
\$X	\$Y		Design %	Const Mang %	Project Delivery %
100,000	800,000	12	31%	16%	46%
800,000	3,000,000	21	30%	30%	59%
3,000,000	10,000,000	12	21%	19%	40%
10,000,000	70,000,000	9	18%	14%	32%

**Table 3-10**  
**Streets (2013-2017) Project Delivery Percentage based on Cost Ranges of TCC**

Dollar Ranges of Projects based on TCC		Number of Projects	AVERAGE of projects between Cost X and Cost Y, % TCC		
\$X	\$Y		Design %	Const Mang %	Project Delivery %
100,000	300,000	37	43%	22%	65%
300,000	600,000	43	34%	21%	55%
600,000	1,300,000	35	27%	14%	41%
1,300,000	2,400,000	25	25%	21%	46%
2,400,000	70,000,000	40	21%	17%	38%

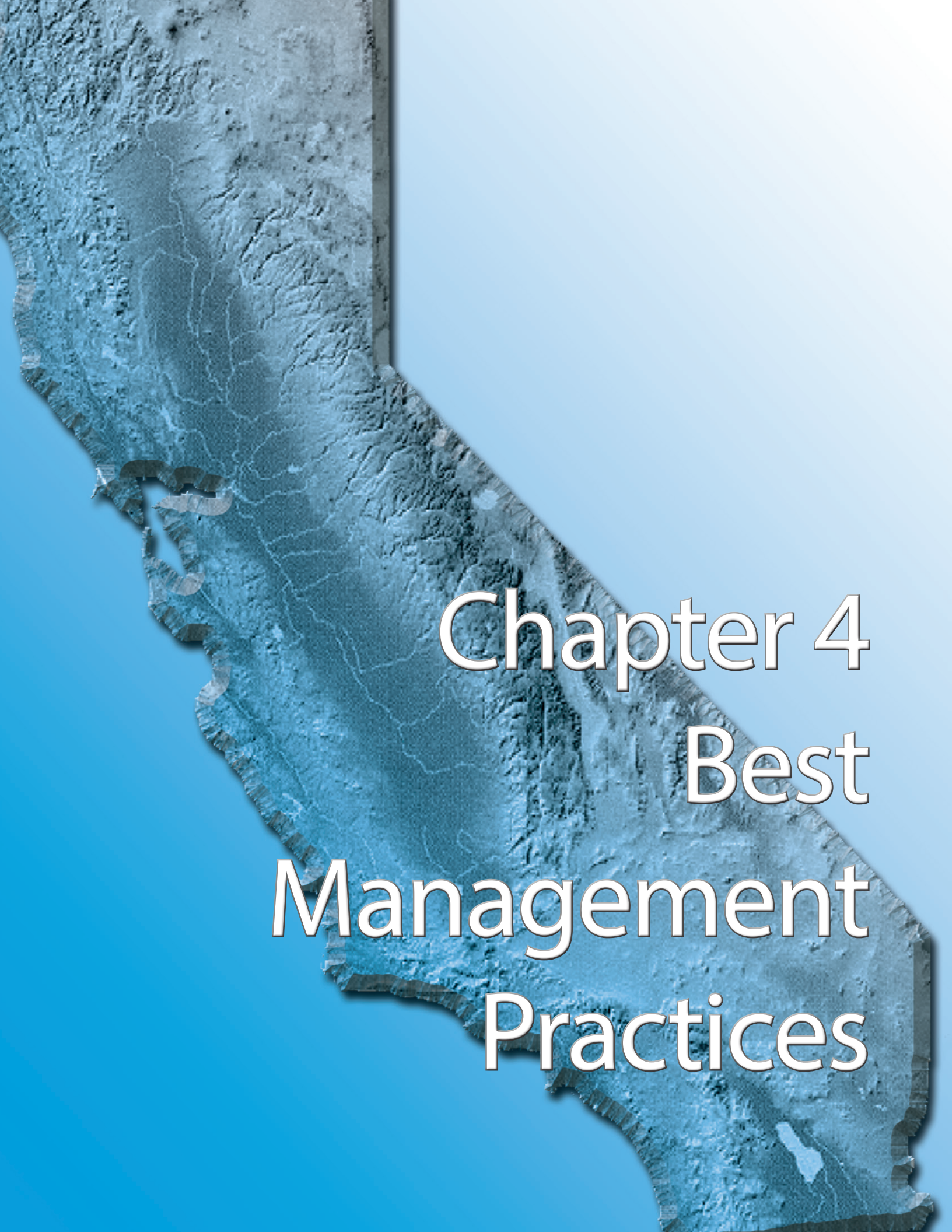
**Table 3-11**  
**Pipes (2013-2017) Project Delivery Percentage based on Cost Ranges of TCC**

Dollar Ranges of Projects based on TCC		Number of Projects	AVERAGE of projects between Cost X and Cost Y, % TCC		
\$X	\$Y		Design %	Const Mang %	Project Delivery %
100,000	300,000	19	35%	26%	61%
300,000	600,000	42	25%	24%	48%
600,000	1,300,000	75	26%	22%	48%
1,300,000	2,400,000	67	24%	22%	46%
2,400,000	17,000,000	71	17%	16%	33%

**Table 3-12**  
**Parks (2013-2017) Project Delivery Percentage based on Cost Ranges of TCC**

Dollar Ranges of Projects based on TCC		Number of Projects	AVERAGE of projects between Cost X and Cost Y, % TCC		
\$X	\$Y		Design %	Const Mang %	Project Delivery %
100,000	350,000	6	38%	24%	62%
350,000	500,000	5	45%	32%	78%
500,000	1,000,000	14	31%	23%	55%
1,000,000	27,000,000	18	18%	14%	32%

Page Intentionally Left Blank



# Chapter 4

## Best Management Practices



# CHAPTER 4 Best Management Practices

At the onset of this *Study* in 2002, the agencies examined over 100 practices used in project delivery. Included in this *Study* were a number of practices that the participants did not commonly use at the time, but believed could add value if ultimately implemented as Best Management Practices (BMPs). Each year the agencies look at changes in the industry and reflect on relevant experiences in order to identify new BMPs. Existing BMPs, in some cases, are reworked by the agencies to address specific challenges encountered during implementation. As in the past, agency implementation of these selected practices continues to be tracked during the *Study*.

A BMP is usually developed to address a specific issue, however, its implementation may affect other elements of project delivery. A BMP that reduces project schedule, for example, may also favorably impact both communication and project costs. While it is not possible to discreetly quantify all the benefits of a given BMP, the participating agencies developed an approach to identify the major benefits associated with each BMP. This was accomplished in Update 2010 *Study* by assigning a Perceived Value to each BMP. The Agencies continue to identify the perceived value on all new BMPs. The participating agencies judge that each

of the BMPs favorably impact one of the following categories:



- Cost



- Schedule



- Quality



- Communication



- Environment



- Customer Service

To identify the predominant **Perceived Values** associated with each new BMP, the participating agencies vote on which *Perceived Values* are most applicable for their Agency. The responses are then tabulated. A *Perceived Value* receiving three or more votes relative to a BMP is considered to be of significance. If a BMP is not shown to have *Perceived Value* in a certain category, it indicates that the *Perceived Value* received two or less votes relative to a BMP; it does not mean that a BMP has no benefit to that *Perceived Value* category. The majority of the BMPs are assigned a *Perceived Value* of either “cost” or “schedule”, followed by “quality”. This indicates that majority of the agencies found these “*Perceived Values*” as most applicable to the adopted BMPs.

## A. PROGRESS ON BEST MANAGEMENT PRACTICE IMPLEMENTATION

BMPs have been included since the *Study* 2002 report. For Update 2017, the agencies continued to exchange ideas regarding strategies for implementing various BMPs by using networking opportunities during the face-to-face meetings. Many Agencies are pursuing the full implementation of the BMPs but have competing priorities such as hiring challenges as a result of prior years’ staffing reductions, furloughs, and the management’s increased involvement in resolving budgetary issues. Constraints continue to limit the full implementation of BMPs for some agencies. In those instances, a partially implemented BMP is considered complete by that agency and is noted in **Table 4-1**. Agencies continue to focus their efforts on adherence to BMPs that have been implemented and judged to provide efficiencies in project delivery

processes for participating departments. The key for the following **Table 4-1** is as follows:

### Cities:



- LA: Los Angeles;
- LB: Long Beach  
(Port: Port of Long Beach);
- OK: Oakland;
- SC: Sacramento  
(DT: Dept. of Transportation,  
DU: Dept. of Utilities),
- SD: San Diego,
- SF: San Francisco,
- SJ: San José







### Level of Implementation:

- ✓ :Implemented,
- PI: Partially implemented,
- NI: No plans to implement at this time,
- TBD: To be determined





The “Ref” column includes a reference number for the item and also includes the year the BMP was added to the *Study*. If no year is referenced, the item was included in the original 2002 Report.








**Table 4-1  
Implementation of BMPs**







Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes
Planning	1.a.	<p><b>BMP:</b> Define capital projects well with respect to scope and budget including community and client approval at the end of the planning phase.</p> <p><b>Description:</b> Changes in project scope or budget increase both total construction cost and the cost of project delivery. The later these changes occur in the life of the project, the greater the increase. Reaching and documenting consensus with the community and the client will reduce changes after the project delivery process begins.</p> <p><b>Perceived Value:</b> </p>	<p>LA, LB, OK, SC DT, SD, SJ</p> <p>SC DU: Community involved after project is better-defined, typically at 30% design.</p> <p>SF: Define the scope and budget at the end of planning phase per the BMP, but often engage the community early in the project, i.e. in the planning phase.</p>
	1.b.	<p><b>BMP:</b> Complete Feasibility Studies on projects prior to defining budget and scope.</p> <p><b>Description:</b> Feasibility studies should be completed early in the process so that issues are identified and either resolved or accommodated within the final definition of scope, budget, and project delivery schedule. This will also reduce overall project delivery costs. Early feasibility studies are particularly important on complex projects and projects with a construction budget greater than \$5 million.</p> <p><b>Perceived Value:</b> </p>	<p>LA, OK, SC DT</p> <p>LB, SD, SJ: When applicable.</p> <p>SC DU: Only on complex projects that require a Feasibility <i>Study</i>.</p> <p>SF: Provide pre-planning feasibility studies on larger, more complex or politically sensitive projects. Developed a 1-Page “Project Development MOU” that allows the Client to fund “seed money” while the project is being scoped.</p>







Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Planning	1.d.	<p><b>BMP:</b> Utilize a Board/Council project prioritization system.</p> <p><b>Description:</b> Departments responsible for project delivery have limited resources. A system will ensure that resources are directed to meet the community's most critical needs.</p> <p><b>Perceived Value:</b>  </p>	✓	<p>OK, SC DT, SD</p> <p>SF: 10-Year Capital plan developed City-wide and priorities set by City-wide committee of major department heads. Individual departments also prioritize projects per their department when they are Bond funded projects.</p> <p>LA: Council establishes oversight committees which develop and manage a priority system and/or process.</p>
			PI	<p>LB: Only on our Major and Secondary Street Program, Utility Undergrounding Program, and projects funded by Tidelands and Measure A funding.</p>
			NI	<p>SJ</p>
			TBD	<p>SC DU: Getting closer to approved Asset Mgt system that would facilitate this BMP, but project drivers vary (permit requirements, projects in other departments, etc).</p>
	1.e.	<p><b>BMP:</b> Resource load all CIP projects for design and construction.</p> <p><b>Description:</b> The resources required to deliver projects according to the master CIP schedule mandated by the Board/Council should become part of the CIP. This will facilitate defining performance measures and ensure that there is a common understanding of the resources required to deliver the CIP.</p> <p><b>Perceived Value:</b>  </p>	✓	<p>LA, OK, SC DT, SJ</p> <p>SC DU: Estimate drafting only.</p> <p>SD: Doesn't include human resource loading.</p>
			NI	<p>LB</p>
TBD			<p>SF: BDC in the process of resource loading projects for long term projections, i.e. 1-3 years; already have short term forecasting in place.</p>	
1.f.	<p><b>BMP:</b> Include a Master Schedule in the CIP that identifies start and finish dates for projects.</p> <p><b>Description:</b> A master schedule can be used to define resource needs and performance measures.</p> <p><b>Perceived Value:</b>  </p>	✓	<p>LA, OK, SC DT, SD, SF, SJ</p> <p>SC DU: Completion date only estimated, not determined by scheduling analysis.</p> <p>LB: In transition - Project tracking software in development, legacy software defunct.</p>	






Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Planning	1.g 2007	<p><b>BMP:</b> Make an early determination on which environmental document is required and incorporate into the schedule.</p> <p><b>Description:</b> Completing the environmental assessment and permitting process influences project schedules and costs. Establish a checklist of potential environmental and permit requirements and examine each project scope against the list early in the planning process.</p> <p><b>Perceived Value:</b> </p>	✓	<p>LA, LB, OK, SC DU, SC DT, SD, SJ</p> <p>SF: House regulatory affairs staff of 3 work full time and interface with the planning department on projects and whether or not CEQA approvals are required. Document to be submitted to Planning is EEA (Early Evaluation Application) if necessary. Standard for “When a project is not a CEQA project” in place.</p>
	Design	1.i.	<p><b>BMP:</b> Show projects on a Geographical Information System.</p> <p><b>Description:</b> Entering and tracking planned projects into a GIS which is available to all private and public sector project planners will reduce the potential for conflicts and re-work.</p> <p><b>Perceived Value:</b> </p>	✓
2.b.		<p><b>BMP:</b> Provide a detailed clear, precise scope, schedule, and budget to designers prior to design start.</p> <p><b>Description:</b> Reliability, maintenance, operational requirements, and standard materials and equipment should be clearly defined in advance, approved by the user/client, and included in the design professional’s contract when a consultant is used.</p> <p><b>Perceived Value:</b> </p>	✓	<p>LA, LB, OK, SC DT, SD, SJ</p> <p>SC DU: General scope only for simple projects.</p> <p>SF: Scope provided for simpler straightforward projects, and in some cases the pre-planning phase used to develop the scope more accurately for the client. Some clients provide a PMP (Project Management Plan) before the start of the project.</p>
2.f.		<p><b>BMP:</b> Define requirements for reliability, maintenance, and operation prior to design initiation.</p> <p><b>Description:</b> Reliability, maintenance, operational requirements, and standard materials and equipment should be clearly defined in advance, approved by the user/client, and included in the design professional’s contract when a consultant is used.</p> <p><b>Perceived Value:</b> </p>	✓	<p>LA, LB, OK, SC DT, SD, SF, SJ</p> <p>SD: Some Asset types only.</p>
			NI	SC DU











Cat.	Ref. *	BMP, Description, and Perceived Value	Implementation and Notes	
Design	2.i.	<p><b>BMP:</b> Adapt successful designs to project sites, whenever possible (e.g. fire stations, gymnasiums, etc).</p> <p><b>Description:</b> Successful designs of fire stations, police facilities, maintenance facilities, pump stations, and many other projects should be re-used when possible. Site adaptations of successful designs may reduce design costs by half.</p> <p><b>Perceived Value:</b>  </p>	✓	LA, LB, OK, SC DU, SC DT, SD, SJ  SF: Accomplished through our detail library, specifications, etc. Provide Lessons Learned sessions on projects with the goal of learning from the project and refining the project delivery approach.
			NI	SD: Due to public input.
	2.k. 2003	<p><b>BMP:</b> Train in-house staff to use Green Building Standards.</p> <p><b>Descriptions:</b> Communities have a stake in the environment as well as in the cost of operating and maintaining public facilities. Utilizing “Green Building Standards” allows facilities to be built and operated with renewable resources and other environmentally sound practices.</p> <p><b>Perceived Value:</b> </p>	✓	LA, LB, OK, SD, SJ, SF
			NI	SC DT, SC DU  SF: All projects are required to be LEED Gold. Have an internal “Green Building Committee” and also work very closely with the Department of the Environment.  LB: All new projects required to be LEED Silver. Envision certification optional.
2.1. 2004	<p><b>BMP:</b> Limit Scope Changes to early stages of design.</p> <p><b>Description:</b> It is well known within the industry that the later a change occurs in the construction process, the more costly the change is.</p> <p><b>Perceived Value:</b>  </p>	✓	LA, LB, OK, SC DT, SF, SJ  SD, SC DU: Control and minimize, but difficult to eliminate, since clients and engineers come up with new/better solutions in addition to the community and politicians influence.	
2.m. 2004	<p><b>BMP:</b> Require scope changes during design to be accompanied by budget and schedule approvals.</p> <p><b>Description:</b> All scope changes after the initial definition within the design agreement will affect project delivery cost and therefore should be documented. Documentation should include an understanding and acceptance/approval by all stakeholders of the cost and time implications of any changes.</p> <p><b>Perceived Value:</b>  </p>	✓	LA, LB, OK, SC DT, SD, SJ  SF: Always the goal, however, not always manageable with some clients. In depth due diligence and good project planning helps this to be more successful.	
		NI	SC DU	







Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Design	2.n. 2006	<p><b>BMP:</b> Implement a rotating Request for Quote process for contracting small projects to streamline the bidding and award process during construction. (Include criteria for exemptions from formal Council approval).</p> <p><b>Description:</b> Smaller projects cost more (as a percentage of construction cost) to deliver. One way of reducing the cost of project delivery on small projects is to shorten the bid and award process by setting a threshold amount under which the delivery team may solicit and receive quotes from qualified contractors and award contracts without getting Board/Council prior approval.</p> <p><b>Perceived Value:</b>  </p>	✓	<p>LB, OK, SD</p> <p>SF: As-needed job order contracting (JOC) and As-Needed Construction Contracts-Master Agreements for projects/work order packages under \$600K; Utilization of Bureau of Building &amp; Repair (BBR) for projects under \$600K and are developing an in-house Design-Build process between A/E team and BBR.</p>
			PI	<p>SJ: Regularly procures a number of on-call contractors for various small projects. Minor contracts (under \$100,000), may be awarded without Council approval.</p> <p>LA: In progress for Sidewalk Repair Program. Sidewalk Repair Program has a new contract in place with pre-negotiated rates. BMP Implemented.</p>
			NI	<p>SC DT, SC DU: Maintains on-call consultant list for various engineering, traffic, landscape, architecture, and geotechnical services.</p>
	2.o 2007	<p><b>BMP:</b> Establish criteria for obtaining independent cost estimates which take in consideration both project characteristics and volatility of the market.</p> <p><b>Description:</b> Having to re-design and re-bid a project on which bids come in over budget can significantly impact project delivery cost. Accurate estimates at the end of each design phase, performed by unbiased, independent, qualified professionals with an understanding of local market conditions will reduce the potential for receiving unexpected bids.</p> <p><b>Perceived Value:</b>  </p>	✓	SF: Establishing estimating database
			PI	<p>LA, SD</p> <p>LB: On-call contracts established for check estimating services as needed.</p> <p>SJ: No criteria established – done on a case-by-case basis.</p>
			NI	SC DU
			TBD	<p>OK</p> <p>SC DT: Cost estimates are developed by project managers rather than independent estimators. PMs have access to a library of bid results from which to determine costs based on similar sites/scopes of work. Additional consideration is given to bidding climate and time of year.</p>
	2.p 2008	<p><b>BMP:</b> Establish criteria for responsible charge design approval such that it occurs at the lowest appropriate organizational level in order to expedite design completion.</p> <p><b>Description:</b> Many times responsible charge design approval is set at a very high level. This can sometimes result in only one person with limited time who can approve all sheets in a design package. This leads to a bottleneck situation.</p> <p><b>Perceived Value:</b>  </p>	✓	<p>LA, LB, SC DT, SC DU, SD, SJ</p> <p>SF: Project cost estimate at every phase. Goal is also to conduct all Value Engineering no later than the Design Development Phase.</p>




Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Design	2.q 2010	<p><b>BMP:</b> Receive bids electronically.</p> <p><b>Description:</b> Electronic bidding programs have increased over the last several years. Receiving bids electronically provides a centralized location to store all bid related documents for public access along with ability to increase bidder participation.</p> <p><b>Perceived Value:</b>  </p>	✓	SD
			PI	OK LB: Slowly transitioning to e-Bid; Port: All bids being received electronically.
			NI	SC DT: Consultant proposals are received electronically, currently working on system for construction bid submittals.  The City has delayed implementation of this process. Found this to be very difficult to meet the needs for the various City departments and funding sources.,  SF: In process and soon to be launched with new F&P financial system.
			TBD	SC DU, SJ LA: BOE is starting to train staff on the new system.
	2.r. 2011	<p><b>BMP:</b> Use of electronic signatures to do direct conversion from CAD to PDF.</p> <p><b>Description:</b> Currently wet signatures on all pages is standard practice. This causes scanned files to be very large electronic files. Use of electronic signatures in all but the cover page will reduce file size and allow for easier distribution.</p> <p><b>Perceived Value:</b>   </p>	✓	SC DT, SC DU, SD, LA
			NI	OK SF: In process and already being used by some divisions.
			TBD	LB, SJ
	2.s. 2011	<p><b>BMP:</b> Have awarding authority to approve plans, advertisement and award of contract in one board/council action.</p> <p><b>Description:</b> Combine approval of plans, advertisement and award of contract by the awarding authority into a single action.</p> <p><b>Perceived Value:</b> </p>	✓	LB, OK, SC DU  SC DT: City Council approval is not required to advertise.  SD: Part of the CIP streamlining, city council approval is obtained once a year on a list of projects to be awarded as a part of the annual budget hearing.  SF: Depends on the city agency. Most agencies have commissions, SF Public Works has sole award authority without a council or board.  SJ: The Director of Public Works approves all plans and advertisements; also generally awards contracts \$1M or less.
			NI	LA









Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Design	2.t. 2011	<p><b>BMP:</b> Lessen time period between design completion and issuance of notice to proceed. Examples include items such as:</p> <ul style="list-style-type: none"> <li>- Pre-qualification of contractors</li> <li>- Good Faith Effort submitted on-line</li> <li>- Submittal incentives (i.e., award and material submittals allowed 30 day period; every day early is added to construction contract duration)</li> <li>- Have ability to issue contracts within your department</li> <li>- Electronic proposal documents provided 48 hours after bid opening; hard copy provided at bid time</li> <li>- Contractor's self-certification</li> </ul> <p><b>Description:</b> Implementation of new practices such as using an electronic process or pre-qualification in an effort to reduce the overall timeframe from design completion to notice to proceed.</p> <p style="text-align: center;">  </p> <p><b>Perceived Value:</b></p>	✓	LA SD: Has an established contractor pre-qualification program
		PI	OK, SC DT, SJ	
		TBD	SC DU LB: Contractor pre-qualification program SF: For some CMGC contracts, contractors prequalified and given incentives for early construction. Also adopted some "best value" language in Chapter 6 so it's not all based on lowest bid.	
Quality Assurance / Quality Control	3.I.a.	<p><b>BMP:</b> Develop and use a standardized Project Delivery Manual.</p> <p><b>Description:</b> Standardized procedures streamline project design, bidding, and construction processes. Standardized design management procedures will reduce scope creep and delays in construction document preparation. During construction, standard procedures will reduce response times on RFIs, and add overall clarity and efficiency to the construction management process. Having a standard manual will also reduce the time necessary for project documentation training.</p> <p style="text-align: center;">  </p> <p><b>Perceived Value:</b></p>	✓	LA, SC DT, SD SC DU, OK: Needs updating. LB: PM and CM Manual updated 2018. SF: Yes, and continually reviewing and updated. Hired a "Technical Manager" who oversees QC/QA processes along with the "Technical Committee"
	PI	SJ		
	3.II.b.	<p><b>BMP:</b> Perform a formal Value Engineering <i>Study</i> for projects larger than \$1 million.</p> <p><b>Description:</b> Value Engineering identifies life cycle costs of design elements included in a project and certain alternatives. While the cost of the value engineering process may initially add costs to project delivery, overall project costs will be reduced.</p> <p style="text-align: center;">  </p> <p><b>Perceived Value:</b></p>	✓	LA, LB, SC DT, SC DU, SD SF: As needed.
NI	OK, SJ			





Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Quality Assurance / Quality Control	3.III.a.	<p><b>BMP:</b> Use a formal Quality Management System.</p> <p><b>Description:</b> Quality management should include all activities from the preparation of design documents through the closeout of construction. (Constructability reviews, independent cost estimates, classification and auditing of change orders, etc.) The implementation and tracking of quality control should be formalized on a checklist to ensure application.</p> <p><b>Perceived Value:</b>  </p>	✓	OK, SC DT, SF LB: Staffing cuts have delayed completion. SD: Some asset types only.
			PI	LA, SJ: When applicable
			NI	SC DU
	3.III.b	<p><b>BMP:</b> Perform and use post-project reviews to identify lessons learned.</p> <p><b>Description:</b> Project Managers should develop formal post project reviews and identify lessons learned. These documents should be made available to PM's on projects of a similar scope and nature. This BMP will make future project management and delivery more efficient and cost effective.</p> <p><b>Perceived Value:</b> </p>	✓	LA, OK, SC DT, SD, SJ SC DU: For selected projects in one-on-one meetings with design and construction staff. Also includes feedback from client. Intended to promote candid discussion. SF: Have a Lessons Learned process and are tracking all projects that have Lessons Learned.
			PI	LB: Is being done only on projects that exceed 10% contingency or go into liquidated damages; Port: Instituting as part of QA/QC process.
	3.III.k 2007	<p><b>BMP:</b> Establish a Utility Coordinating Committee with members from public and private entities.</p> <p><b>Description:</b> Regular meetings of a committee will establish a forum for ideas to improve the utility relocation process and thus improve project progress. Meetings will also be an opportunity for problem projects (relocations) to be discussed.</p> <p><b>Perceived Value:</b>    </p>	✓	LA, LB, OK, SC DT, SC DU, SD, SF, SJ
	3.III.l 2007	<p><b>BMP:</b> Designate a responsible person for and establish a process of notifications and milestones for utility relocations.</p> <p><b>Description:</b> Identifying a utility relocation specialist within the project delivery team who is familiar with the procedures and contacts within the public and private utility entities will improve communication and problem solving during design and construction.</p> <p><b>Perceived Value:</b>   </p>	✓	LA, SC DT, SC DU, SD, SF SJ: Various Divisions/Sections have a utility coordinator and processes as needed.
			PI	OK
NI			LB: PM remains responsible for all utility work on their projects.	





Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Construction Management	3.III.m 2008	<p><b>BMP:</b> Maintain and regularly update electronic standard contract specifications and related documents as well as technical/special provision.</p> <p><b>Description:</b> Standard contract specifications and technical special provisions need to be regularly maintained and updated in order to reduce the amount of time required to create contract bid documents. If a City implements new requirements, the standards should be modified for every project one time instead of each manager having to modify these documents of every project.</p> <p><b>Perceived Value:</b>   </p>	✓	LA, LB, OK, SC DT, SC DU, SF, SD
	4.I.a.	<p><b>BMP:</b> Delegate authority to the City Engineer/Public Works Director or other departments to approve change orders to the contingency amount.</p> <p><b>Description:</b> Change order work should be authorized as soon as is practically possible in order to avoid potential delays to critical work. Scheduling a significant change order for review and authorization by the Board may delay project progress, even though it may be within the contingency amount allowed in the project budget. Authorization of the City Engineer/Public Works Director to approve changes within the contingency budgeted for changes will ensure that critical changes are acted on promptly and that delays are minimized.</p> <p><b>Perceived Value:</b>  </p>	✓	<p>LB, OK, SC DU</p> <p>LA, SJ: Individual CO &lt; \$100,000.</p> <p>SD: Individual CO &lt; \$500,000.</p> <p>SF: Reviews start at Bureau level but also need to be approved by Deputy Director &amp; Director of Public Works.</p>
	4.I.m.	<p><b>BMP:</b> Classify types of change orders.</p> <p><b>Description:</b> Classification of change orders into categories such as changed conditions, unforeseen conditions, owner requests, or design changes for owner use improves understanding of the project and lessons learned from the data may improve project delivery on similar projects.</p> <p><b>Perceived Value:</b> </p>	✓	LB, OK, SC DT, SC DU, SD, SF, SJ, LA







Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Construction Management	4.II.a.	<p><b>BMP:</b> Include a formal Dispute Resolution Procedure in all contract agreements.</p> <p><b>Description:</b> Construction is acknowledged as a dispute prone industry. As such, it makes sense to provide options in the contract documents to avoid litigation and to expedite disputes resolution using alternatives to litigation.</p> <p><b>Perceived Value:</b> </p>	✓	LA, OK, SC DT, SC DU, SD, SF SJ: For projects > \$10 M
			NI	LB: City Attorney will not allow this language in project specifications.
	4.III.a.	<p><b>BMP:</b> Use a team building process for projects greater than \$5 million.</p> <p><b>Description:</b> Partnering is a team-building process that has a proven record of improving working relationships and production, and reducing claims and disputes on construction projects. It is one of several team-building processes that should be used in the interest of reducing conflict and facilitating project delivery.</p> <p><b>Perceived Value:</b> </p>	✓	OK, SC DT SF: The Mayor requires all city projects over \$100K to undergo partnering, although threshold being reviewed. Also tracking partnering through EPM. LA, LB, SC DU, SD: As-needed. SJ: For projects > \$10M.
	4.IV.a.	<p><b>BMP:</b> Involve the Construction Management Team prior to completion of design.</p> <p><b>Description:</b> : Experienced contractors and construction managers should be included in the design process to make designs more constructible and lower cost. Construction managers and contractors are frequently more experienced about the products and/or equipment as well as construction methods that are readily available. Their contributions to selections and decisions during the design process will facilitate construction procurement, means and methods.</p> <p><b>Perceived Value:</b> </p>	✓	LA, LB, OK, SC DT, SC DU, SJ SD: Always request a constructability review service from the CM team on all projects. SF: Request the internal CM team review all projects for constructability no later than 50% CD. Infrastructure projects are reviewed by CM at 95%. All projects over \$5M required to have outside constructability reviews in addition.







Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Construction Management	4.IV.b 2010	<p><b>BMP:</b> Implement Electronic Contract Payment Process.</p> <p><b>Description:</b> Many approvals are required to process contract payments. Using electronic procedures provides an avenue to expedite the necessary approvals.</p> <p><b>Perceived Value:</b>  </p>	✓	<p>SF: We are doing payments electronically via our first generation system which was demonstrated back in San Diego around 2008. We pay within the Mayor's directive of 10 to 15 days. And direct deposit is already available to the contractors through BofA.</p> <p>SJ: Upon request, City will pay by wire transfer.</p> <p>SD: City will pay by wire transfer.</p>
			PI	LB: Currently done for some street related projects.
			NI	SC DT
			TBD	LA, OK, SC DU
	4.IV.c 2010	<p><b>BMP:</b> Agency should file As-built drawings within 6 months of project completion.</p> <p><b>Description:</b> One of the last tasks for a project is the updating and filing of As-built drawings. Many times, this task is put off for other pressing matters. This BMP establishes a 6 month deadline.</p> <p><b>Perceived Value:</b>  </p>	✓	<p>OK, SC DT, SC DU</p> <p>SF: Process currently under review</p> <p>LA: Procedures are established in the Bureau of Engineering Project Delivery Manual.</p>
			PI	<p>LB: Being done on a go forward basis. Past projects still backlogged.</p> <p>SD: Has been implemented on sewer and water pipeline projects.</p> <p>SJ: Generally yes, however, it depends on post-construction circumstances.</p>
	4.V.a. 2003	<p><b>BMP:</b> Delegate authority below Council to make contract awards under \$1 million.</p> <p><b>Description:</b> The time and costs of scheduling and presenting a Council or Board item can be saved and project starts can be expedited if awards on projects with budgets under \$1 million can be awarded administratively.</p> <p><b>Perceived Value:</b>  </p>	✓	<p>LA, SF, SJ</p> <p>LB: Board must approve all contracts over \$100,000.</p> <p>SD: Up to \$30M.</p>
			NI	OK, SC DT, SC DU







Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Construction Management	4.V.b 2003	<p><b>BMP:</b> Establish a pre-qualification process for contractors on large, complex projects.</p> <p><b>Description:</b> Prequalification helps screen contractors for prior performance on similar projects, safety and financial capability thus reducing risk and, ultimately, project delivery cost.</p> <p><b>Perceived Value:</b> </p>	✓	LA, LB, OK, SC DU, SD, SF, SJ
			NI	SC DT
	4.V.c 2003	<p><b>BMP:</b> Make bid documents available online.</p> <p><b>Description:</b> Making bid documents available on line will reduce Agency printing costs. It may also increase bidder participation by making documents easily available to a larger pool of potential bidders and subcontractors.</p> <p><b>Perceived Value:</b> </p>	✓	LA, LB, OK, SC DT, SJ, SD SF: Documents available on line and on CD.
			PI	SC DU
Project Management	5.I.f.	<p><b>BMP:</b> Assign a client representative to every project.</p> <p><b>Description:</b> Client (end user) representation during the life of the project will expedite decisions on submittals, substitutions, and changes. Their involvement will also help determine intent and streamline the commissioning and occupancy process.</p> <p><b>Perceived Value:</b> </p>	✓	LA, LB, OK, SC DT, SC DU, SD, SF, SJ
	5.I.j 2003	<p><b>BMP:</b> Create in-house project management team for small projects.</p> <p><b>Description:</b> It has been documented that the cost of project delivery of small projects is a higher percentage of the construction cost. Establishing a project management team that specializes in smaller projects may lead to economies such as grouping similar projects during permitting and bidding thus reducing project delivery cost.</p> <p><b>Perceived Value:</b> </p>	✓	LB, OK, SF, SJ
			NI	SC DT, SD LA: Wastewater Programs has a dedicated team for PM/CM of small projects. SC DU: Not enough PMs to justify this. Don't want to restrict staff to small, less-rewarding projects.



Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Project Management	5.I.k 2004	<b>BMP:</b> Institutionalize Project Manager performance and accountability. <b>Description:</b> Recognize that professional project management requires specific education, training, and experience. Provide for PMI, CCM, or other formal training and certification and establish performance measures for project delivery personnel.  <b>Perceived Value:</b>	✓	LA, LB, OK, SC DT, SD, SF, SJ
			PI	SC DU: There is interest but no definite plan. Implementation, although partially complete, is taken as far as it can go with our Agency.
	5.II.a	<b>BMP:</b> Provide formal training for Project Managers on a regular basis. <b>Description:</b> Project Managers come to projects with varying degrees of skill and familiarity with Agency procedures. Orientation and training will improve their ability to deliver the project on the intended schedule. It is also important that updated training is available at least on an annual basis.  <b>Perceived Value:</b>	✓	LA, LB, SC DT, SF, OK, SDSF: In place but needs review.
			NI	SC DU
			TBD	SJ: As a formal program is being revised/ updated, ad-hoc trainings are being provided as necessary.
	5.II.d 2006	<b>BMP:</b> Implement verification procedures to ensure that PM training includes Agency policies, procedures, forms, and standards of practice (scheduling, budgeting, claims avoidance, risk analysis, etc). <b>Description:</b> The success of a project is influenced significantly by the education and skills of the project manager. Agencies should verify that PM's know and use the tools available within an Agency and that they are current with industry practices.  <b>Perceived Value:</b>	✓	LA, OK, SC DT, SD
			PI	SF: Have training courses for claims avoidance. Needs review and more robust training.
			NI	SC DU
			TBD	LB, SJ
	5.III.a.	<b>BMP:</b> Adopt and use a Project Control System on all projects. <b>Description:</b> A web-based project control system will improve collaboration and documentation during the design and construction process. Questions, answers, proposals, and decisions can be expedited using a collaborative system.  <b>Perceived Value:</b>	✓	LA, LB, OK, SC DT, SD, SF, SJ
			NI	SC DU

Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Project Management	5.III.e 2006	<p><b>BMP:</b> Implement a financial system that tracks expenditures by category to monitor project hard and soft costs during project delivery.</p> <p><b>Description:</b> It is recommended that a system that identifies actual expenditures against planned budgets be made available to project managers to be used as a performance measurement tool.</p> <p><b>Perceived Value:</b> </p>	✓	<p>LA, LB, OK, SC DT, SD, SJ</p> <p>SC DU: Intend to utilize SC DT's software if it proves to function well with our PM Database.</p> <p>SF: New financial system in place but still working out the kinks.</p>
	5.III.f 2006	<p><b>BMP:</b> Implement a Work Breakdown Structure (WBS) to measure progress on project deliverables.</p> <p><b>Description:</b> Getting accurate data on the cost of project delivery depends upon being able to capture and classify expenses to the phases of construction on each project. Ideally, costs would be identified by each of five project delivery phases and coded to particular milestones or deliverables.</p> <p><b>Perceived Value:</b>  </p>	✓	<p>LB, OK, SC DT, SD, SF: Recently updated</p>
			PI	LA
			NI	SC DU
			TBD	SJ
	5.III.g 2006	<p><b>BMP:</b> Monitor "earned value" versus budgeted and actual expenditures during project delivery.</p> <p><b>Description:</b> Soft costs "burn rate" should be proportionate to percent complete during the design and construction phases. Using a program which measures and relates soft cost expenses to earned values permits better tracking and control during project delivery.</p> <p><b>Perceived Value:</b> </p>	✓	LA, OK, SC DT, SF
			PI	SD
			NI	LB, SC DU, SJ
	5.III.h 2007	<p><b>BMP:</b> Include a fixed ROW acquisition milestone schedule and obtain commitments from participating City departments.</p> <p><b>Description:</b> Prolonged ROW acquisition can be avoided if all stakeholders agree on milestones to complete the acquisitions.</p> <p><b>Perceived Value:</b> </p>	✓	SC DT, SJ
			PI	<p>LA, LB</p> <p>SD: It is difficult to get the commitments side.</p>
		NI	OK, SC DU, SF	
5.III.i 2008	<p><b>BMP:</b> Implement an electronic progress payment/schedule of values system to improve efficiency.</p> <p><b>Description:</b> Reduction in the length of time and inefficiencies in processing of progress payments through the use of electronic means.</p> <p><b>Perceived Value:</b> </p>	✓	SC DT, SF	
		NI	<p>LA, SC DU, SJ, SD</p> <p>LB: Current accounting system cannot accommodate a fully electronic approval process; Port: Implementing software to this end.</p>	
		TBD	OK	

Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Project Management	5.III.j	<p><b>BMP:</b> Implement a schedule tracking system that monitors the actual percent complete against the percent of time elapsed for each identified phase of the approved project schedule.</p> <p><b>Description:</b> Establishing a system where a project's schedule is broken into its phases. Actual percent complete is then measured against time elapsed in each phase throughout the development of the project. This system becomes a tool for management by project managers and supervisors.</p> <p><b>Perceived Value:</b> </p>	✓	LA, OK, SC DT LB: City uses project tracking software.
			PI	SC DU, SD SF: Developed the Enterprise Project Management (EPM) which is used for project updates, financial and schedule tracking, and as a reporting tool. Project Leads are responsible for creating the schedules per client department MOUs, and tracking actual schedules to baselines.
			TBD	SJ
	5.III.k. 2014	<p><b>BMP:</b> Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient.</p> <p><b>Description:</b> The dashboard concept is based on the ability to drill down to multiple levels of data so the user can get the level of detail desired. The level of detail to be provided in each dashboard is at the discretion of each Agency. The external dashboard increases public awareness of the project delivery performance and increases agency accountability. The internal dashboard provides a platform to measure, monitor, evaluate, and report performance to assist in establishing clear business rules and improve internal communication.</p> <p><b>Perceived Value:</b> </p>	✓	LA, SD, SF
			PI	LB, OK, SC DT, SJ
			TBD	SC DU
	5.IV.a 2006	<p><b>BMP:</b> Bundle small projects whenever possible.</p> <p><b>Description:</b> Bundling small projects so that they are designed, bid, and constructed together will reduce project delivery cost proportionately.</p> <p><b>Perceived Value:</b> </p>	✓	LA, LB, OK, SC DT, SC DU, SD, SF, SJ
	5.IV.b 2007	<p><b>BMP:</b> Have a coordinator with expertise in the environmental process within the department delivering the engineering/capital project.</p> <p><b>Description:</b> Identifying an environmental specialist within the project delivery team who is familiar with procedures and contacts within the approving entities will reduce permit procurement time and costs.</p> <p><b>Perceived Value:</b> </p>	✓	LA, SD, SF SJ: Various Divisions/Sections have an environmental coordinator as needed.
			NI	LB, OK, SC DT, SC DU



Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Consultant Selection and Use	6.c.	<p><b>BMP:</b> Include a standard consultant contract in the RFQ/RFP with an indemnification clause.</p> <p><b>Description:</b> The negotiation of the design contract can be expedited if the consultant understands and agrees to the conditions of the contract at the time a proposal is submitted.</p> <p><b>Perceived Value:</b>  </p>	✓	LA, LB, OK, SC DT, SC DU, SF, SJ SD: Some asset types only.
	6.e.	<p><b>BMP:</b> Delegate authority to the Public Works Director/ City Engineer to approve consultant contracts under \$250,000 when a formal RFP selection process is used.</p> <p><b>Description:</b> Authorization for the Public Works Director/City Engineer to award consulting contracts ensures earlier start of design and construction management activities and will reduce consultant selection process costs.</p> <p><b>Perceived Value:</b> </p>	✓	SD, SF LA, OK, SC DT LB: City Manager retains authority up to \$100,000; Port: Authority up to \$200,000. SC DU: Threshold is \$100,000. SJ: City Manager has authority described.
	6.g.	<p><b>BMP:</b> Implement and use a consultant rating system that identifies quality of consultant performance.</p> <p><b>Description:</b> The performance of consultants should be tracked so that those who deliver quality services at reasonable costs can be adequately considered for future awards.</p> <p><b>Perceived Value:</b> </p>	✓	LA, OK, SD, SF, SJ SF: Have a contractor rating system but need to review and update the consultant rating system. LB: Used for on-call consulting services contracts; Port: Implementing process as a compliment to contractor rating system. SC DT SC DU: Track performance for those selected for “support services.”
	6.m 2006	<p><b>BMP:</b> Implement as-needed, rotating, or on-call contracts for design and construction management work that allow work to be authorized on a task order basis to expedite the delivery of smaller projects.</p> <p><b>Description:</b> Establishing an on-call list of qualified consultants with expertise in a variety of design disciplines will expedite the start of the design process.</p> <p><b>Perceived Value:</b>  </p>	✓	LA, LB, OK, SC DT, SC DU, SD, SF, SJ

Cat.	Ref.*	BMP, Description, and Perceived Value	Implementation and Notes	
Consultant Selection and Use	6.n 2013	<p><b>BMP:</b> Determine appropriate consultant costs for professional services agreements.</p> <p><b>Description:</b> Establish a documented agency methodology for analyzing acceptable consultant costs and billing rates for use in contract negotiations.</p> <p><b>Perceived Value:</b> </p>	PI	LA, OK, SF, SJ
			TBD	LB, SC DT, SC DU, SD
Sustainable Development	7.a. 2009	<p><b>BMP:</b> Identify the environmental benefits of the project at the time of award.</p> <p><b>Description:</b> Provide written, environmental benefits to the awarding authority on projects that use sustainable practices or aim to achieve LEED certification.</p> <p><b>Perceived Value:</b> </p>	✓	LA, LB, OK, SC DT, SJ
			PI	SD
			TBD	SC DU SF: For building projects, this is done at the start of planning for the application of LEED. All projects over 10,000 SF required to be LEED Gold.

## Notes:

- LA: Los Angeles; LB: Long Beach (Port: Port of Long Beach); OK: Oakland; SC: Sacramento (DT: Dept. of Transportation, DU: Dept. of Utilities), SD: San Diego, SF: San Francisco, SJ: San José
- ✓: Implemented, PI: Partially implemented, NI: No plans to implement at this time, TBD: To be determined
- \* See Process Questionnaire in Appendix C of 2002 Report; year noted indicates this BMP was added later.

Page Intentionally Left Blank



# Chapter 5

# Acknowledgements



# CHAPTER 5 Acknowledgements

The participation and contribution of the following individuals to the Study is gratefully appreciated. This work would not have been possible without their contributions.



*Update 2018 Project Team*



**Study Team:**

---

**Kyleen Marcella,  
Consultant**  
Stantec Consulting, Inc.  
300 N. Lake Avenue, Suite 400  
Pasadena, CA 91101  
(626) 568-6047  
kyleen.marcella@stantec.com

**Adnan Anabtawi,  
Consultant**  
Stantec Consulting, Inc  
2353 130th Ave NE, Suite 200  
Bellevue, WA 98005  
(425) 602-3539  
adnan.anabtawi@stantec.com

**Robert Flory,  
Consultant**  
Roebbelen Contracting Inc.  
1241 Hawks Flight Court  
El Dorado Hills, CA 95762  
(916) 939-8305  
(510) 305-5788 (cell)  
robertf@roebbelen.com

**Akram Bassyouni, P.E., Deputy  
Director**  
City of San Diego, Public Works  
Department, Right of Way Division  
525 B Street, Suite 750  
San Diego, CA 92101  
(619) 533-3616  
ABassyouni@sandiego.gov

**Mark Nasser, P.E.,  
Deputy Director**  
City of San Diego,  
Public Works Department,  
Project Implementation  
Division Division  
525 B Street, Suite 750  
San Diego, CA 92101  
(619) 533-6600  
MNassar@sandiego.gov

**Luis Schaar, P.E.,  
Deputy Director**  
City of San Diego, Public Works  
Department, Right of Way Division  
9573 Chesapeake Drive  
San Diego, CA 92123  
(858) 627-3220  
LSchaar@sandiego.gov

**Debbie Van Martin, P.E., Senior Civil  
Engineer**  
City of San Diego, Public Works  
Department, Architectural Engineering  
and Parks Division  
525 B Street, Suite 750  
San Diego, CA 92101  
(619) 533-6651  
DVanMartin@sandiego.gov

**Alvin Papa, P.E.,  
Acting City Engineer**  
City of Long Beach,  
Department of Public Works  
333 W. Ocean Blvd., 9th Floor  
Long Beach, CA 90802  
(562) 570-6386  
(562) 570-6012 (fax)  
Alvin.Papa@longbeach.gov

**Sean Gamette, P.E., Managing  
Director**  
Port of Long Beach,  
Engineering Bureau  
Airport Plaza, 48th floor  
Long Beach, CA 90815  
(562) 283-7277  
Sean.gamette@polb.com

**Suzanne Plezia, P.E.,  
Senior Director of Program Delivery**  
Port of Long Beach, Engineering Bureau  
Airport Plaza, 4th floor  
Long Beach, CA 90815  
(562) 283-7208  
Suzanne.plezia@polb.com

**Marlene Dupras, P.E.,  
Director of Project Controls**

Port of Long Beach,  
Engineering Bureau  
Airport Plaza, 4th floor  
Long Beach, CA 90815  
(562) 283-7288  
Marlene.dupras@polb.com

**Gary Lee Moore, P.E.,  
City Engineer**

City of Los Angeles,  
Department of Public Works, Bureau of  
Engineering  
1149 S. Broadway, Suite 700  
Los Angeles, CA 90015  
(213) 485-4935  
(213) 485-4923 (fax)  
gary.lee.moore@lacity.org

**Ted Allen, P.E.,  
Deputy City Engineer**

City of Los Angeles,  
Department of Public Works, Bureau of  
Engineering  
1149 S. Broadway, Suite 700  
Los Angeles, CA 90015  
(213) 485-4915  
(213) 485-4923 (fax)  
ted.allen@lacity.org

**Edick Ohanian, P.E. Principal Civil  
Engineer**

City of Los Angeles,  
Department of Public Works, Bureau of  
Engineering  
1149 S. Broadway, Suite 140  
Los Angeles, CA 90015  
(213) 847-0577  
(213) 847-0703 (fax)  
edick.ohanian@lacity.org

**Nicholas Theocharides,  
Engineering Services Division Manager**

City of Sacramento,  
Department of Transportation  
915 I Street, Room 2000  
Sacramento, CA 95814  
(916) 808-5065  
(916) 808-8281 (fax)  
nicolas@cityofsacramento.org

**Jesse Gothan, P.E., Supervising  
Engineer**

City of Sacramento,  
Department of Public Works  
915 I Street, Room 2000  
Sacramento CA 95814  
(916) 808-6897  
(916) 808-8281 (fax)  
jgothan@cityofsacramento.org

**Judy Matsui-Drury, P.E. T.E.,  
Supervising Engineer**

City of Sacramento,  
Department of Public Works  
915 I Street, Room 2000  
Sacramento CA 95814  
(916) 808-7610  
(916) 808-8281 (fax)  
JMatsui-Drury@cityofsacramento.org

**Philip Vulliet, P.E., Senior Engineer**

City of Sacramento,  
Department of Public Works  
915 I Street, Room 2000  
Sacramento CA 95814  
(916) 808-5092  
(916) 808-8281 (fax)  
pvulliet@cityofsacramento.org

**Adam Randolph, P.E.,  
Senior Engineer**

City of Sacramento,  
Department of Public Works  
915 I Street, Room 2000  
Sacramento CA 95814  
(916) 808-7803  
(916) 808-8281 (fax)  
arandolph@cityofsacramento.org

**Jonathan Warren,  
Program Analyst**  
City of Sacramento,  
Department of Public Works  
915 I Street, Room 2000  
Sacramento CA 95814  
(916) 808-7122  
(916) 808-8281 (fax)  
JWarren@cityofsacramento.org

**Dan Sherry,  
Engineering and Water Resources  
Division Manager**  
City of Sacramento, Department of  
Utilities  
1395 35th Avenue  
Sacramento, CA 95822  
(916) 808-1419  
dsherry@cityofsacramento.org

**Brett Grant,  
Supervising Engineer**  
City of Sacramento, Department of  
Utilities  
1395 35th Avenue  
Sacramento, CA 95822  
(916) 808-1413  
bgrant@cityofsacramento.org

**Mark Dorian, A.I.A., Operations  
Manager**  
City and County of San Francisco, Dept.  
of Public Works,  
Building Design and Construction  
30 Van Ness Avenue, 4th Floor  
San Francisco, CA 94102  
(415) 557-4719  
(415) 522-7777 (fax)  
Mark.Dorian@sfdpw.org

**Patrick Rivera, P.E.,  
Bureau Manager**  
City and County of San Francisco, Dept.  
of Public Works, Infrastructure Design &  
Construction  
30 Van Ness Avenue, 5th Floor  
San Francisco, CA 94102  
(415) 558-4001  
Patrick.Rivera@sfdpw.org

**Julia Laue, A.I.A.,  
Bureau Manager**  
City and County of San Francisco, Dept.  
of Public Works, Building Design and  
Construction  
30 Van Ness Avenue, 4th Floor  
San Francisco, CA 94102  
(415) 557-4704  
(415) 522-7777 (fax)  
Julia.Laue@sfdpw.org

**Matt Cano, P.E.,  
Director**  
City of San José, Department of Public  
Works  
200 E. Santa Clara St.,  
5th Floor Tower  
San José, CA 95113  
(408) 535-8477  
matt.cano@sanjoseca.gov

**Michael O'Connell, P.E., Deputy  
Director**  
City of San José,  
Department of Public Works  
200 E. Santa Clara St.  
5th Floor Tower  
San José, CA 95113  
(408) 975-7333  
michael.oconnell@sanjoseca.gov

Page Intentionally Left Blank


**Patricia A. Cannon,  
P.E., L.S., Division Manager**  
City of San José, Department of Public  
Works  
1661 Senter Road, Building A, 1st Floor  
San José, CA 95112  
(408) 975-7380  
patty.cannon@sanjoseca.gov

**Rodney Rapson, AIA, Division  
Manager**  
City of San José,  
Department of Public Works  
200 E. Santa Clara St., 6th Floor Tower  
San José, CA 95113  
(408) 535-8410  
rodney.rapson@sanjoseca.gov

**Mathew Nguyen, P.E., Division  
Manager**  
City of San José,  
Department of Public Works  
200 E. Santa Clara St., 6th Floor Tower  
San José, CA 95113  
(408) 535-8384  
mathew.nguyen@sanjoseca.gov

Page Intentionally Left Blank





APPENDIX A  
PERFORMANCE  
QUESTIONNAIRE

# APPENDIX A Performance Questionnaire

## California Multi-Agency Benchmarking Study Update 2018 Performance Questionnaire

Agency:  Project Name:

Project Type:

New/Rehab Index:  Sustainability Goal:

Alternative Project Delivery <sup>(1)</sup>:  Project Grant Source:

(1) On-call engineering services does not use pre-negotiated, fixed prices on units of material/labor. Job order contracting (JOC) uses pre-negotiated, fixed-prices on units of material/labor.

Project financial elements closed and complete

Description:

Comments:


	Planning		Design		Construction		Total	
	DOLLAR	% of TCC*	DOLLAR	% of TCC*	DOLLAR	% of TCC*	DOLLAR	% of TCC*
AGENCY LABOR								
AGENCY COSTS <sup>(2)</sup>								
<i>Art Fees</i>								
<b>SUB-TOTAL AGENCY</b>								
CONSULTANT								
<b>TOTALS</b>								
PHASE DURATION		Months		Months		Months		

AMOUNT OF CONSTRUCTION CONTRACT ENGINEER'S ESTIMATE	
COST OF CHANGE ORDERS	
Changed Conditions	
Changed Bid Documents	
Client-Initiated Changes:	
Total Change Orders	\$-
UTILITY RELOCATION COST	
CITY FORCES CONSTRUCTION (HARD COSTS ONLY)	
<b>TOTAL CONSTRUCTION COST (TCC)</b>	
LAND ACQUISITION (ONLY COST OF LAND, NO ASSOCIATED LABOR COST)	
<b>DATE STARTED TO INCUR CONSTRUCTION MANAGEMENT COSTS (IF AVAILABLE)</b>	
<b>BID OPENING DATE (IF AVAILABLE)</b>	
<b>CONSTRUCTION COMPLETION DATE</b>	
<b>TOTAL PROJECT COST</b>	\$-
NUMBER OF BIDS RECEIVED	

(2) Agency costs include other direct costs and can be listed underneath. This value is locked and it is calculated from its items (Rows 15 - 19).

Page Intentionally Left Blank



A topographic map of South Carolina, rendered in shades of blue and grey, showing terrain features like mountains and rivers. The map is positioned on the left side of the page, with the rest of the background being a solid light blue gradient.

# APPENDIX B PERFORMANCE CURVES

# APPENDIX **B** | Performance Curves

## REGRESSION ANALYSIS RESULTS

The results of the regression analysis performed using the performance model are presented in the following paragraphs.

## REGRESSION DEFINITIONS

A brief overview of the relevant statistical terminology and their definitions is provided in the following paragraphs:

Performance curves produced for this *Study* are regressions of data, demonstrating how close of a relationship exists between the dependent variable (on the y-axis) and the independent variable (on the x-axis). For instance, a regression curve of design cost versus total construction cost (TCC) would be prepared to evaluate how much of the variability in design cost is due to the TCC value.

The regression trendline can be used as a starting point for evaluating the budget for a suite of projects. Caution and use of professional judgment is required if using the regression trendline to budget an individual project.

### ***Confidence Interval***

The upper and lower bounds of the confidence interval indicates the level of certainty in a data set and how likely it is that a random sample from the data set will fall within the interval. The wider the distance between the upper and lower bounds of a confidence interval, the less certainty in the model and greater the need to collect more data before drawing conclusions from the data set.

### ***Coefficient of Determination***

A best-fit logarithmic curve is calculated using the least-squares method in Excel®, and a R<sup>2</sup> value is displayed. The R<sup>2</sup> value, also called the coefficient of determination, is a value between 1 and 0, with a value approaching 0 indicating a poor model and a value approaching 1 indicating a high dependence of the y-value statistic on the x-value statistic.

### ***Statistical Significance***

To evaluate the statistical significance of the result obtained, the regression analyses included a calculation of p-values. Whereas the R<sup>2</sup> value is a descriptive statistic (i.e., describes the current set of data), the p-value is a predictive statistic. It indicates whether there are enough data points to arrive at statistically-significant results and whether the data set could be used to forecast new values. The selection of a desirable p-value is subjective, though 0.10 or 0.05 is typically used as the maximum desirable value.

For the purposes of this *Study*, a critical p-value of 0.10 was selected. Thus, any result where  $p \leq 0.10$  is considered statistically significant. There is no difference between a p-value slightly below 0.10 as one that is far below 0.10. Both results are considered to have equal statistical significance.

For regressions resulting in a p-value above 0.10, additional projects should be added to the database to improve the result. Please see the *Study 2002* report for additional detail on the connection



between the number of projects and p-values. Pump stations and restroom projects had p-values less than 0.1, and therefore the values obtained are not statistically significant.

For each of the regressions, the R<sup>2</sup> value and p-value should be considered separately. A high R<sup>2</sup> value does not mean the result is statistically-significant, and vice-versa.

The results of the regression analyses are discussed in the remainder of this section. The results of the regression analyses are summarized in **Table B-1** and **Table B-2**. **Table B-1** summarizes the performance model results for the full range of TCC while **Table B-2** summarizes the results for the 80th percentile subset of TCC. These tables also summarize the design, construction management, and project delivery costs expressed as a percentage of the TCC and the R<sup>2</sup> and the p-values for the different project types.

It is important to note that while the slopes of the linear regression models are an expression of the project delivery cost as a percentage of construction, the slopes are not equal to the average and median project delivery percentages shown in **Table 3-5**, **Table 3-6** and **Table 3-7**. This is due to the fact that the linear trendline is fit by the least squares method.

This is better explained by the following example. Consider 5 projects in the municipal category having the a1, a2, a3, a4, and a5 as their individual project delivery costs and b1, b2, b3, b4, and b5 as their individual TCC. The arithmetic

average of the project delivery percentages would be represented as:

$$\text{Project Delivery Percentage} = \left( \frac{a1}{b1} + \frac{a2}{b2} + \frac{a3}{b3} + \frac{a4}{b4} + \frac{a5}{b5} \right) / 5$$

The project delivery percentages presented in **Table 3-5** through **Table 3-12** are computed using the above formula which is the average of the individual project delivery percentages.

In the regression analysis, the project delivery percentage is computed in fashion that is more similar to the following formula which represents the average slope of the least squares fit.

$$\text{Project Delivery Percentage} = \left( \frac{a1 + a2 + a3 + a4 + a5}{b1 + b2 + b3 + b4 + b5} \right)$$

The project delivery percentages presented in **Table B-1** and **Table B-2** are computed using the above formula.

The plots depicting the regression relationships are shown in this section. It should also be noted that while majority of projects are clustered near the origin of the graph, the slope of the trendline is predominantly governed by the data points scattered at relatively high TCC values. Since the slope of the trendline provides the design, construction management, or the project delivery costs as a percentage of the TCC for a group of projects, the results better reflect the properties of a program of projects rather than that of an individual project. Therefore, the reader must avoid budgeting individual projects based solely on these analyses.

In most cases, the results reflect the agencies' experience with the delivery of capital projects that on a percentage basis projects with lower TCCs are more expensive to deliver than projects with higher TCCs. Only 3 out of the 16 categories have lower project delivery percentages for the 80th percentile subset of projects than the full range of projects. It is concluded that the model results are reasonable from a statistical perspective.

For projects belonging to the Parks category, there is no increase in the project delivery percentages for projects evaluated in the 80th percentile subset of TCC. Project delivery percentages for projects belonging to the Pipes, Streets and Municipal category exhibit a 13, 16, and 16 percent increase, respectively, than the 80th percentile subset. Comparing the results summarized in **Table B-1** and **Table B-2** shows that an economy of scale exists in delivering projects with a higher TCC versus those with a lower TCC.

The elimination of auto-correlation in Update 2008 and the use of the linear trendline to describe the relationship between project delivery costs and the TCC have significantly improved the  $R^2$  values as compared to the *Study* years prior to 2008. The linear regression trendline equations are shown in **Table B-3**.

The reader is cautioned that these tables should only be used as a reference and not for prediction of performance. Readers are urged to review the curves in this section in conjunction with using this table.

**Table B-1  
Summary of Performance Models (Full Range of TCC)**

Project Type or Classification	Number of Projects <sup>1</sup>	Design Cost			Construction Management Cost			Project Delivery Cost					
		(% of TCC)	95% CI (% of TCC)	R <sup>2</sup>	p-value	(% of TCC)	95% CI (% of TCC)	R <sup>2</sup>	p-value	(% of TCC)	95% CI (% of TCC)	R <sup>2</sup>	p-value
<b>Municipal Facilities</b>	<b>54</b>	<b>24%</b>	<b>22%-27%</b>	<b>0.89</b>	<b>5.8E-27</b>	<b>12%</b>	<b>10%-13%</b>	<b>0.80</b>	<b>4.2E-20</b>	<b>36%</b>	<b>34%-39%</b>	<b>0.95</b>	<b>2.1E-35</b>
Libraries <sup>2</sup>	1	21%	N/A	N/A	N/A	23%	N/A	N/A	N/A	44%	N/A	N/A	N/A
Police/Fire Stations	11	25%	20%-31%	0.91	1.4E-06	11%	9%-13%	0.92	8.0E-07	37%	32%-41%	0.97	9.0E-09
Comm./Rec. Center/Child Care/Gyms	18	22%	17%-27%	0.83	5.4E-08	14%	7%-21%	0.52	5.0E-04	36%	28%-44%	0.85	2.4E-08
Other Municipal	24	17%	13%-21%	0.77	8.2E-09	15%	12%-17%	0.86	1.9E-11	31%	27%-36%	0.90	3.7E-13
<b>Streets</b>	<b>180</b>	<b>17%</b>	<b>16%-18%</b>	<b>0.85</b>	<b>2.2E-74</b>	<b>14%</b>	<b>13%-15%</b>	<b>0.83</b>	<b>6.7E-70</b>	<b>31%</b>	<b>30%-33%</b>	<b>0.90</b>	<b>6.4E-93</b>
Widening/New/Grade Separations	12	14%	13%-16%	0.98	3.6E-10	14%	13%-16%	0.97	2.2E-09	28%	26%-31%	0.99	1.3E-11
Bridges	15	31%	26%-37%	0.92	3.3E-09	34%	23%-44%	0.77	7.0E-06	65%	51%-80%	0.87	1.4E-07
Reconstructions	66	25%	23%-27%	0.87	5.2E-31	11%	9%-13%	0.69	4.2E-18	36%	33%-38%	0.93	3.6E-39
Bike/Pedestrian/ Streetscapes	57	27%	24%-30%	0.85	5.4E-25	22%	19%-24%	0.85	1.1E-24	49%	45%-52%	0.92	7.0E-33
Signals	30	19%	12%-27%	0.50	8.5E-06	16%	13%-19%	0.85	1.7E-13	35%	28%-43%	0.75	2.4E-10
<b>Pipes</b>	<b>274</b>	<b>17%</b>	<b>16%-18%</b>	<b>0.73</b>	<b>3.0E-80</b>	<b>17%</b>	<b>16%-18%</b>	<b>0.73</b>	<b>5.7E-80</b>	<b>34%</b>	<b>32%-36%</b>	<b>0.80</b>	<b>3.9E-97</b>
Gravity Mains	200	18%	16%-19%	0.74	1.2E-60	17%	16%-19%	0.73	4.7E-58	35%	32%-37%	0.80	4.3E-72
Pressure Systems	52	14%	11%-16%	0.70	4.6E-15	14%	12%-15%	0.82	6.1E-21	27%	24%-31%	0.81	3.4E-20
Pump Stations	14	22%	16%-28%	0.81	5.4E-06	18%	13%-23%	0.83	2.3E-06	40%	29%-50%	0.84	1.6E-06
Other Pipes	8	18%	11%-25%	0.84	4.6E-04	35%	27%-44%	0.93	2.5E-05	53%	47%-60%	0.98	2.6E-07
<b>Parks</b>	<b>43</b>	<b>24%</b>	<b>22%-25%</b>	<b>0.96</b>	<b>2.0E-31</b>	<b>14%</b>	<b>14%-15%</b>	<b>0.97</b>	<b>6.1E-34</b>	<b>38%</b>	<b>37%-40%</b>	<b>0.98</b>	<b>1.6E-37</b>
Playgrounds	29	26%	25%-27%	0.98	9.7E-27	14%	13%-15%	0.98	1.3E-25	40%	39%-42%	0.99	4.7E-29
Sport Fields	10	15%	9%-21%	0.79	2.7E-04	15%	11%-19%	0.87	2.4E-05	30%	22%-39%	0.88	1.7E-05
Restrooms	4	19%	16%-23%	0.99	4.9E-04	14%	9%-20%	0.96	2.9E-03	34%	30%-37%	1.00	6.3E-05
<b>Water/Wastewater Treatment Plants</b>	<b>30</b>	<b>18%</b>	<b>15%-22%</b>	<b>0.79</b>	<b>2.3E-11</b>	<b>21%</b>	<b>18%-25%</b>	<b>0.84</b>	<b>4.3E-13</b>	<b>40%</b>	<b>34%-46%</b>	<b>0.87</b>	<b>3.2E-14</b>
Water/Wastewater Treatment Plants	30	18%	15%-22%	0.79	2.3E-11	21%	18%-25%	0.84	4.3E-13	40%	34%-46%	0.87	3.2E-14

Notes:

TCC = Total Construction Cost; CI = Confidence Interval. The project delivery percentages indicated are the ranges corresponding to the 95 percent confidence intervals on the mean slope of the linear regression trendline. Caution and review of the report text are urged in using this information. Refer to Appendix B for the corresponding regression curves, R<sup>2</sup> values, and N values for more details.

- Total excludes projects delivered by alternative delivery mechanisms such as design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the projects selected for analysis in the *Study*.
- Municipal Facilities – Libraries has too few projects to calculate statistics.

**Table B-2**  
**Summary of Performance Models (80th Percentile Subset of TCC)**

Project Type or Classification	Number of Projects <sup>1</sup>	Design Cost			Construction Management Cost			Project Delivery Cost					
		(% of TCC)	95% CI (% of TCC)	R <sup>2</sup>	p-value	(% of TCC)	95% CI (% of TCC)	R <sup>2</sup>	p-value	(% of TCC)	95% CI (% of TCC)	R <sup>2</sup>	p-value
<b>Municipal Facilities</b>	<b>43</b>	<b>26%</b>	<b>21%-30%</b>	<b>0.74</b>	<b>9.1E-14</b>	<b>22%</b>	<b>18%-27%</b>	<b>0.69</b>	<b>3.1E-12</b>	<b>48%</b>	<b>42%-54%</b>	<b>0.85</b>	<b>7.2E-19</b>
Libraries <sup>2</sup>	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Police/Fire Stations	8	13%	11%-15%	0.97	9.7E-07	19%	14%-23%	0.92	3.6E-05	31%	26%-37%	0.96	3.8E-06
Comm./Rec. Center/Child Care/Gyms	14	36%	25%-46%	0.79	8.2E-06	26%	14%-39%	0.62	5.1E-04	62%	50%-73%	0.91	4.0E-08
Other Municipal	19	23%	15%-31%	0.69	6.6E-06	18%	12%-25%	0.68	8.1E-06	41%	28%-54%	0.70	3.8E-06
<b>Streets</b>	<b>144</b>	<b>24%</b>	<b>22%-27%</b>	<b>0.68</b>	<b>4.6E-37</b>	<b>19%</b>	<b>17%-22%</b>	<b>0.66</b>	<b>9.6E-36</b>	<b>44%</b>	<b>40%-48%</b>	<b>0.76</b>	<b>9.2E-46</b>
Widening/New/Grade Separations	9	25%	12%-38%	0.72	1.9E-03	19%	13%-25%	0.86	1.0E-04	44%	27%-62%	0.81	4.1E-04
Bridges	11	33%	24%-41%	0.88	6.1E-06	20%	9%-31%	0.62	2.3E-03	53%	36%-70%	0.83	3.6E-05
Reconstructions	52	19%	16%-23%	0.67	7.3E-14	14%	12%-17%	0.76	2.1E-17	34%	29%-39%	0.80	1.8E-19
Bike/Pedestrian/ Streetscapes	45	30%	24%-36%	0.70	5.2E-13	20%	16%-23%	0.75	6.2E-15	50%	43%-57%	0.82	4.2E-18
Signals	23	43%	33%-53%	0.78	1.1E-08	20%	14%-26%	0.69	4.6E-07	63%	55%-71%	0.92	1.1E-13
<b>Pipes</b>	<b>219</b>	<b>23%</b>	<b>22%-25%</b>	<b>0.76</b>	<b>8.3E-69</b>	<b>20%</b>	<b>18%-21%</b>	<b>0.80</b>	<b>3.6E-77</b>	<b>43%</b>	<b>40%-46%</b>	<b>0.84</b>	<b>1.6E-87</b>
Gravity Mains	159	24%	22%-26%	0.79	4.3E-55	21%	19%-22%	0.83	2.7E-62	45%	42%-48%	0.86	7.3E-69
Pressure Systems	41	22%	17%-26%	0.70	5.2E-12	18%	15%-21%	0.78	1.3E-14	39%	33%-45%	0.81	6.2E-16
Pump Stations	11	19%	15%-23%	0.92	9.6E-07	19%	12%-25%	0.81	6.0E-05	37%	29%-46%	0.90	2.2E-06
Other Pipes	6	23%	5%-42%	0.67	2.4E-02	42%	30%-54%	0.94	2.5E-04	65%	49%-81%	0.96	1.5E-04
<b>Parks</b>	<b>34</b>	<b>21%</b>	<b>17%-25%</b>	<b>0.77</b>	<b>6.1E-12</b>	<b>16%</b>	<b>13%-20%</b>	<b>0.77</b>	<b>4.9E-12</b>	<b>37%</b>	<b>31%-43%</b>	<b>0.83</b>	<b>2.6E-14</b>
Playgrounds	23	24%	20%-28%	0.87	2.2E-11	22%	19%-26%	0.87	3.7E-11	46%	40%-52%	0.92	1.3E-13
Sport Fields	7	20%	4%-35%	0.61	2.2E-02	13%	8%-19%	0.87	7.1E-04	33%	15%-51%	0.77	4.2E-03
Restrooms	3	28%	21%-36%	0.99	4.0E-03	3%	-16%-21%	0.18	5.8E-01	31%	6%-56%	0.94	3.3E-02
<b>Water/Wastewater Treatment Plants</b>	<b>24</b>	<b>24%</b>	<b>17%-30%</b>	<b>0.71</b>	<b>1.1E-07</b>	<b>18%</b>	<b>15%-21%</b>	<b>0.86</b>	<b>2.4E-11</b>	<b>41%</b>	<b>33%-50%</b>	<b>0.82</b>	<b>6.5E-10</b>
Water/Wastewater Treatment Plants	24	24%	17%-30%	0.71	1.1E-07	18%	15%-21%	0.86	2.4E-11	41%	33%-50%	0.82	6.5E-10

Notes:

TCC = Total Construction Cost; CI = Confidence Interval. The project delivery percentages indicated are the ranges corresponding to the 95 percent confidence intervals on the mean slope of the linear regression trendline. Caution and review of the report text are urged in using this information. Refer to Appendix B for the corresponding regression curves, R<sup>2</sup> values, and N values for more details.

- Total excludes projects delivered by alternative delivery mechanisms such as design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the projects selected for analysis in the *Study*.
- Municipal Facilities – Libraries has too few projects to calculate statistics.

**Table B-3  
Summary of Regression Equations**

Project Type or Classification	Design Cost (x) vs. TCC Full Range of TCC	Design Cost (x) vs. TCC Smaller Project Subset of TCC	CM Cost (x) vs. TCC Full Range of TCC	CM Cost (x) vs. TCC Smaller Project Subset of TCC	Project Delivery Cost (x) vs. TCC Full Range of TCC	Project Delivery Cost (x) vs. TCC Smaller Project Subset of TCC
<b>Municipal Facilities</b>	<b>0.2436x</b>	<b>0.2566x</b>	<b>0.1185x</b>	<b>0.2240x</b>	<b>0.3621x</b>	<b>0.4806x</b>
Libraries	0.2077x	N/A	0.2310x	N/A	0.4388x	N/A
Police/Fire Stations	0.2538x	0.1291x	0.1117x	0.1855x	0.3655x	0.3147x
Comm./Rec. Center/Child Care/Gyms	0.2224x	0.3554x	0.1410x	0.2618x	0.3634x	0.6172x
Other Municipal	0.1666x	0.2292x	0.1471x	0.1830x	0.3137x	0.4122x
<b>Streets</b>	<b>0.1698x</b>	<b>0.2448x</b>	<b>0.1445x</b>	<b>0.1928x</b>	<b>0.3143x</b>	<b>0.4376x</b>
Widening/New/Grade Separations	0.1414x	0.2521x	0.1435x	0.1925x	0.2849x	0.4446x
Bridges	0.3149x	0.3263x	0.3387x	0.2030x	0.6536x	0.5292x
Reconstructions	0.2493x	0.1938x	0.1079x	0.1438x	0.3572x	0.3377x
Bike/Pedestrian/ Streetscapes	0.2721x	0.3041x	0.2152x	0.1988x	0.4873x	0.5029x
Signals	0.1940x	0.4334x	0.1601x	0.1992x	0.3541x	0.6326x
<b>Pipes</b>	<b>0.1680x</b>	<b>0.2331x</b>	<b>0.1675x</b>	<b>0.1973x</b>	<b>0.3355x</b>	<b>0.4303x</b>
Gravity Mains	0.1753x	0.2415x	0.1724x	0.2074x	0.3477x	0.4489x
Pressure Systems	0.1363x	0.2158x	0.1357x	0.1777x	0.2721x	0.3935x
Pump Stations	0.2192x	0.1884x	0.1796x	0.1856x	0.3988x	0.3740x
Other Pipes	0.1807x	0.2309x	0.3506x	0.4204x	0.5313x	0.6513x
<b>Parks</b>	<b>0.2392x</b>	<b>0.2089x</b>	<b>0.1431x</b>	<b>0.1647x</b>	<b>0.3823x</b>	<b>0.3736x</b>
Playgrounds	0.2589x	0.2395x	0.1423x	0.2245x	0.4013x	0.4639x
Sportfields	0.1533x	0.1951x	0.1504x	0.1337x	0.3037x	0.3288x
Restrooms <sup>1</sup>	0.1924x	0.2839x	0.1442x	0.0283x	0.3366x	0.3122x
<b>Water/Wastewater Treatment Plants</b>	<b>0.1847x</b>	<b>0.2352x</b>	<b>0.2134x</b>	<b>0.1780x</b>	<b>0.3980x</b>	<b>0.4133x</b>
Water/Wastewater Treatment Plants	0.1847x	0.2352x	0.2134x	0.1780x	0.3980x	0.4133x

Note:

TCC = Total Construction Cost; CM = Construction Management.

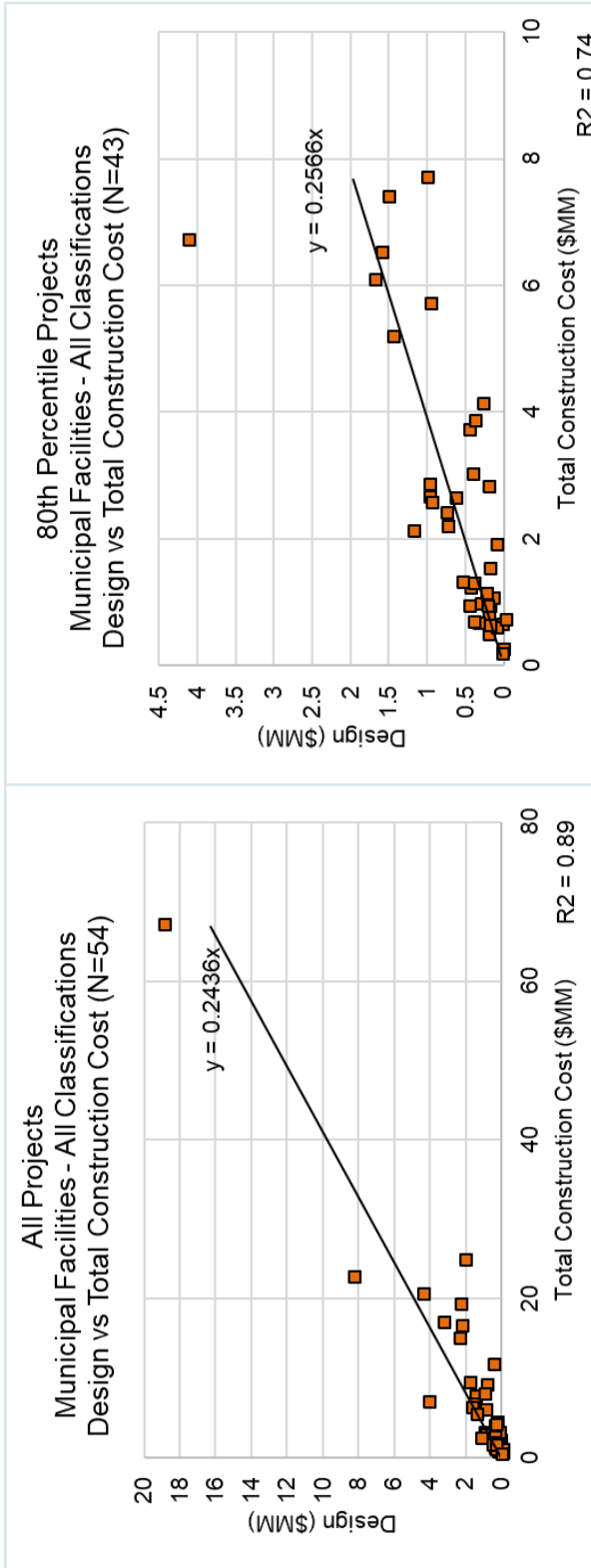
1. Municipal Facilities – Libraries has too few projects to calculate statistics for smaller project subset.

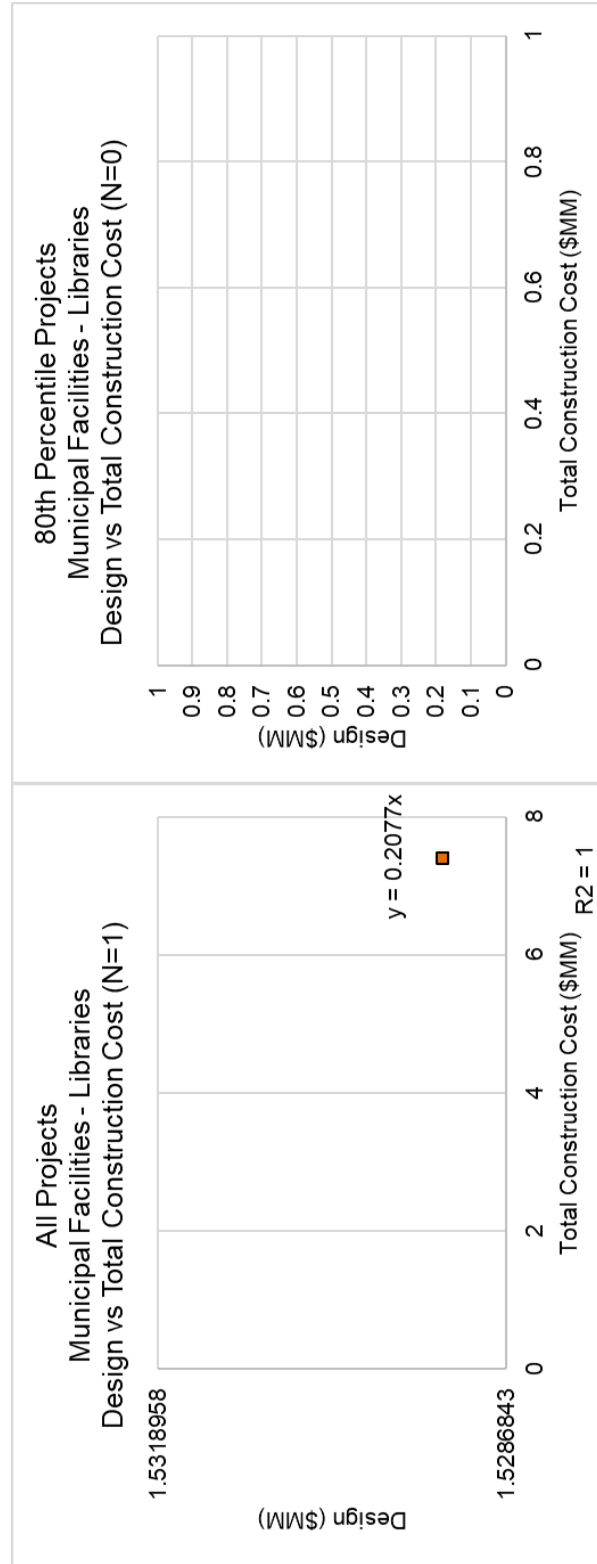


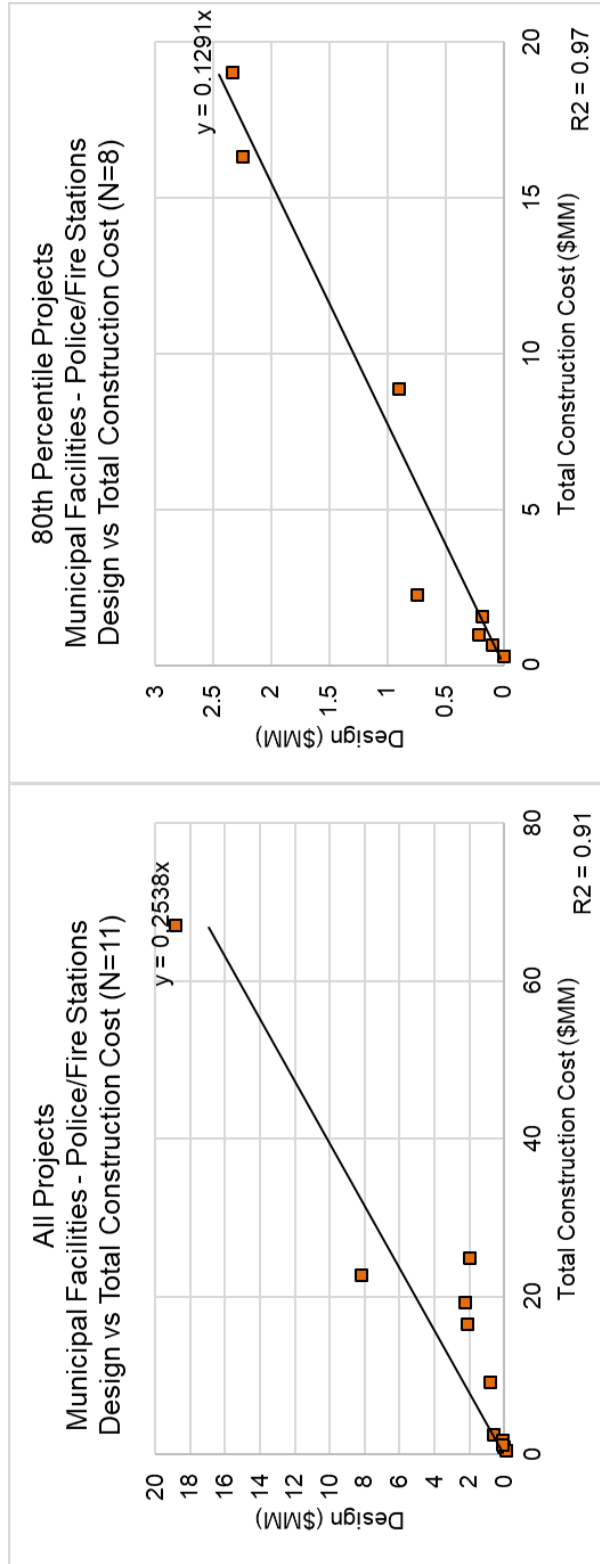
---

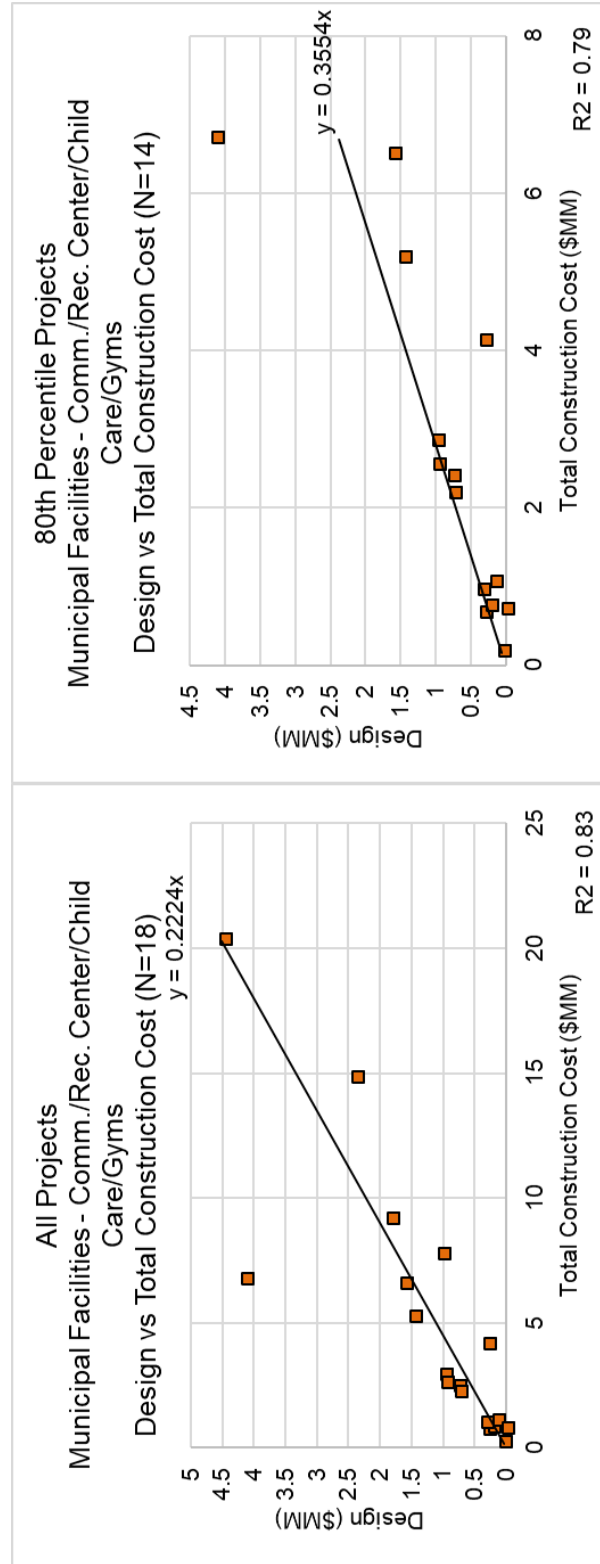
**CURVES GROUP 1**

**Design Cost  
vs  
Total Construction Cost**

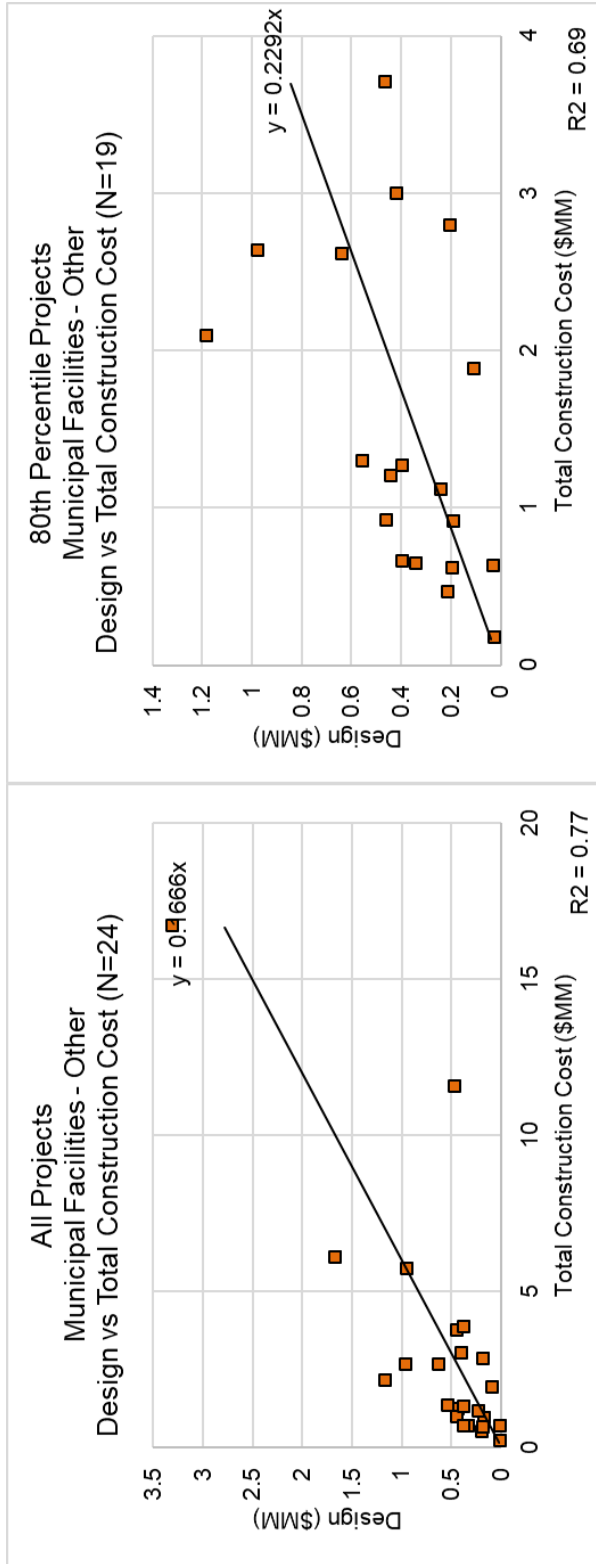


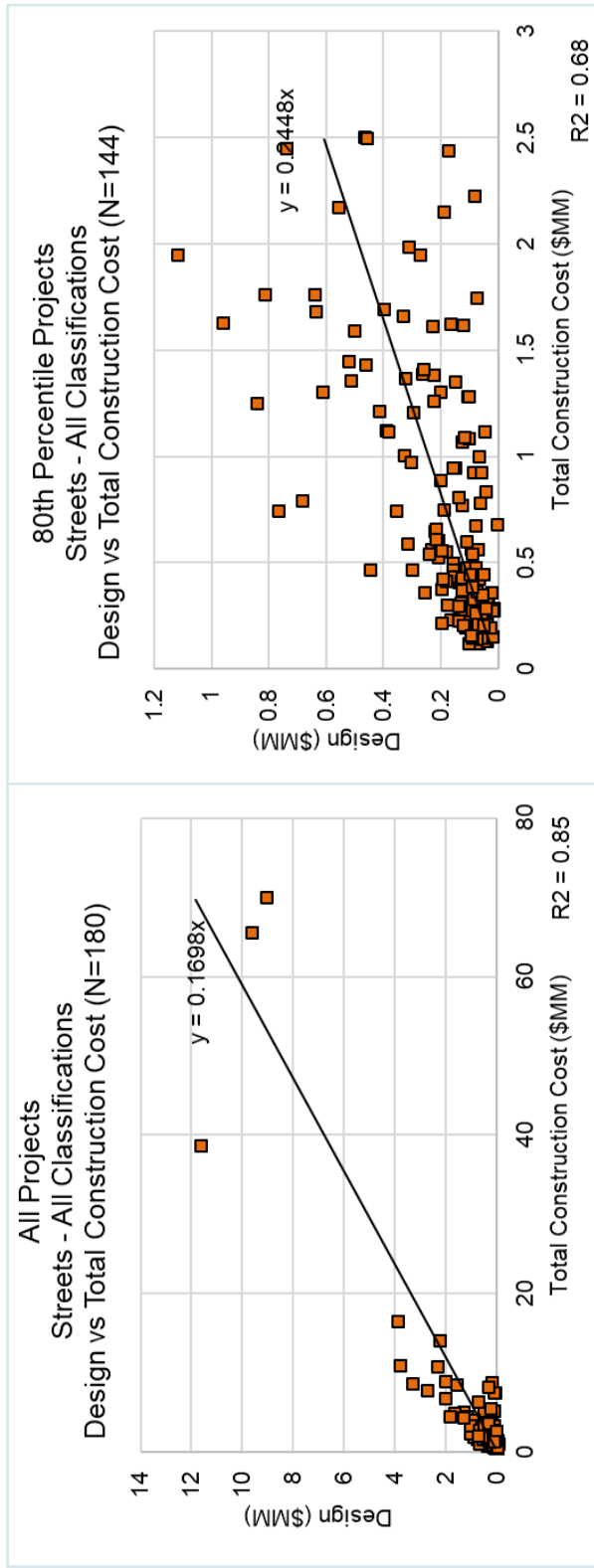


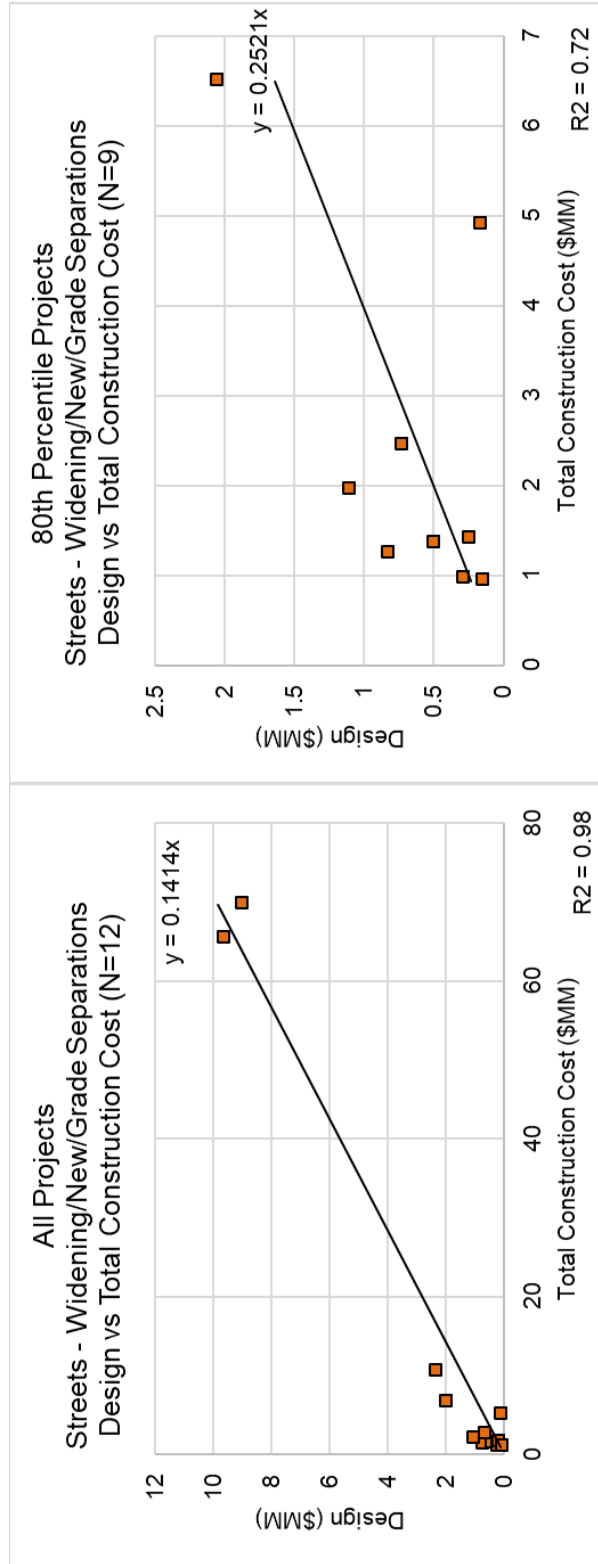


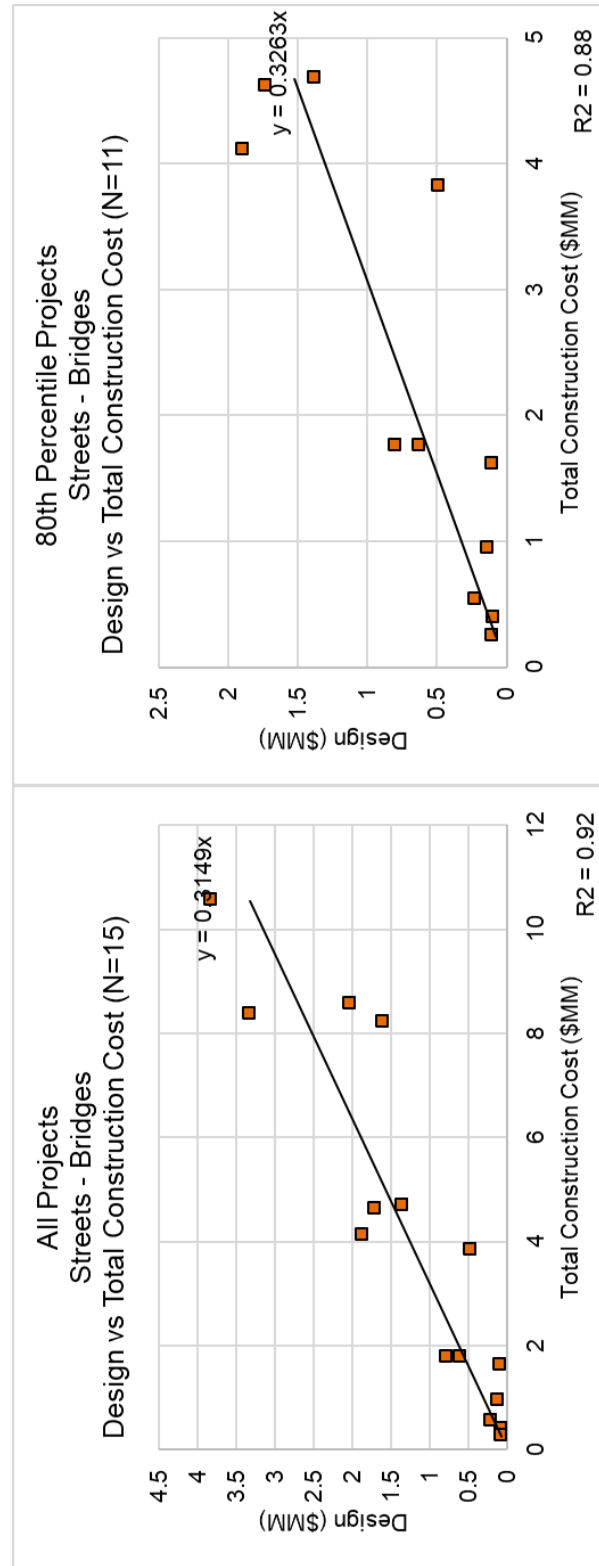


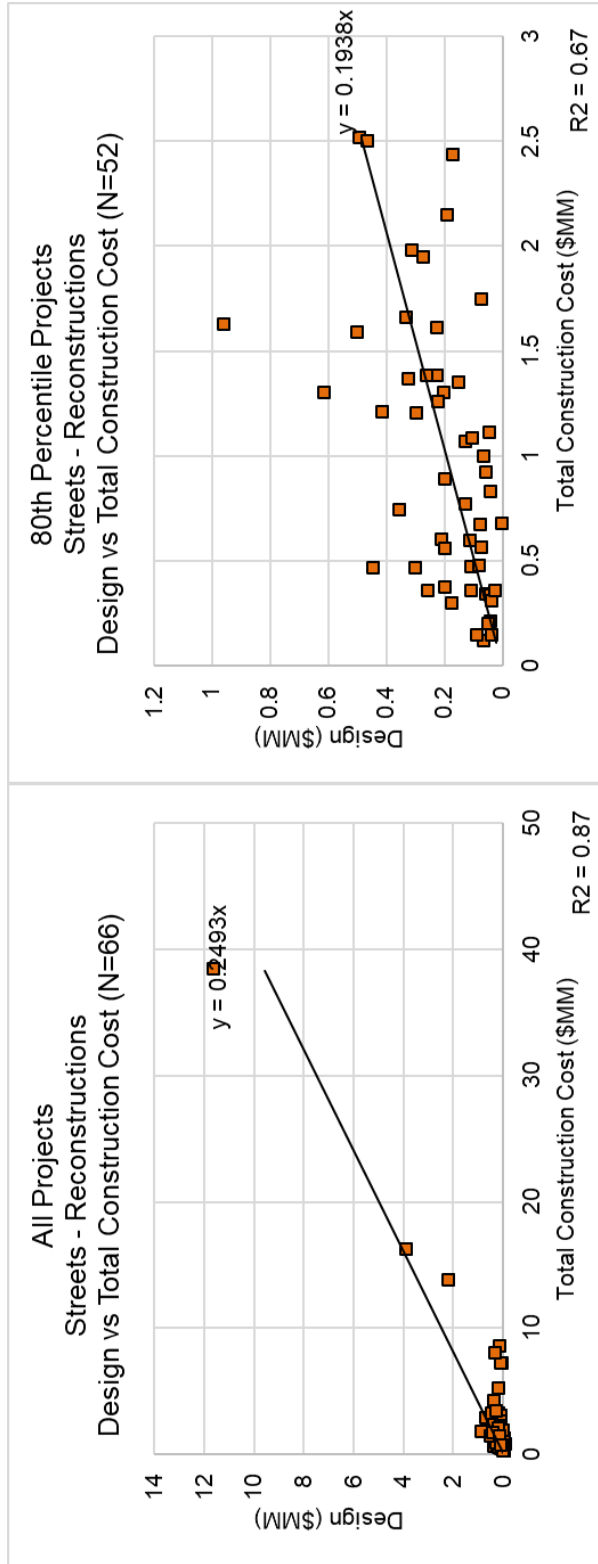




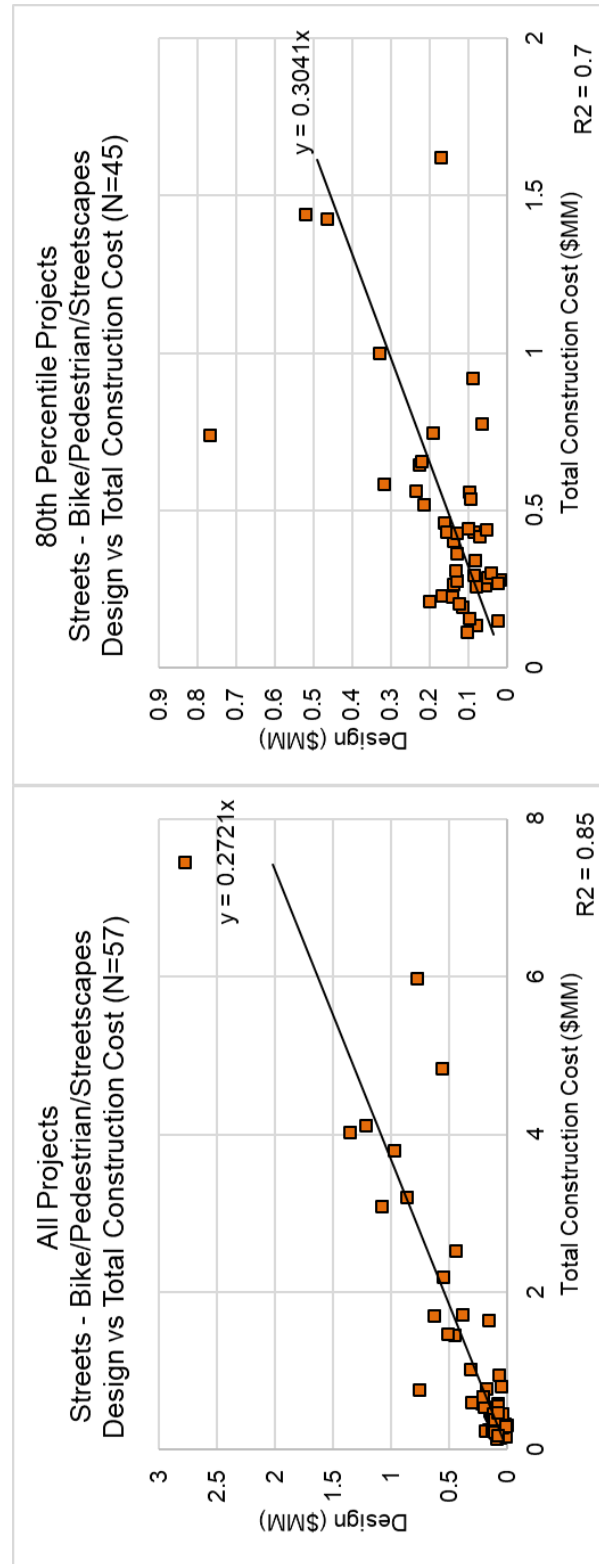


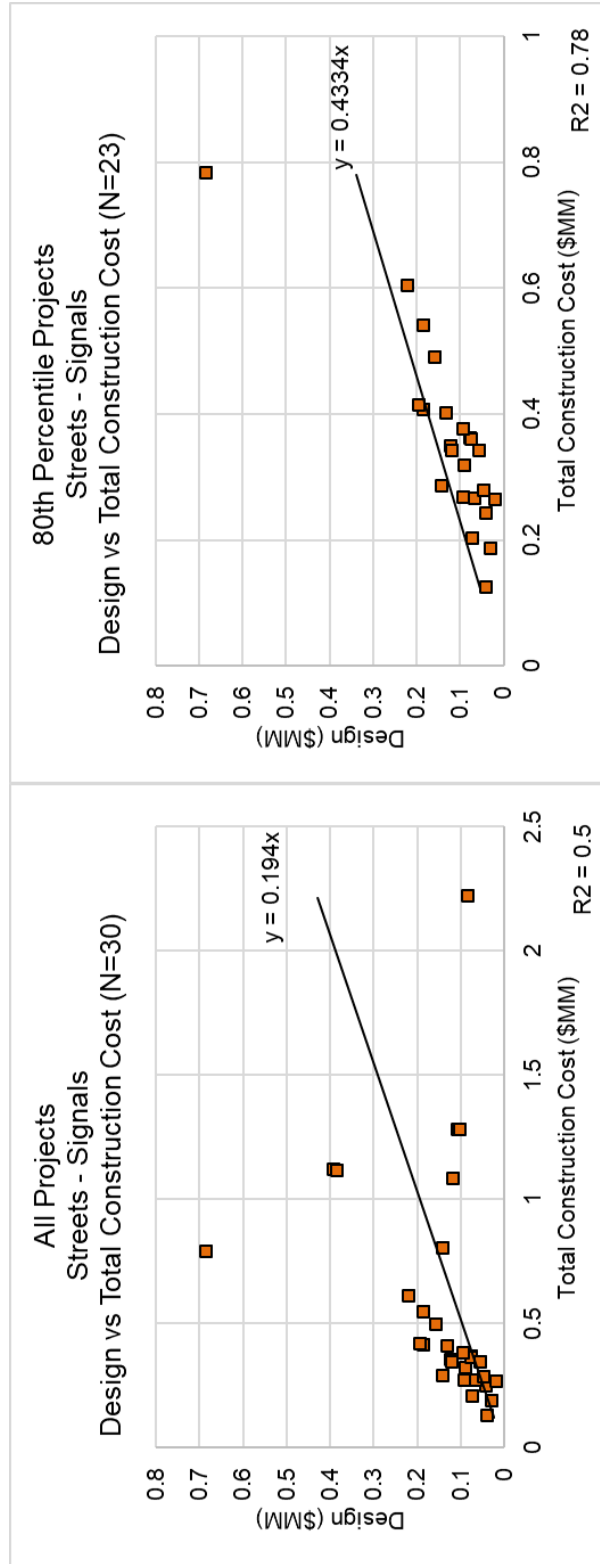


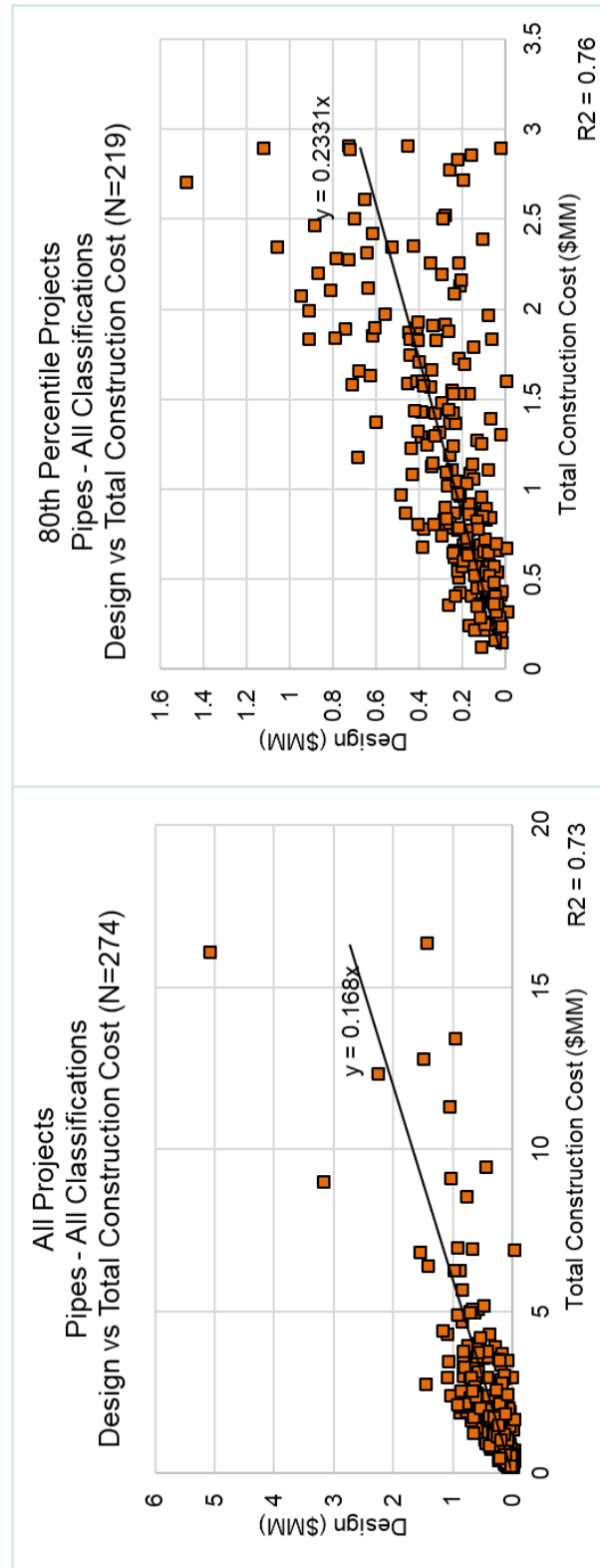


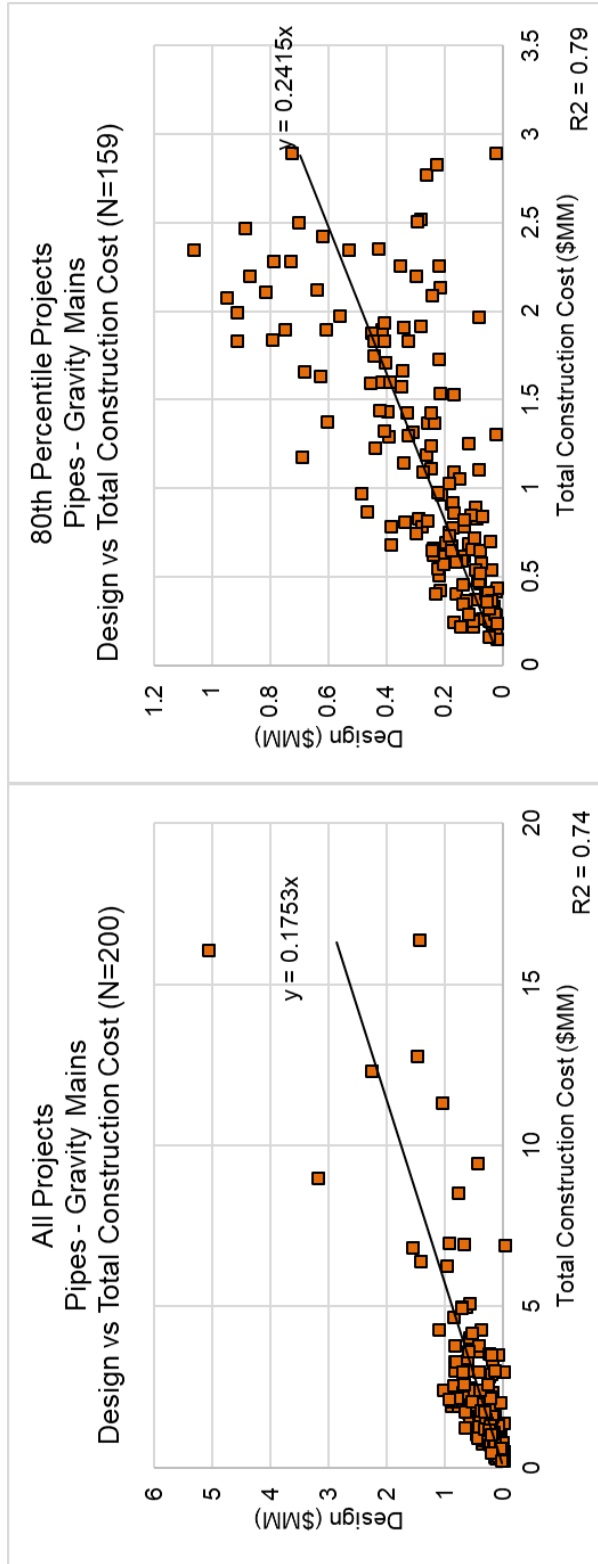


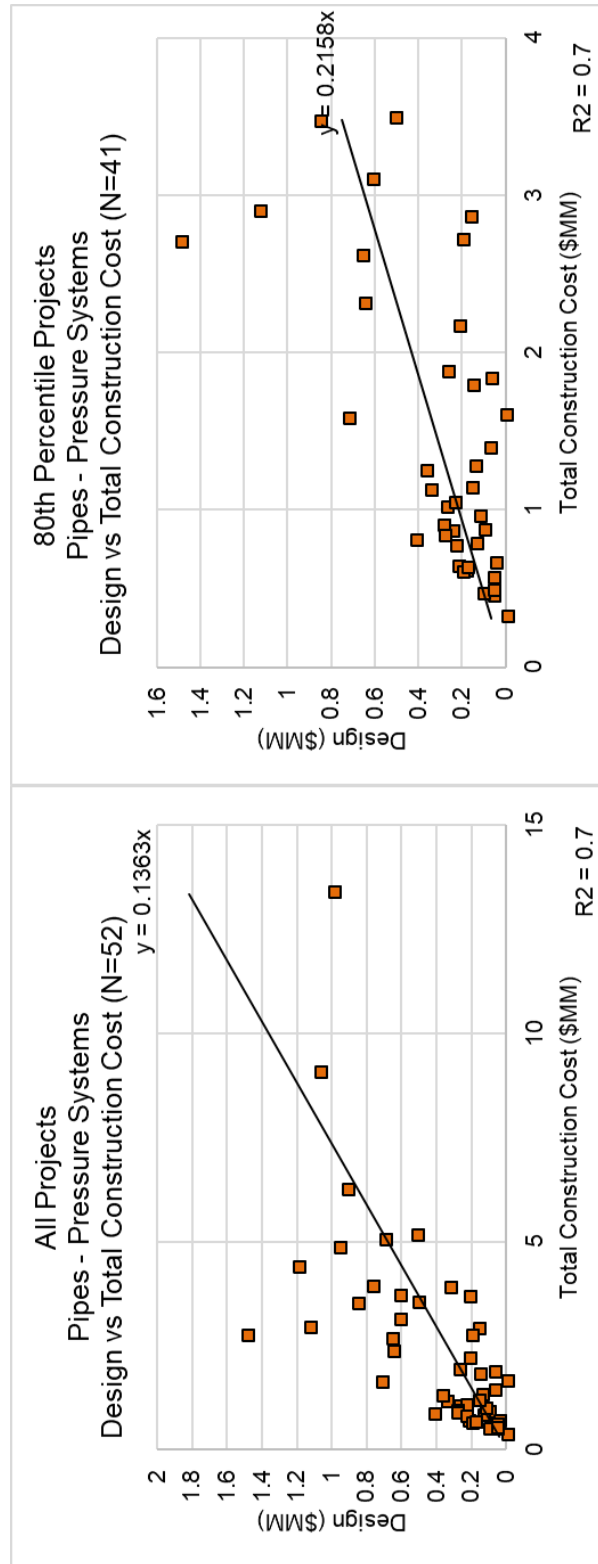




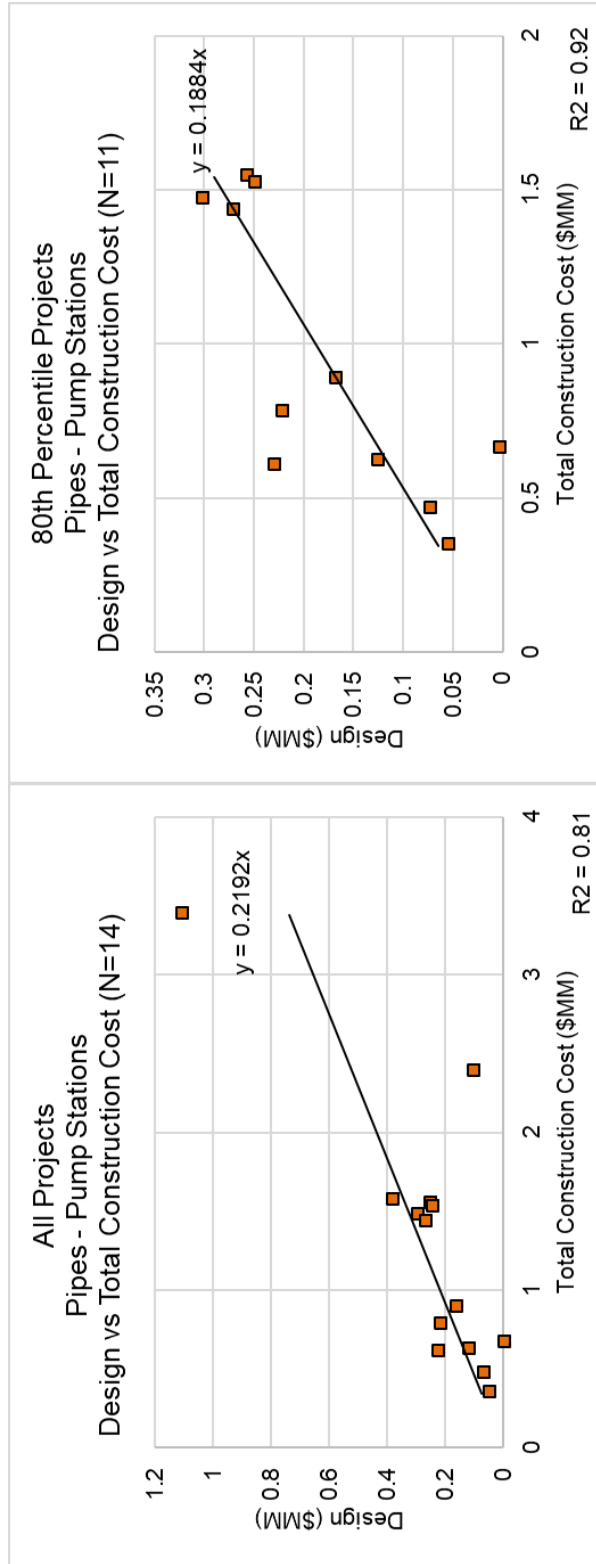


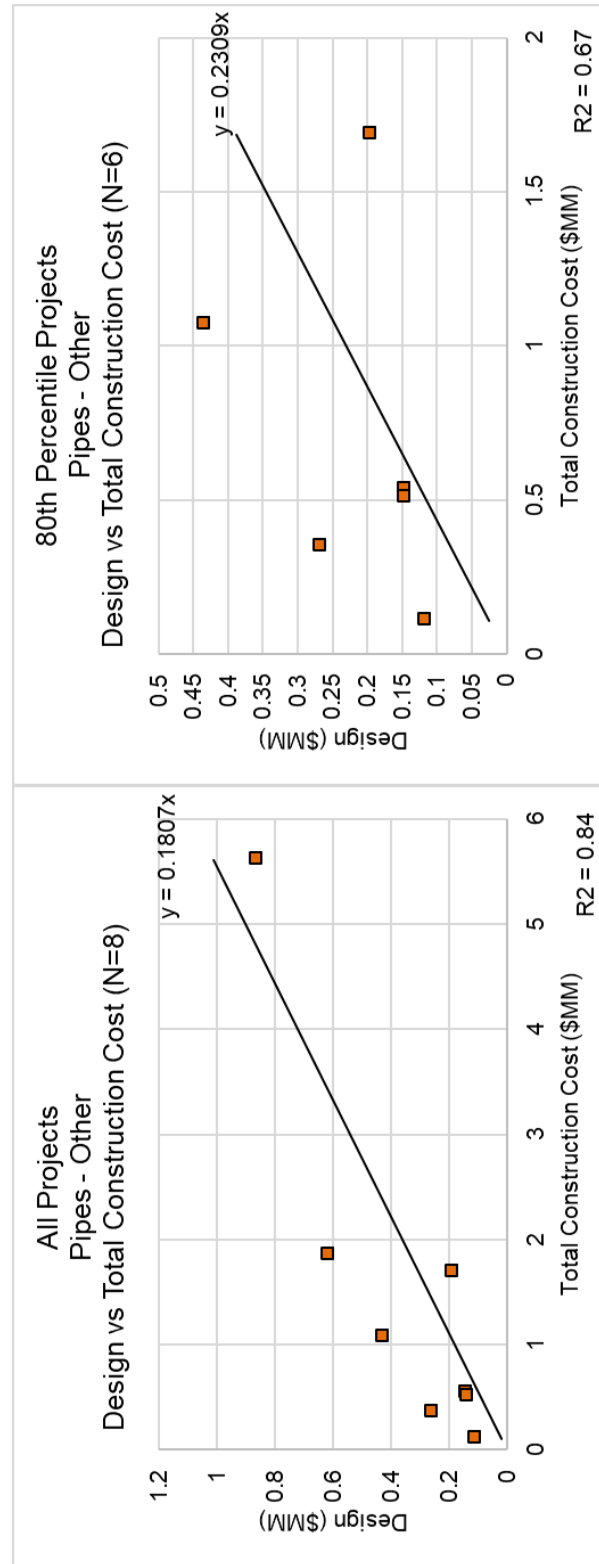


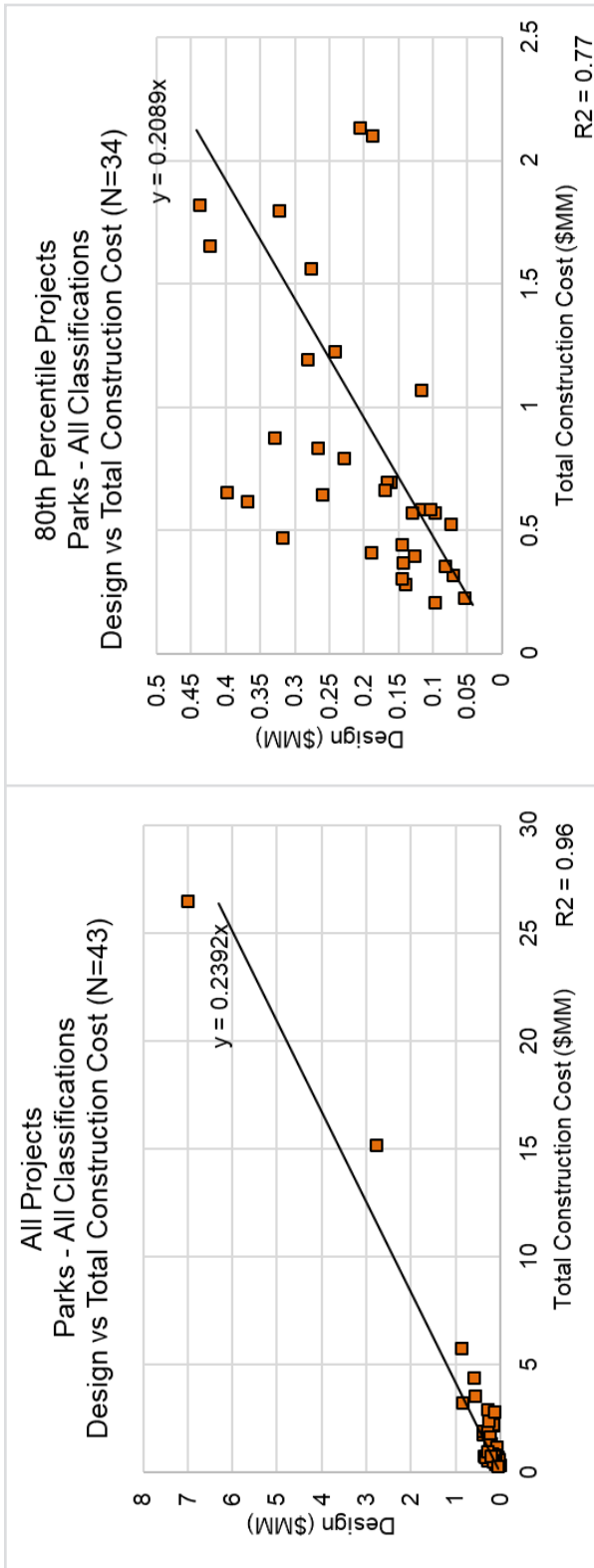


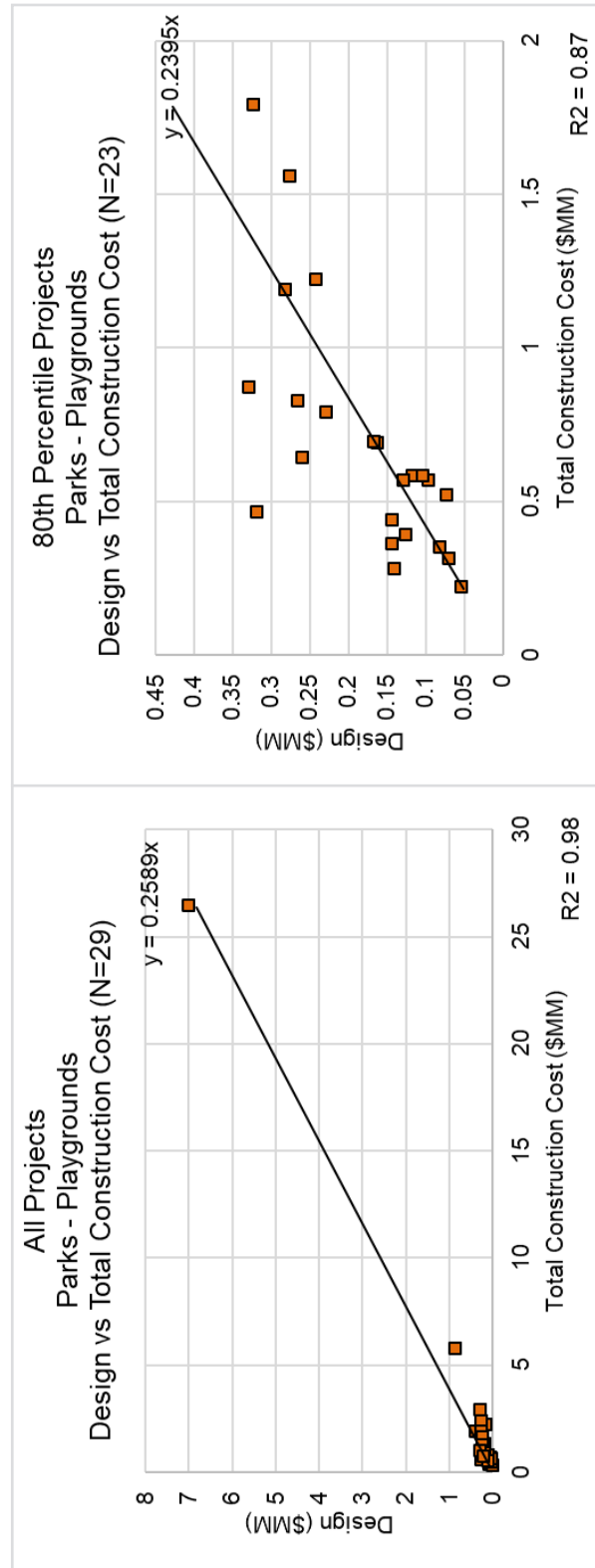


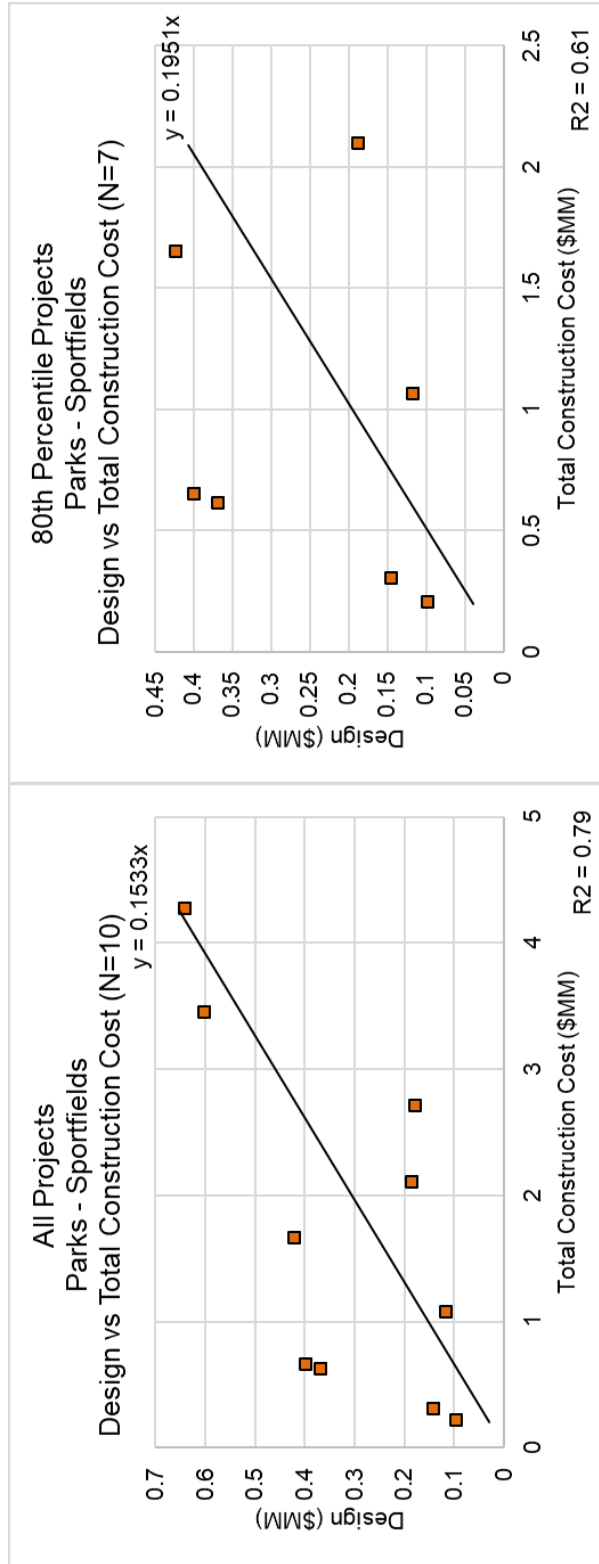




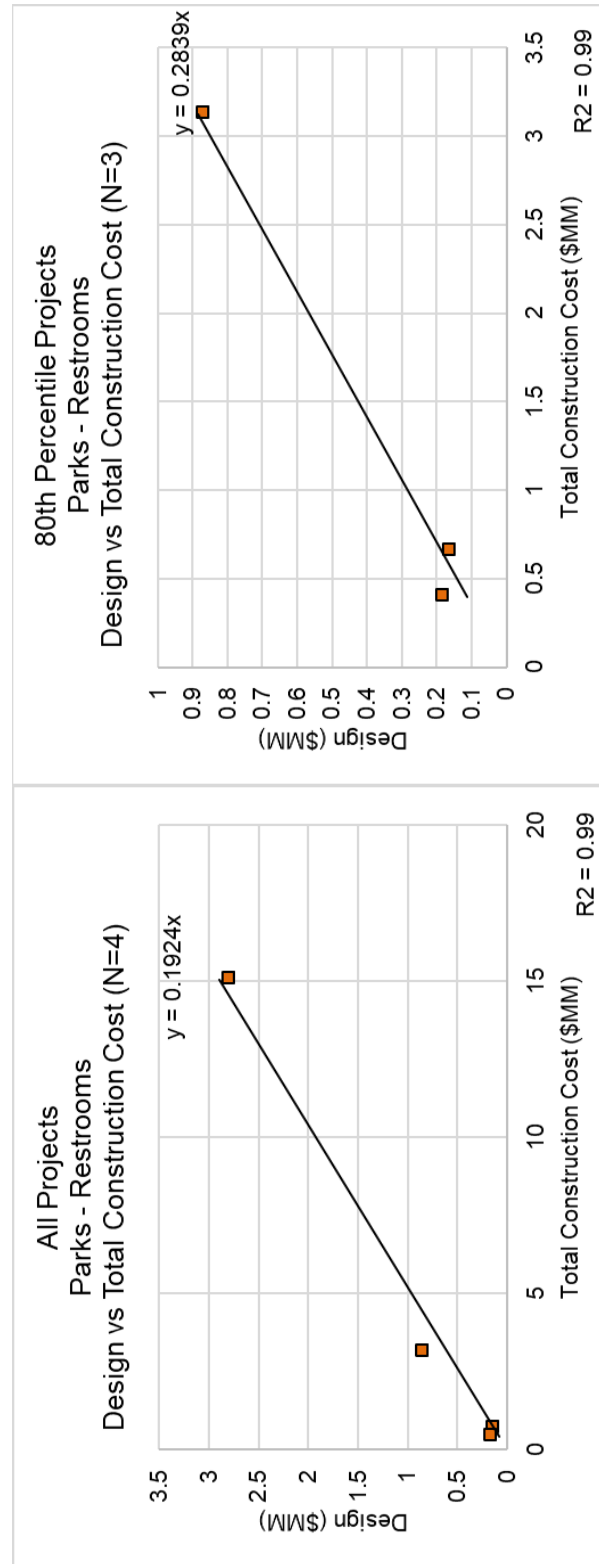


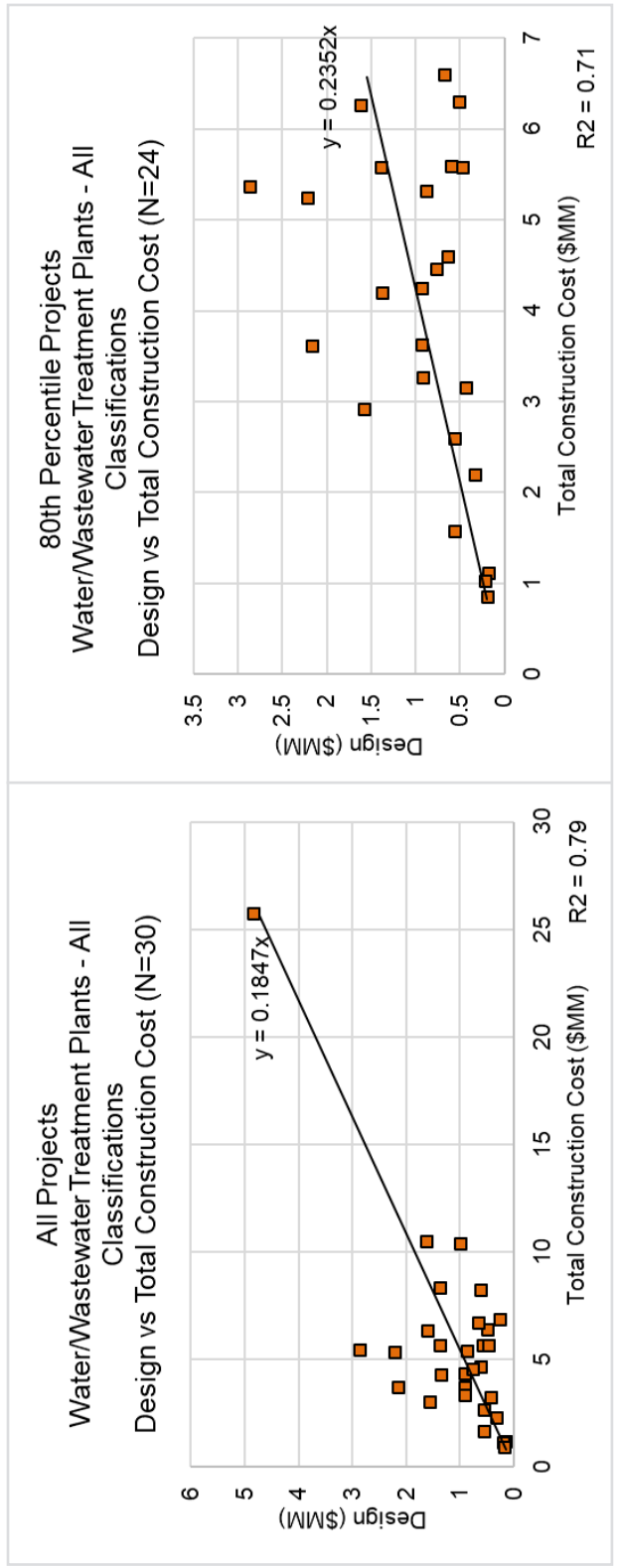






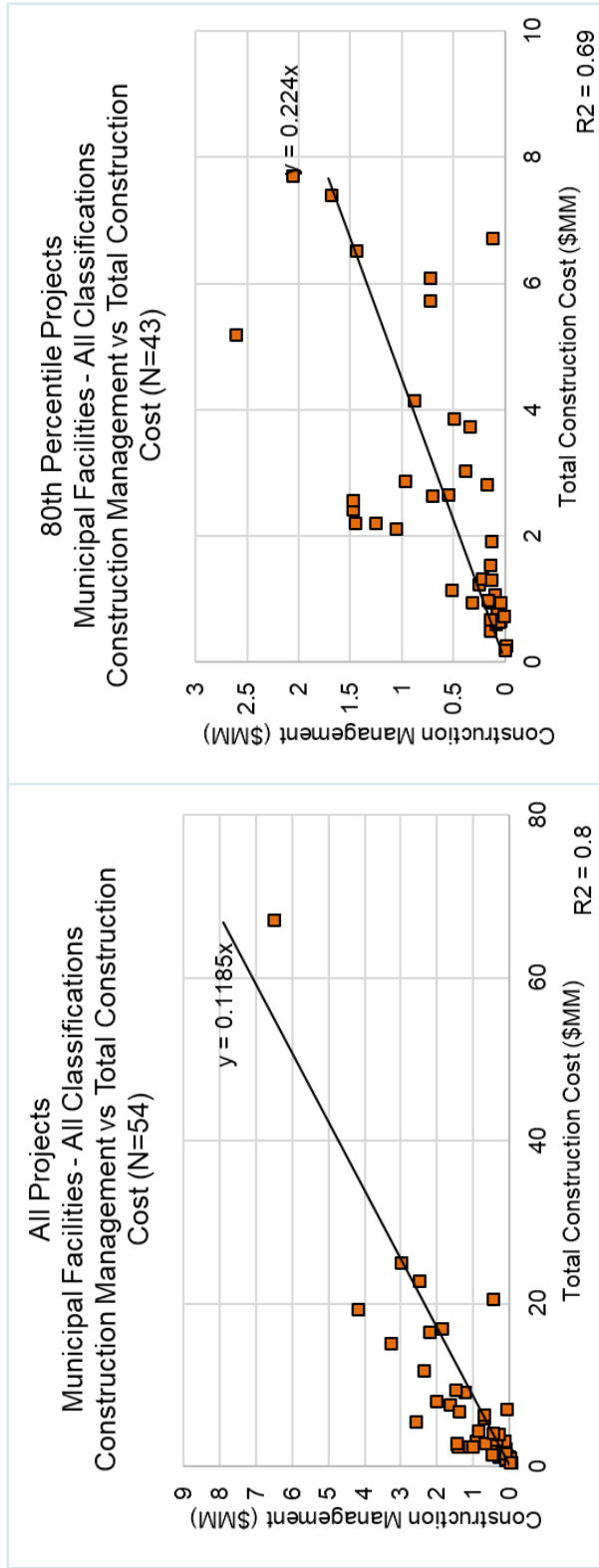


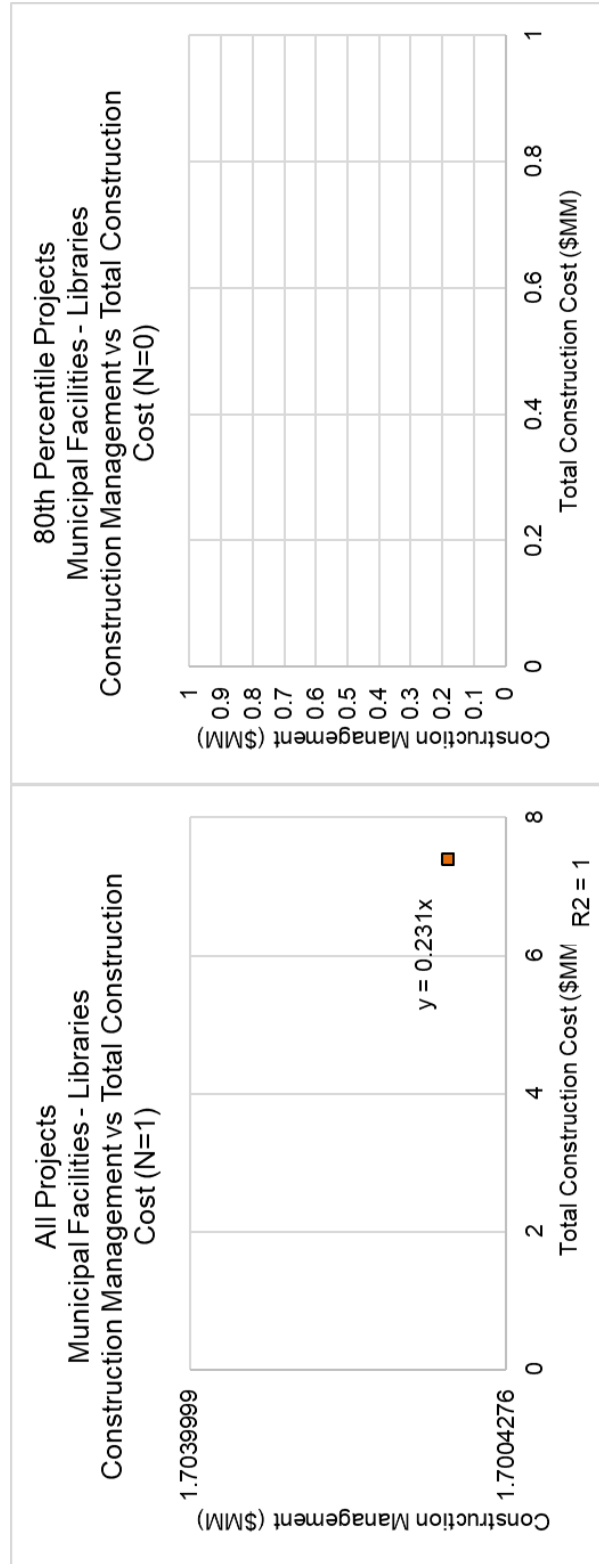


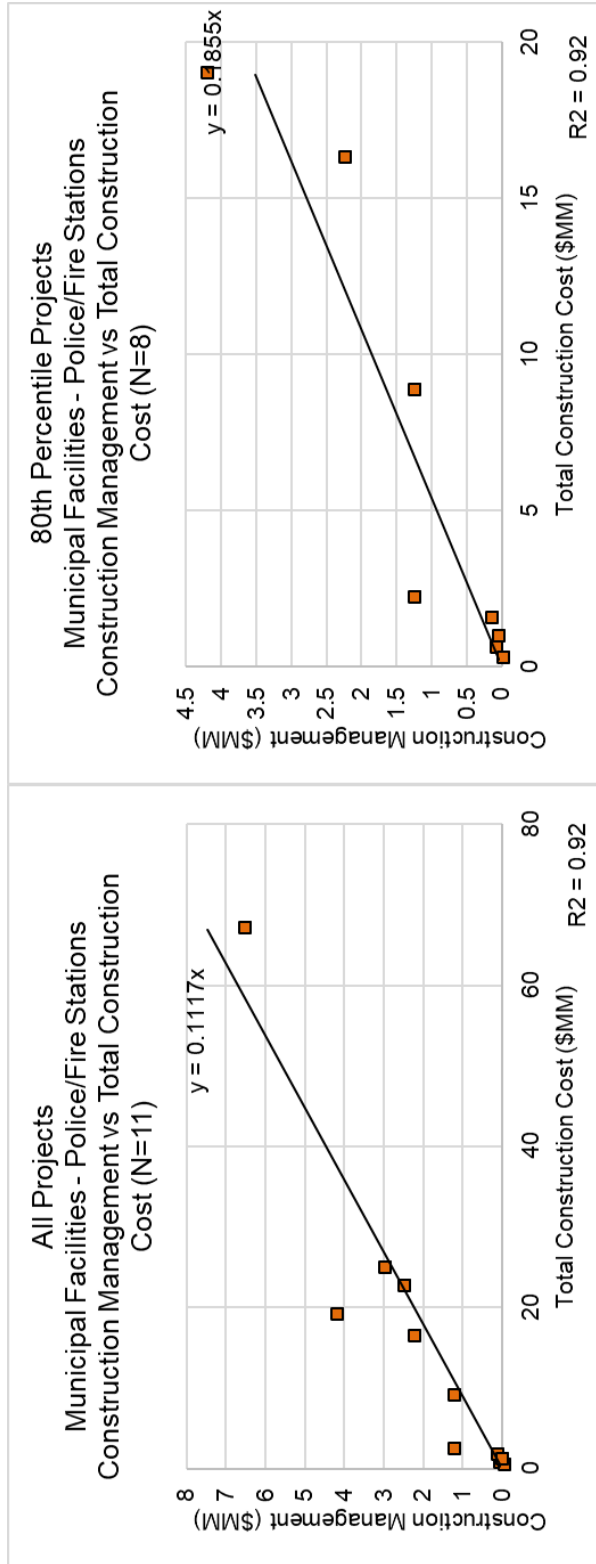


## **CURVES GROUP 2**

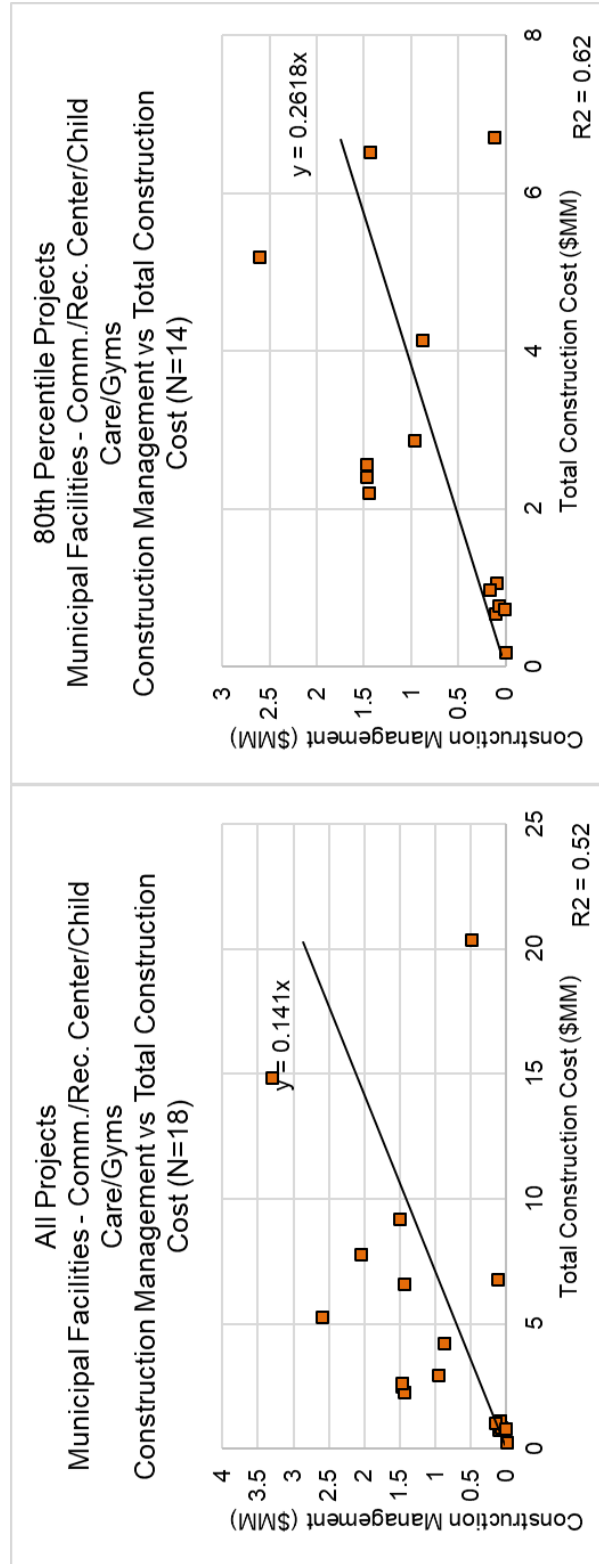
# **Construction Management Cost vs Total Construction Cost**

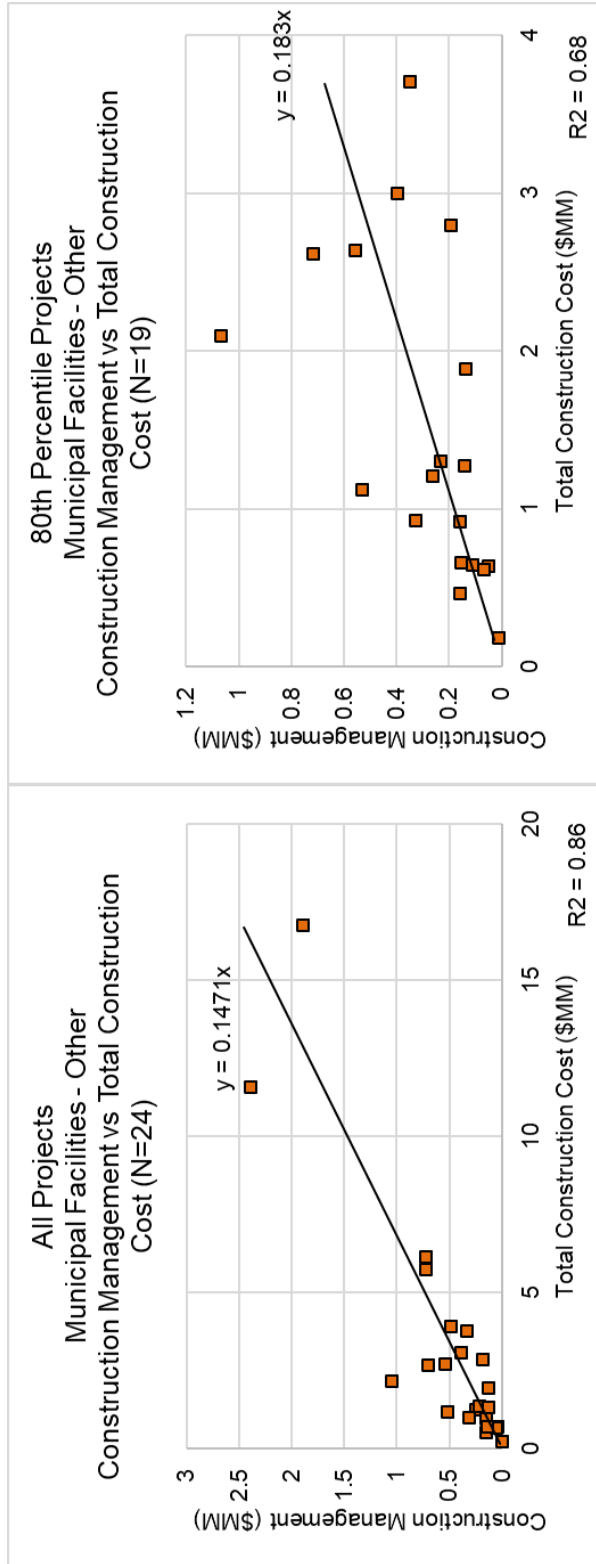


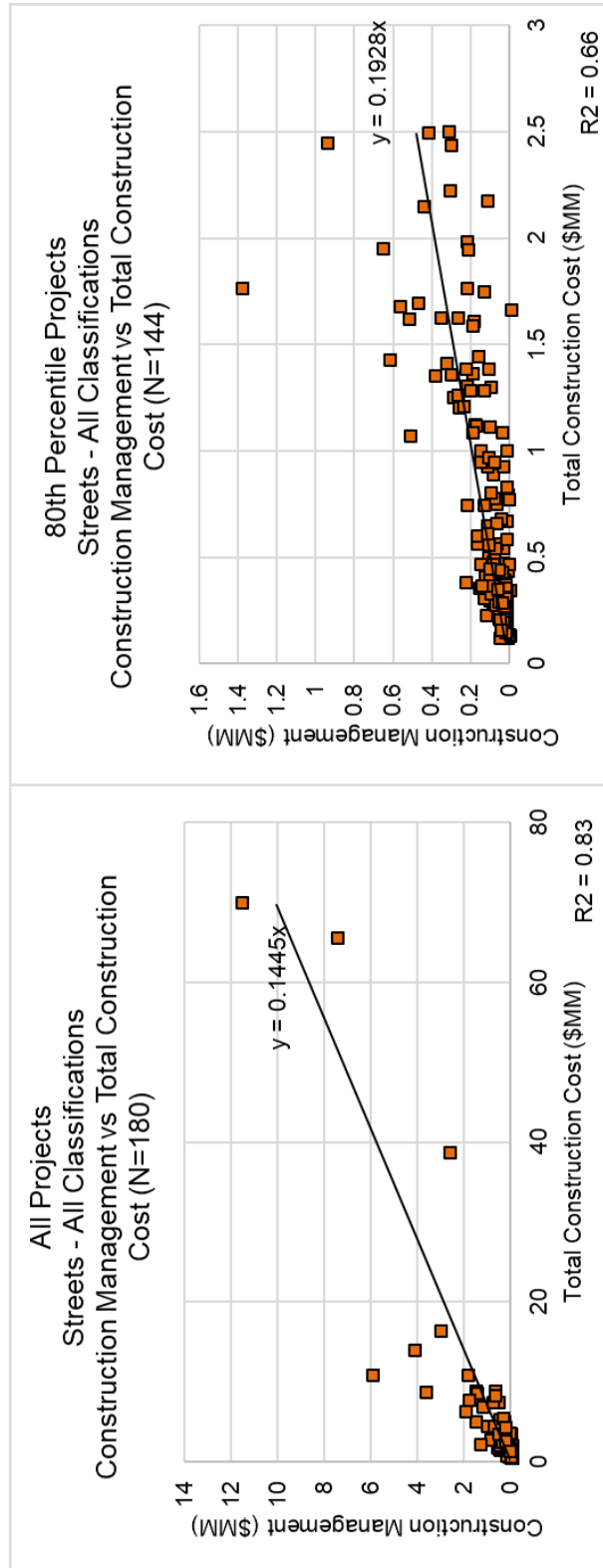


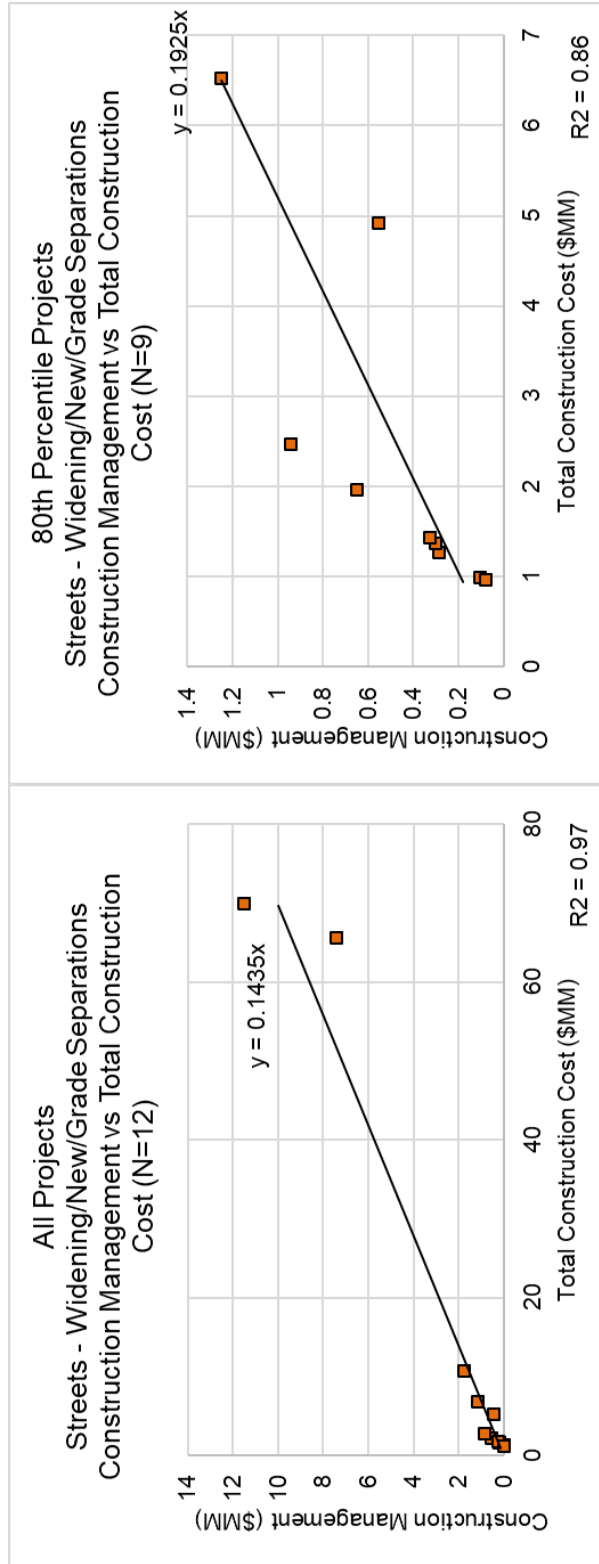


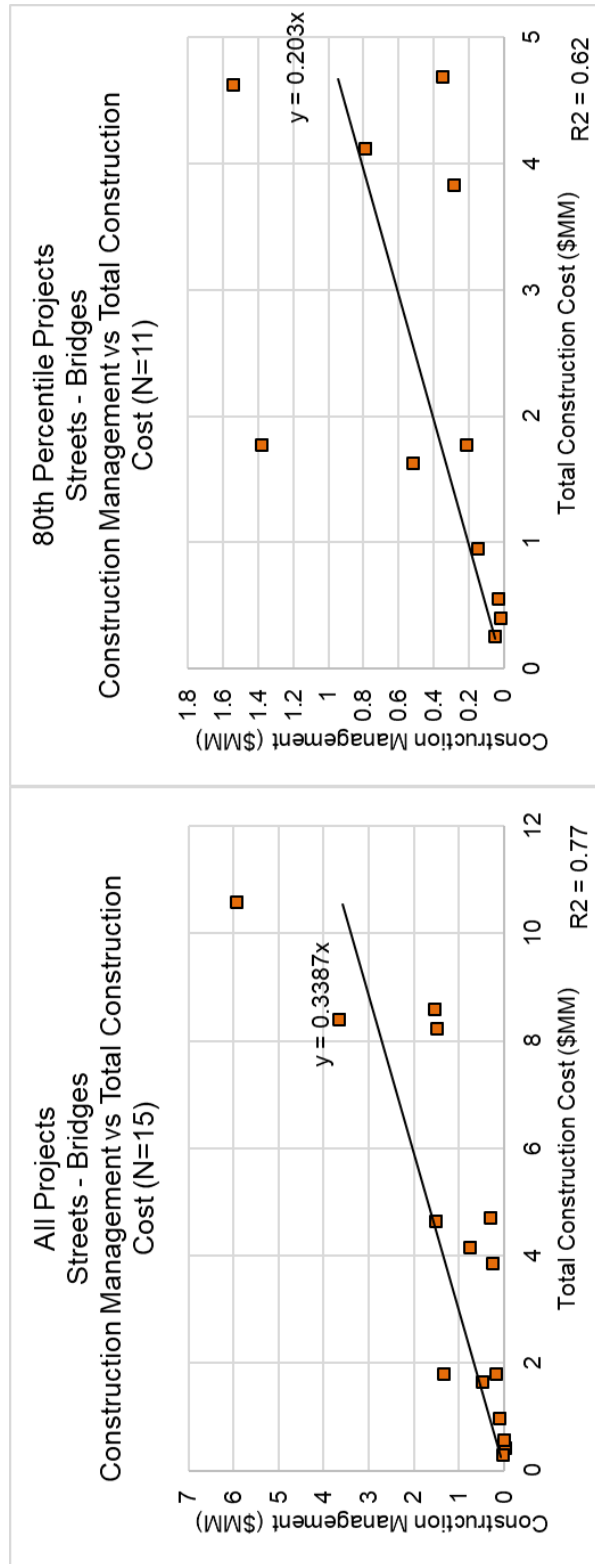


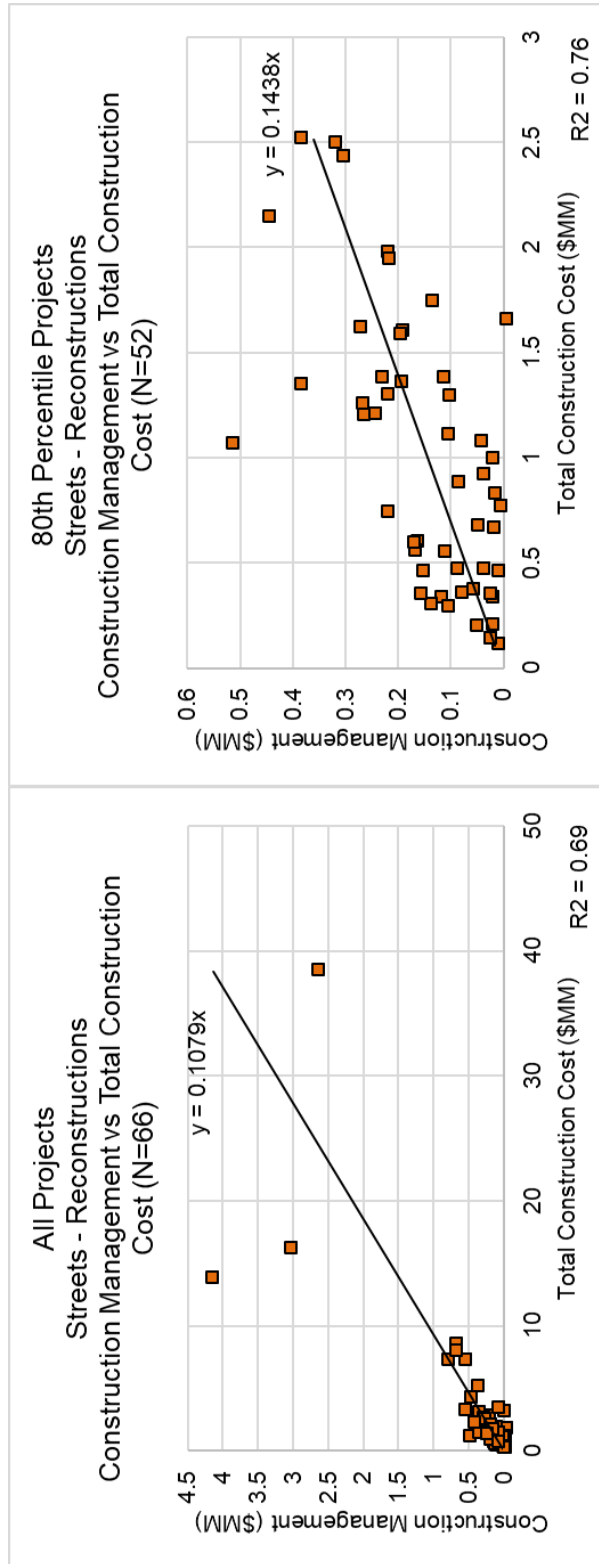




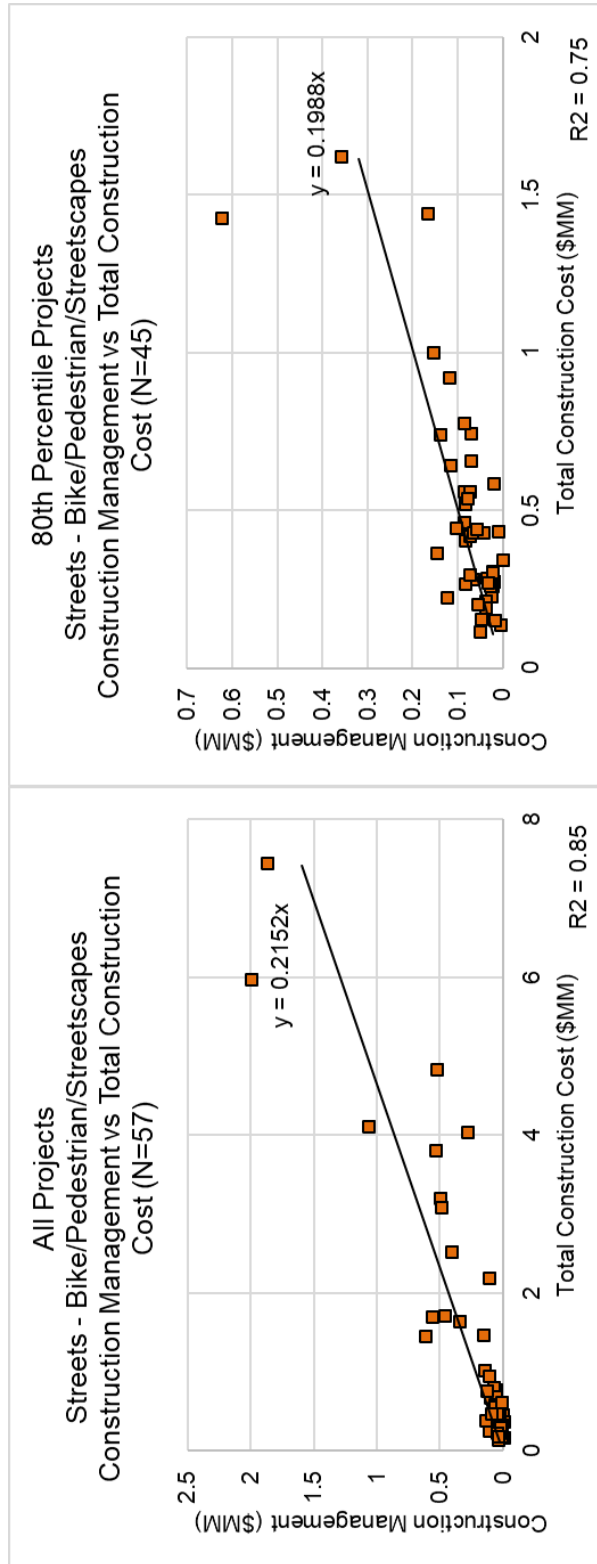


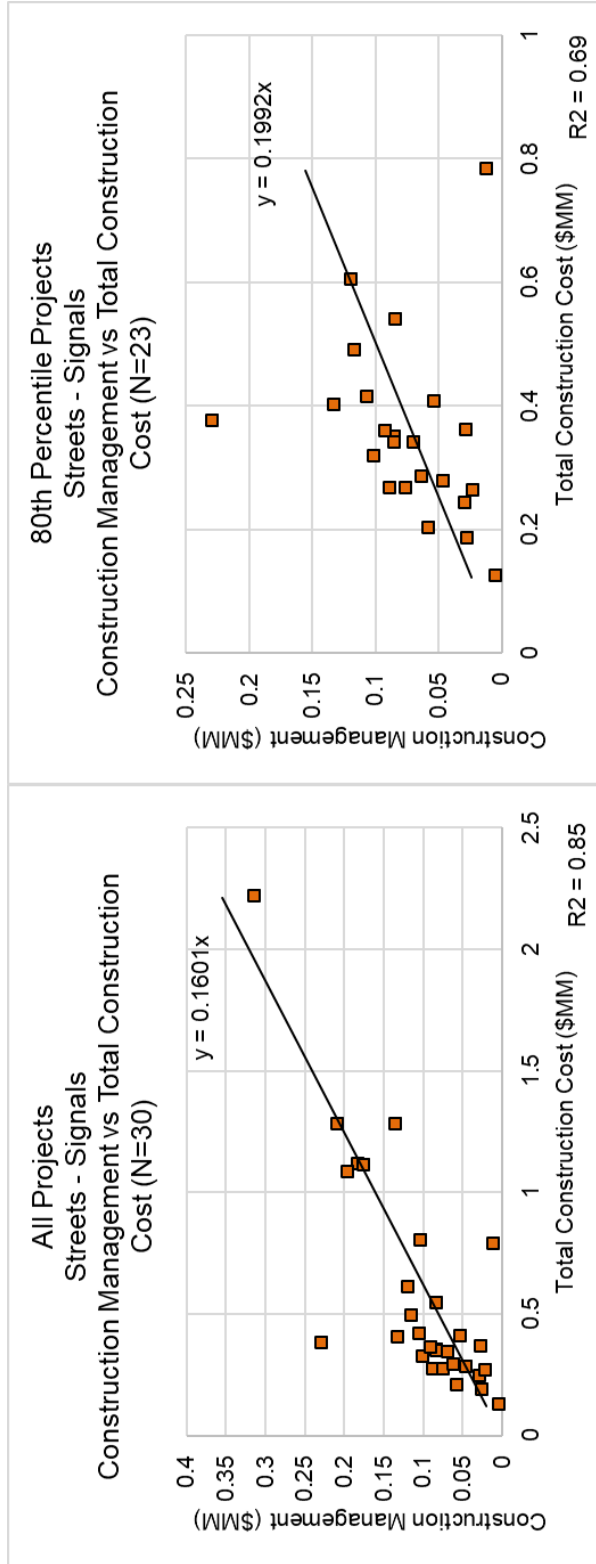


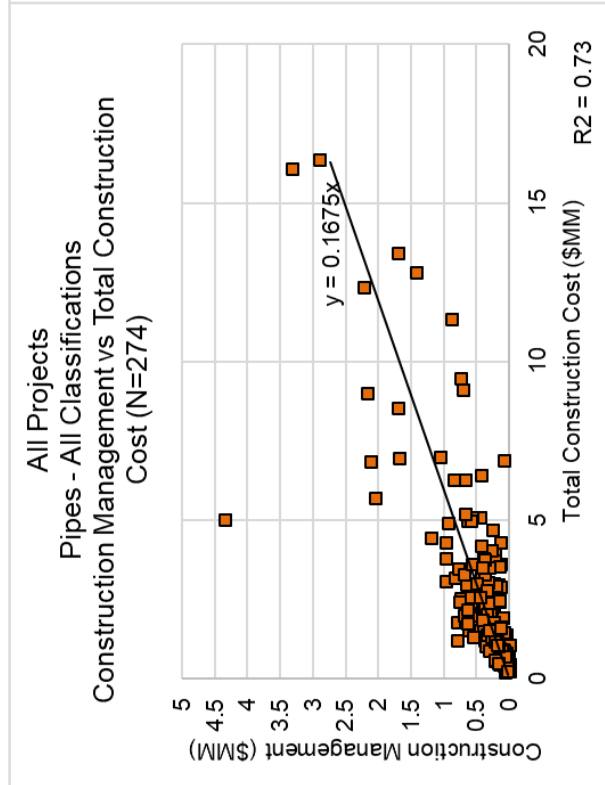
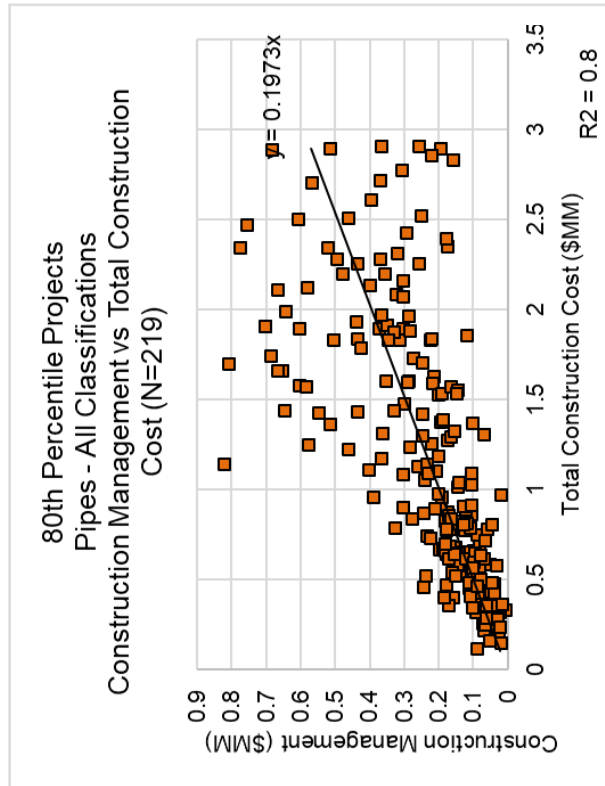


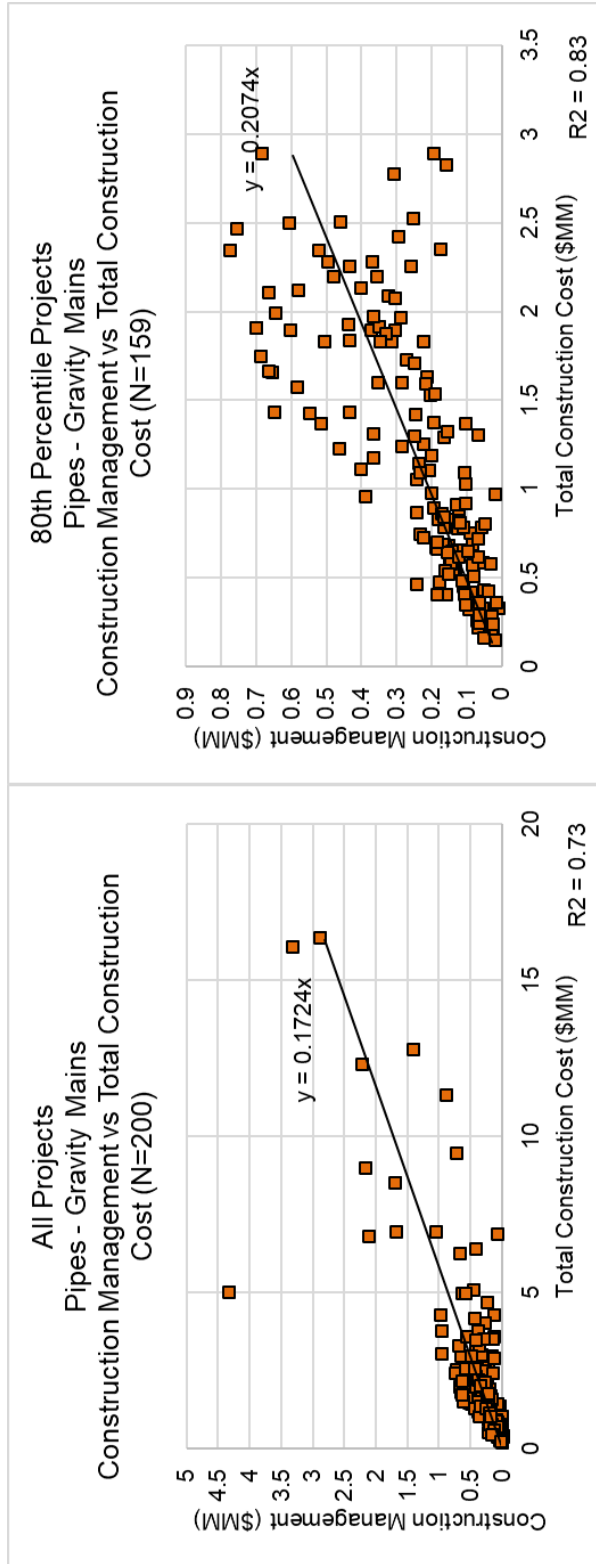


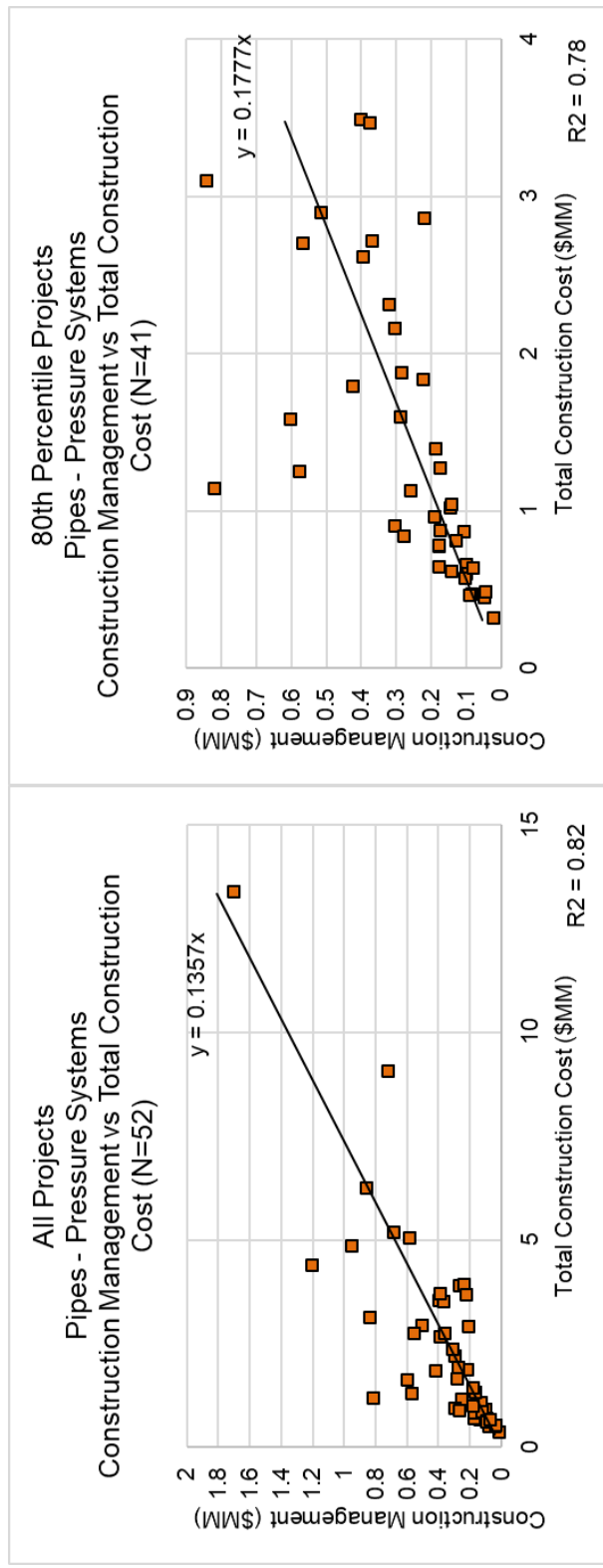


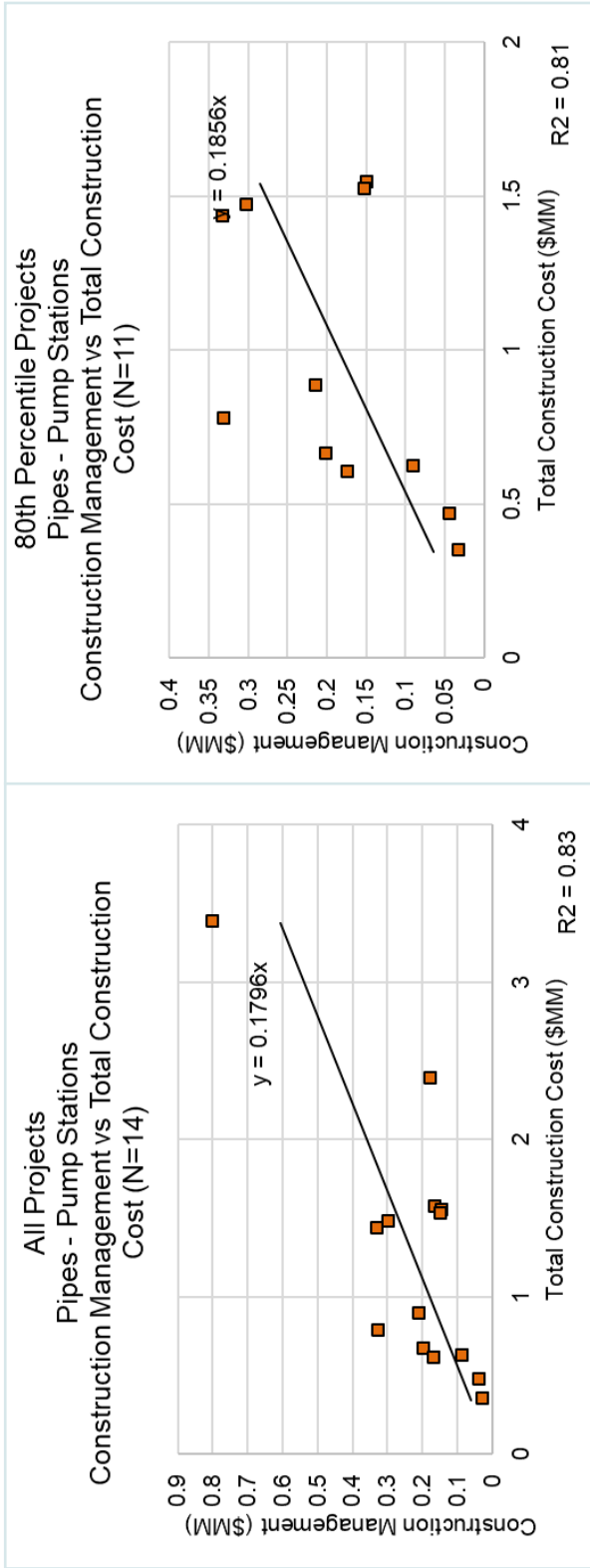




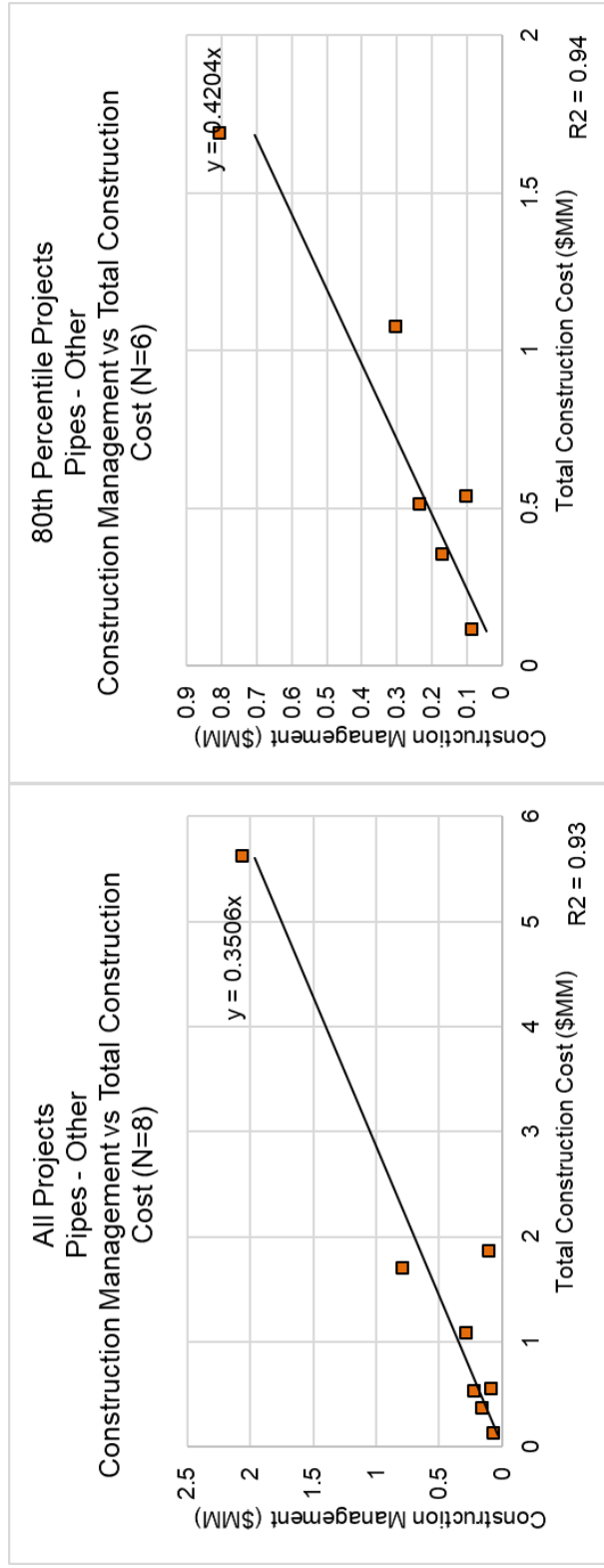


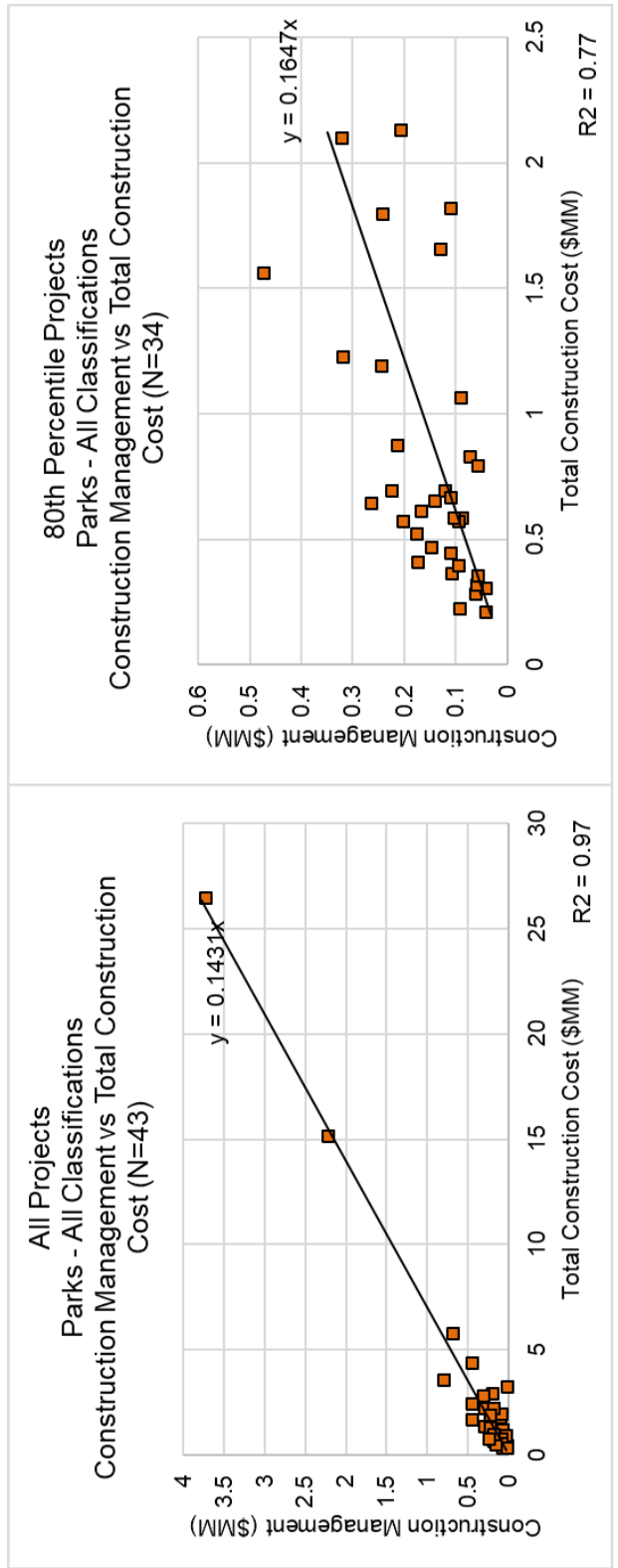


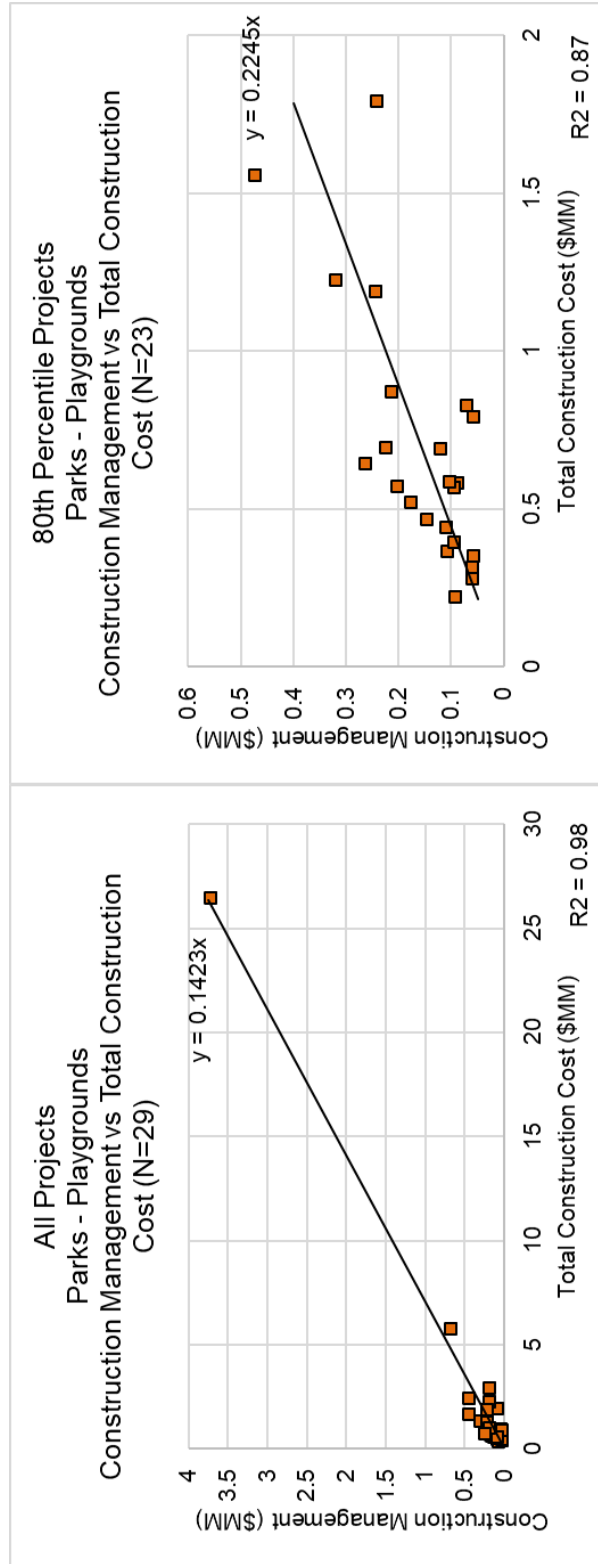


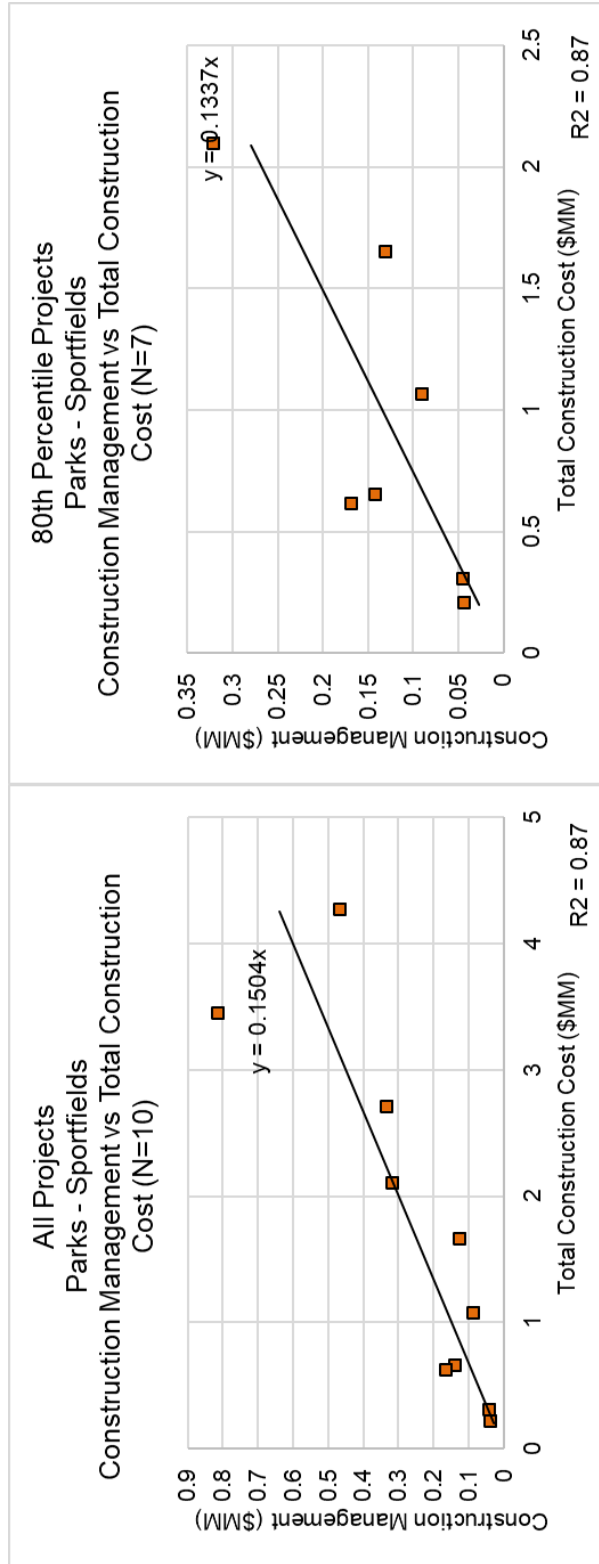


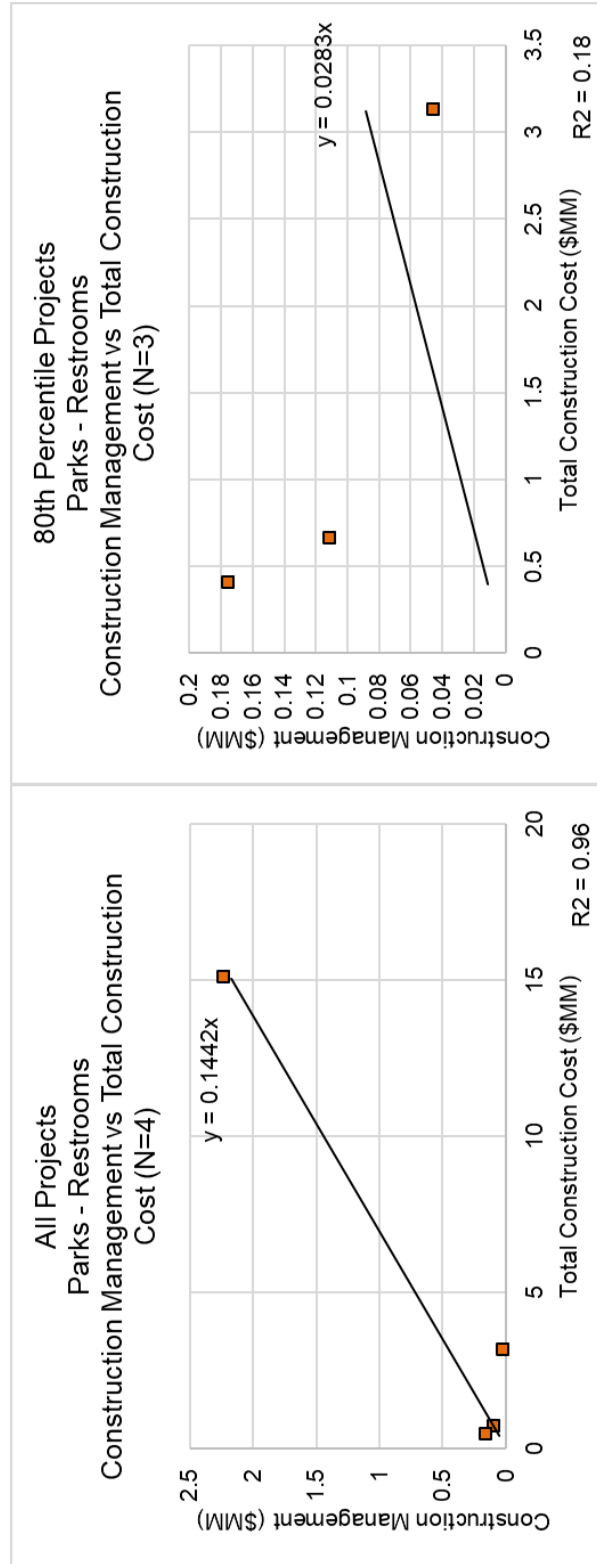


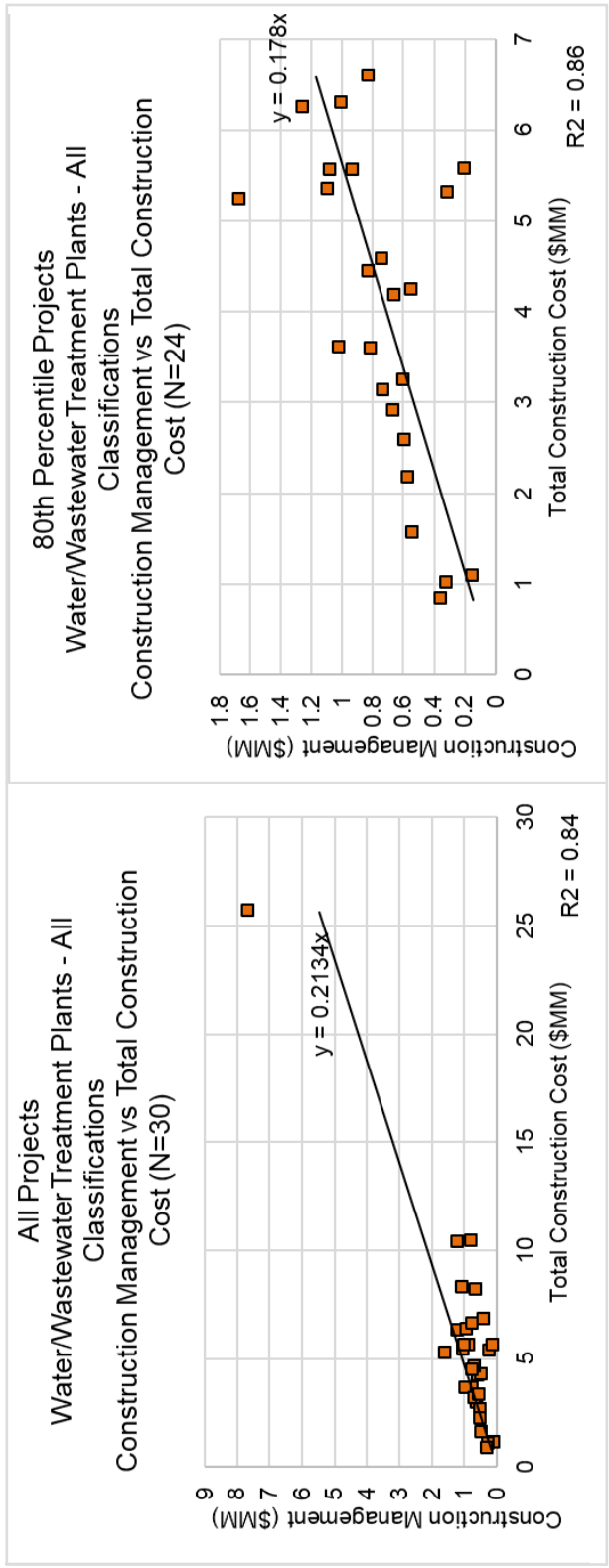








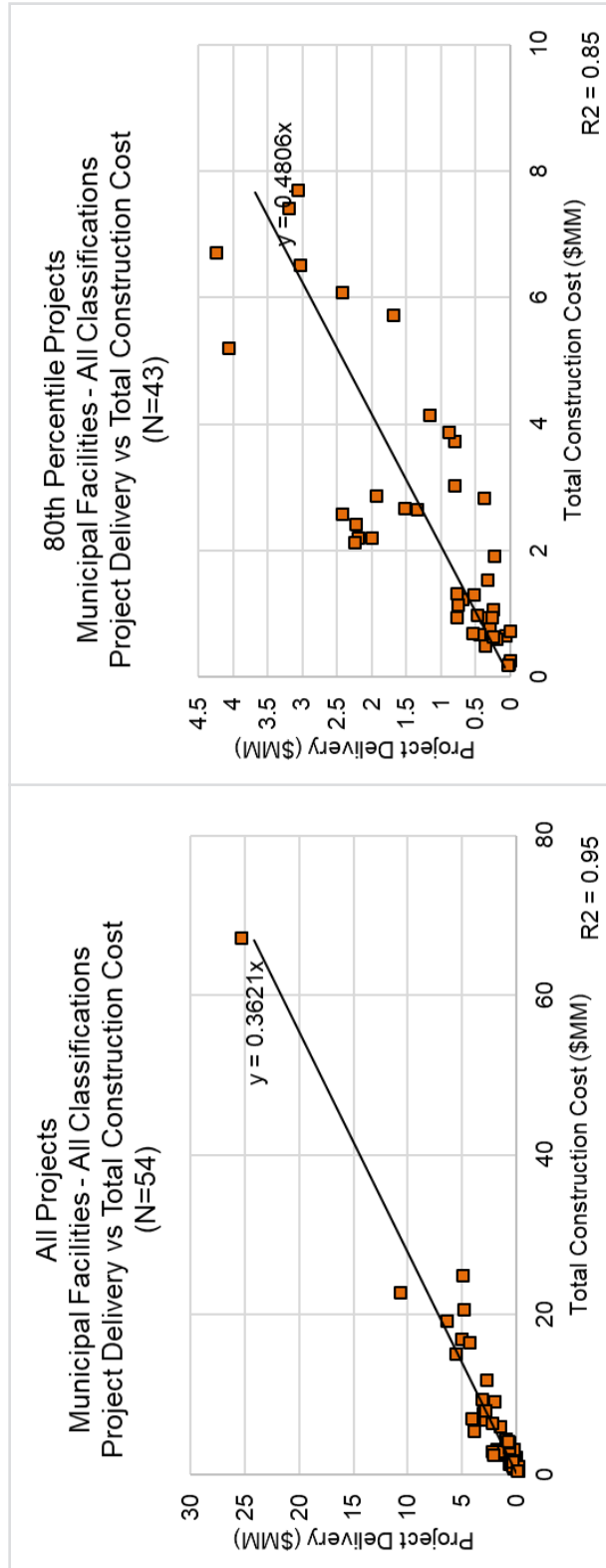


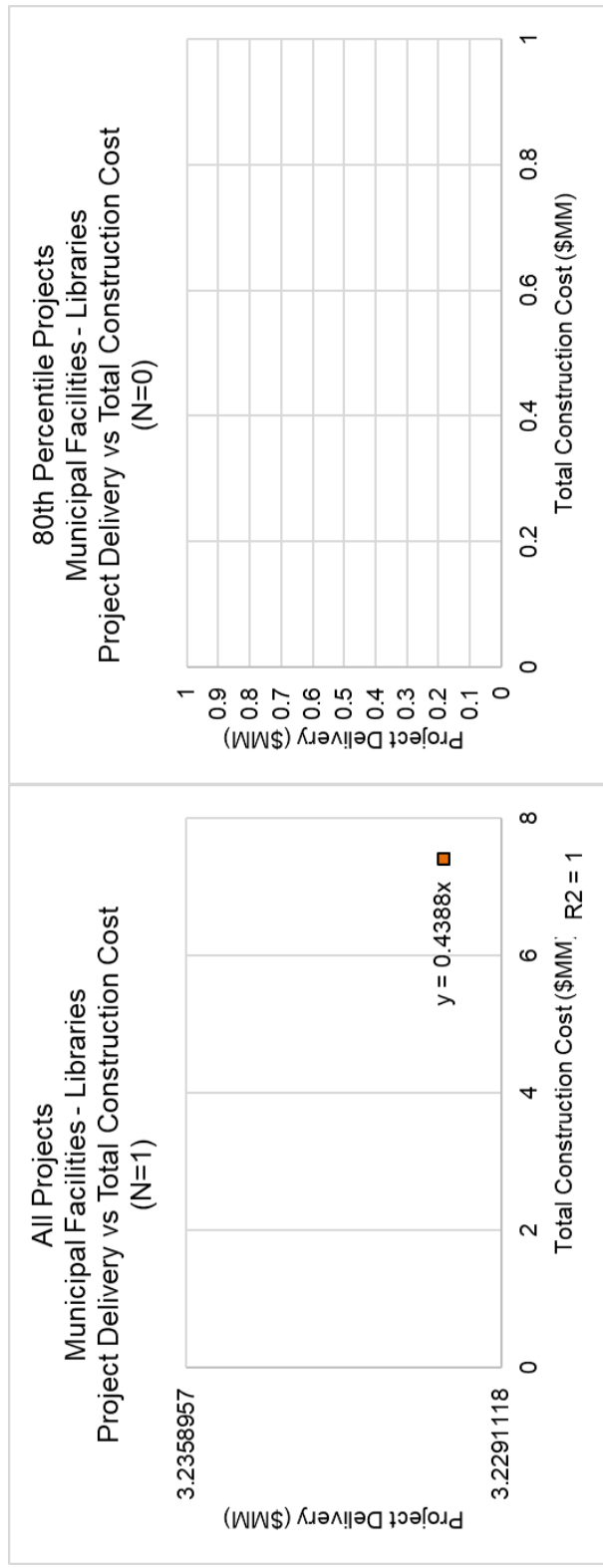


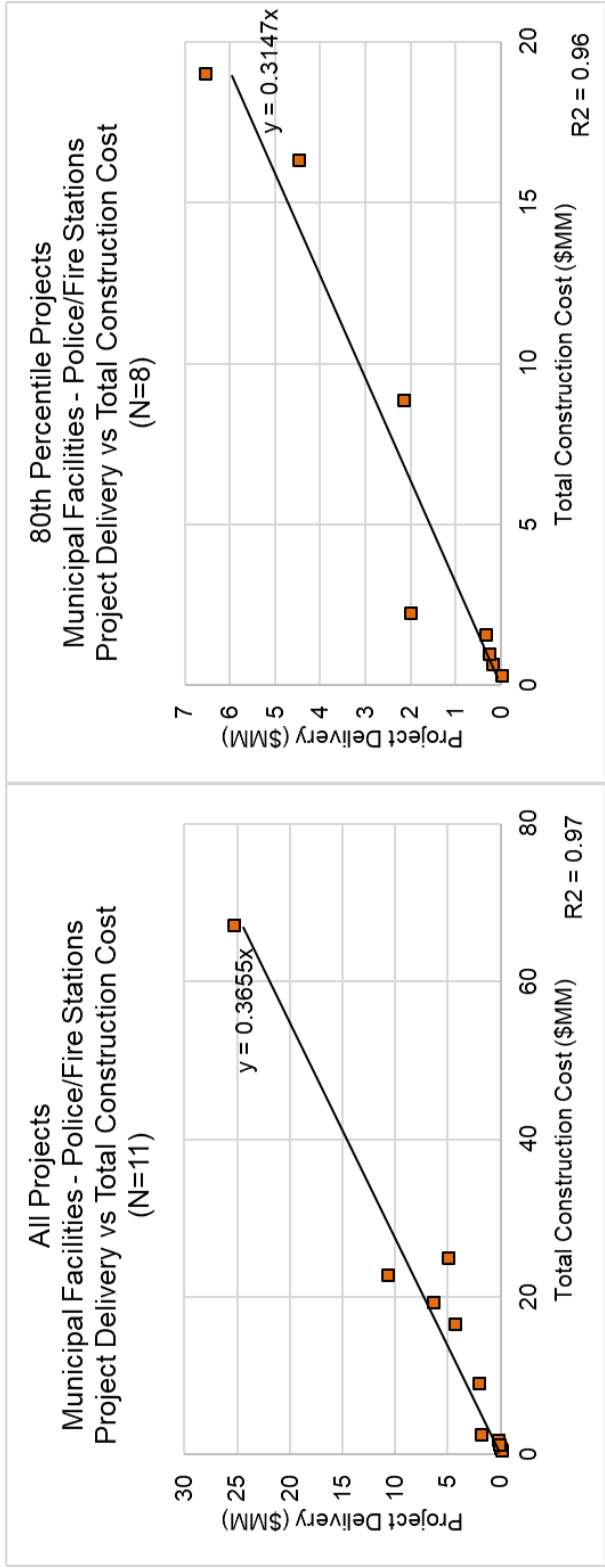
## **CURVES GROUP 3**

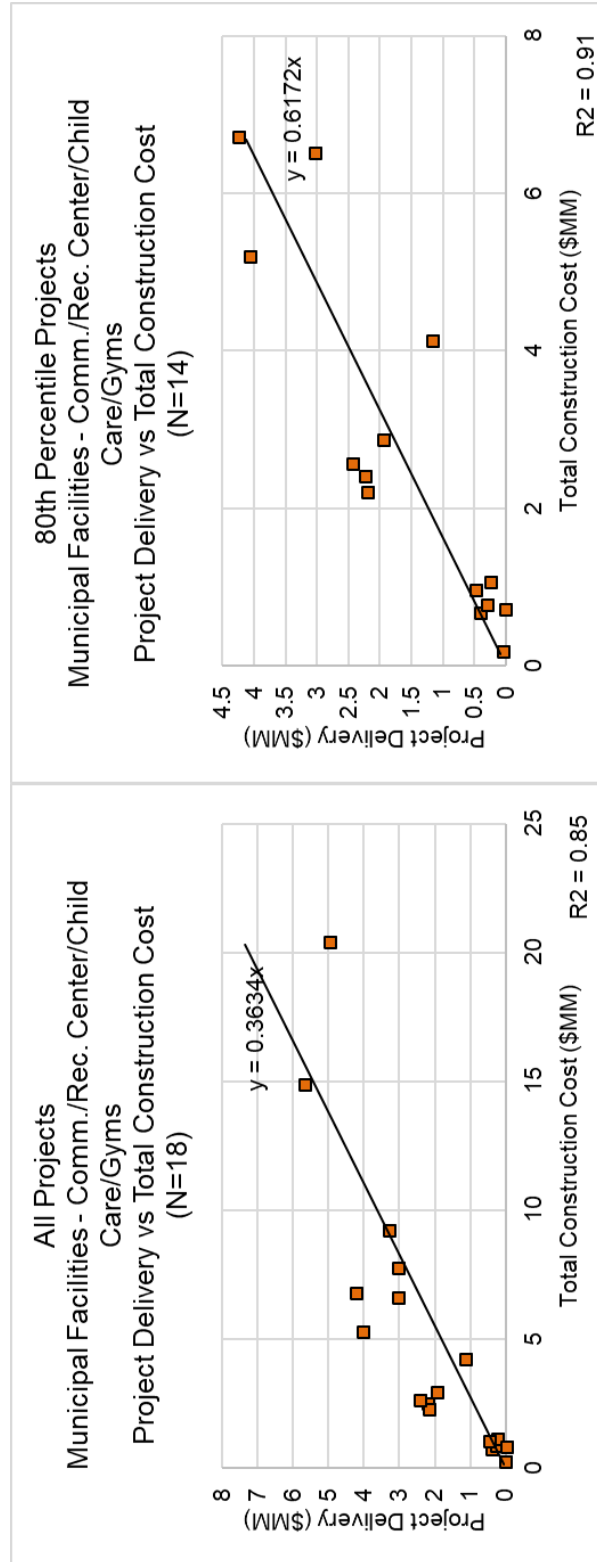
**Project Delivery Cost  
vs  
Total Construction Cost**

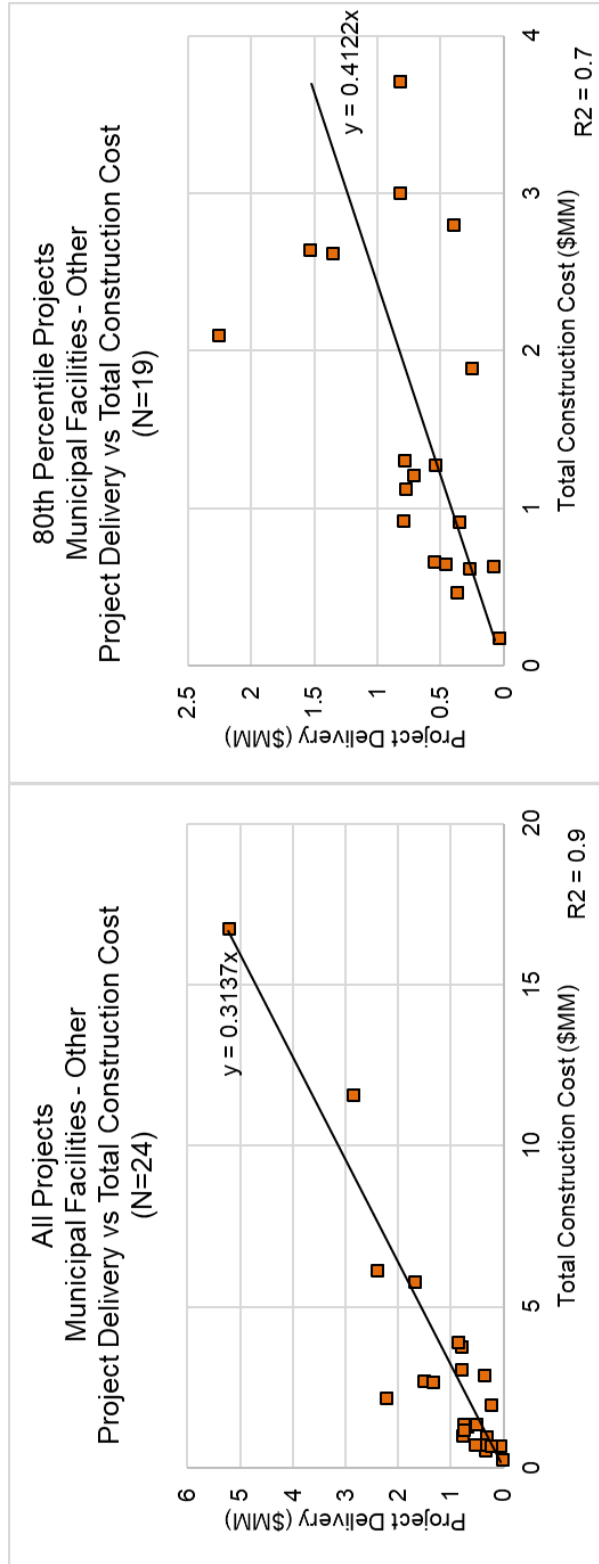


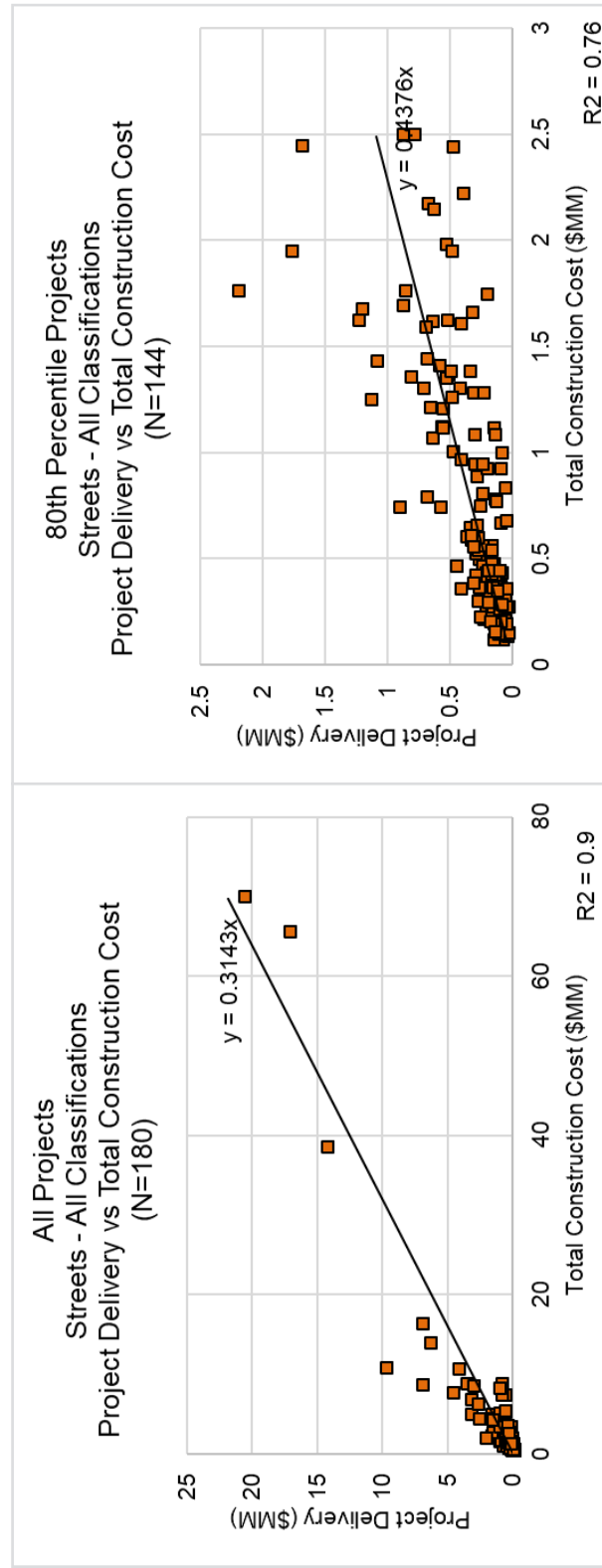


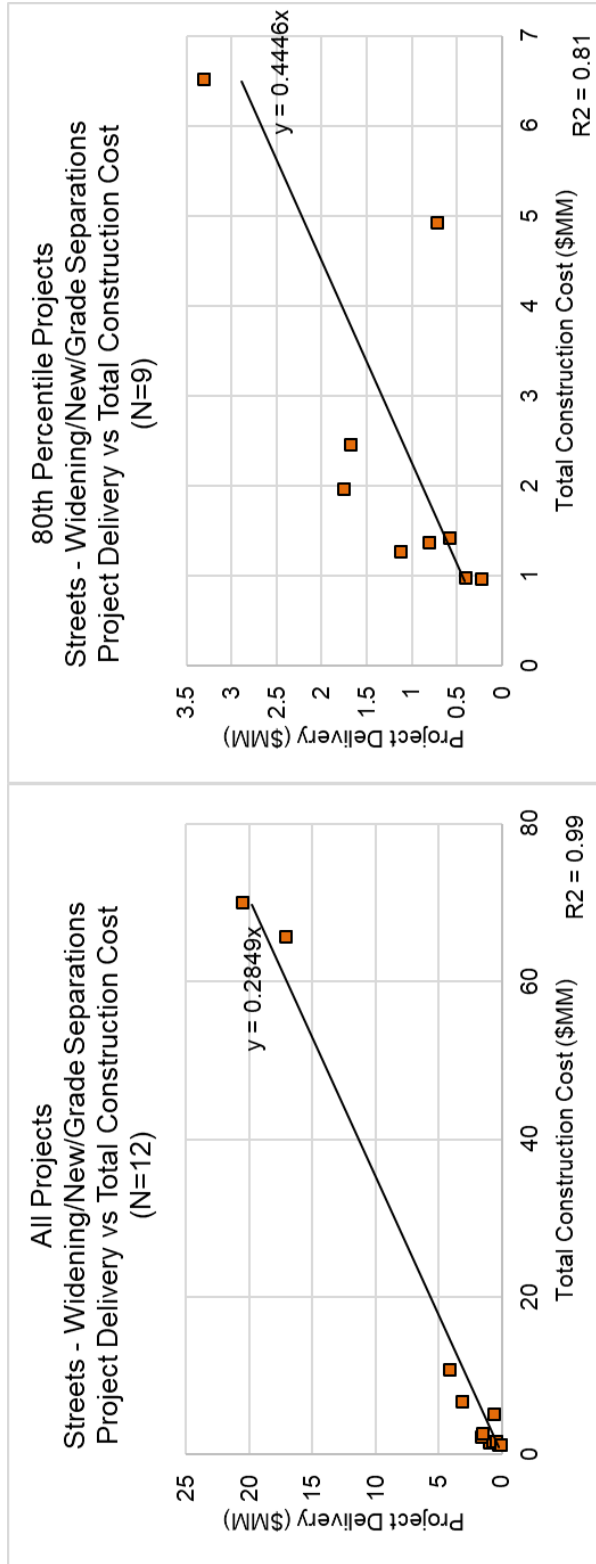




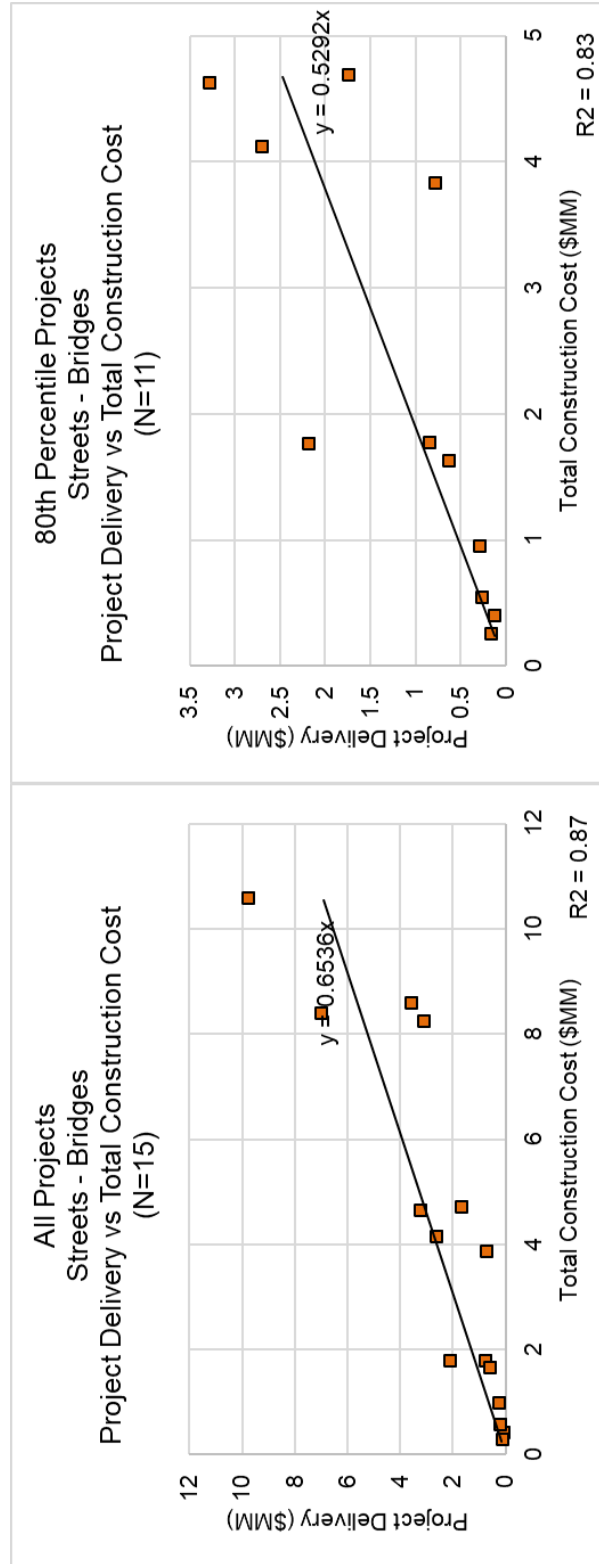


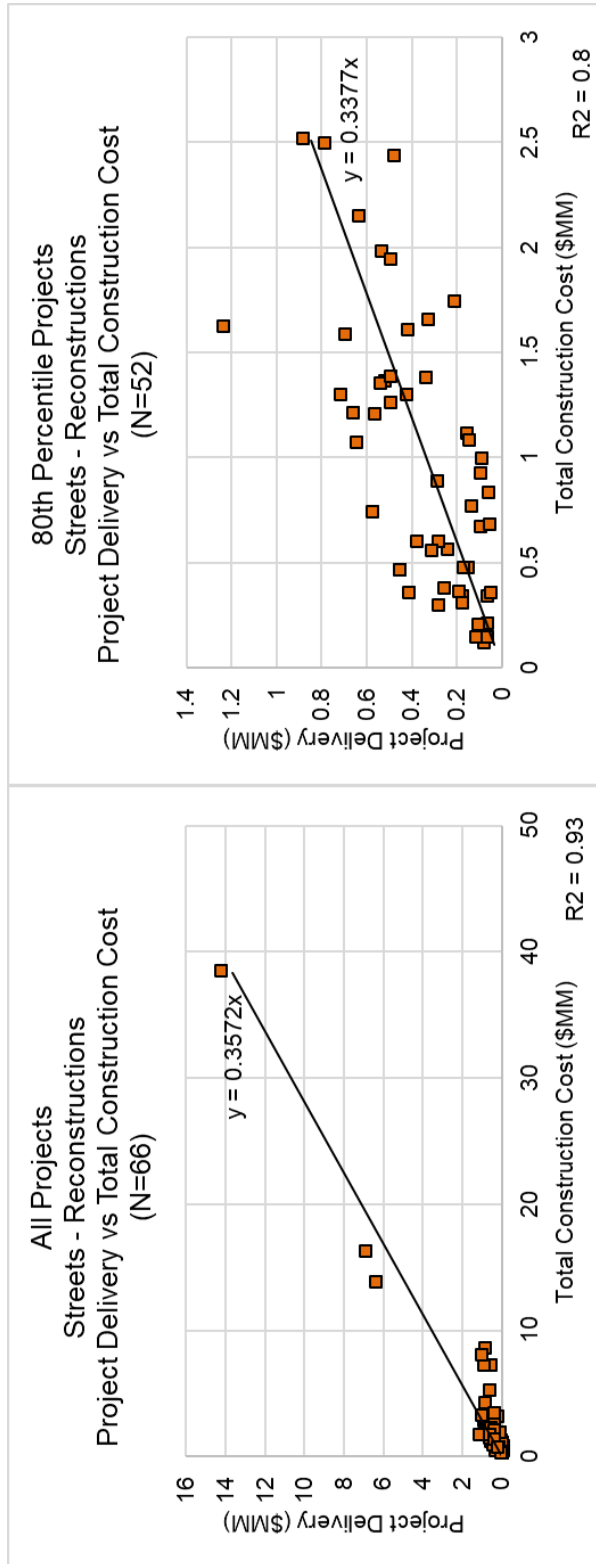


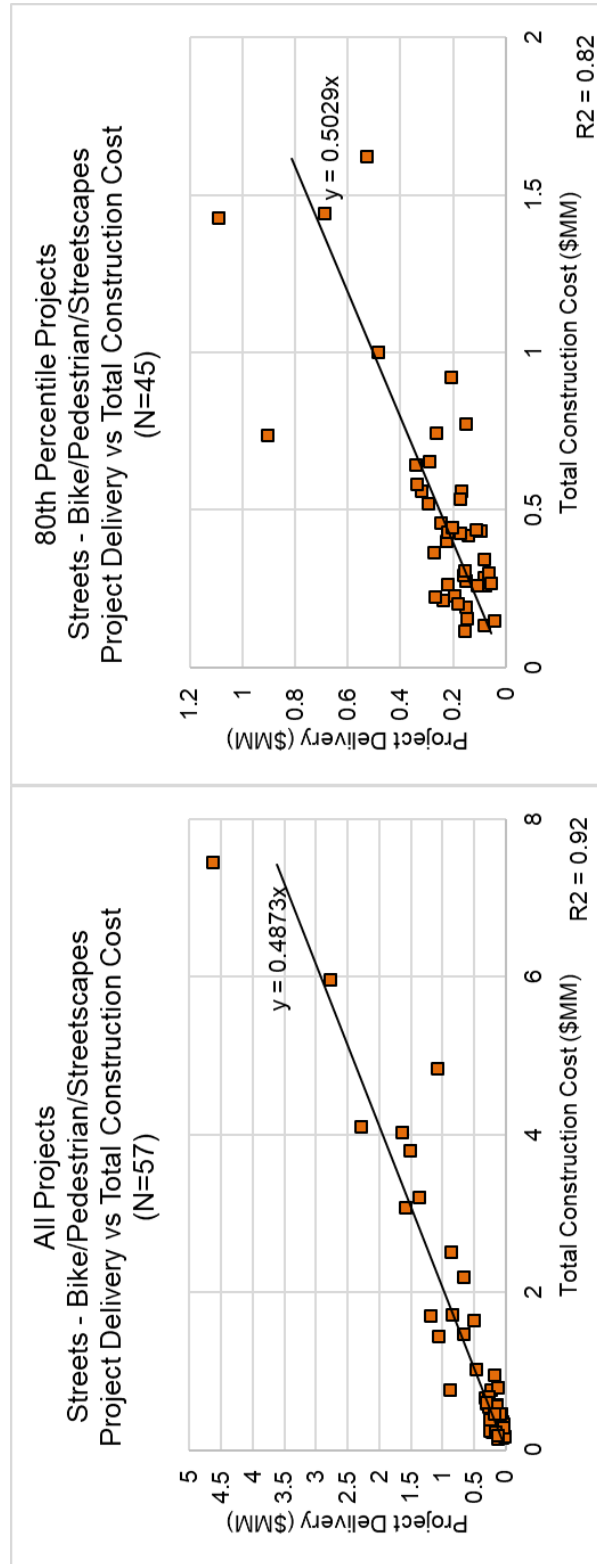


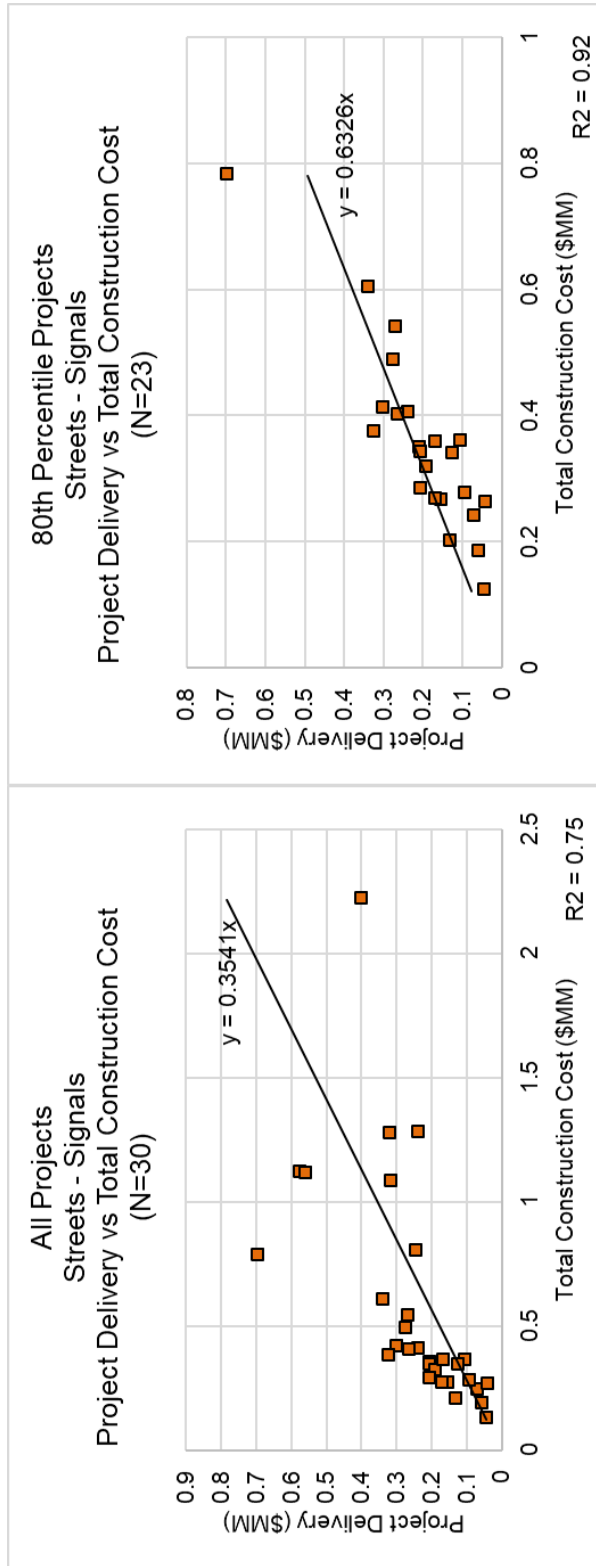


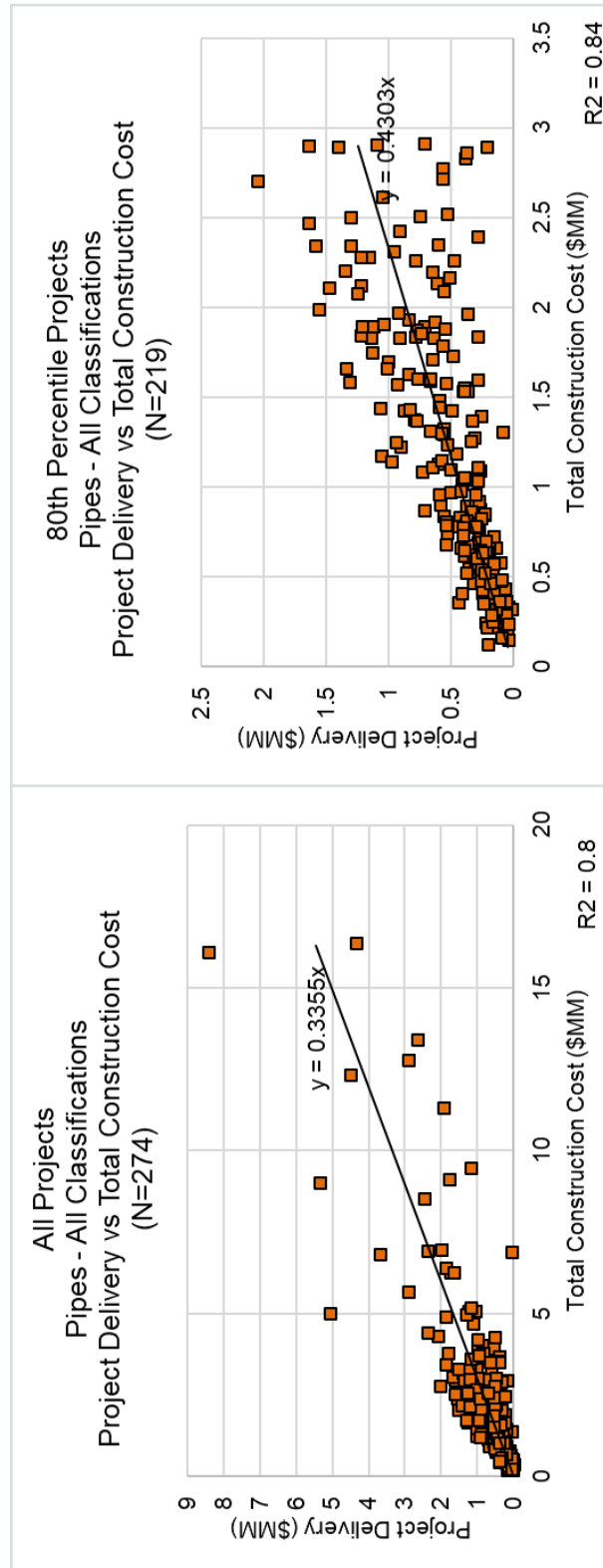


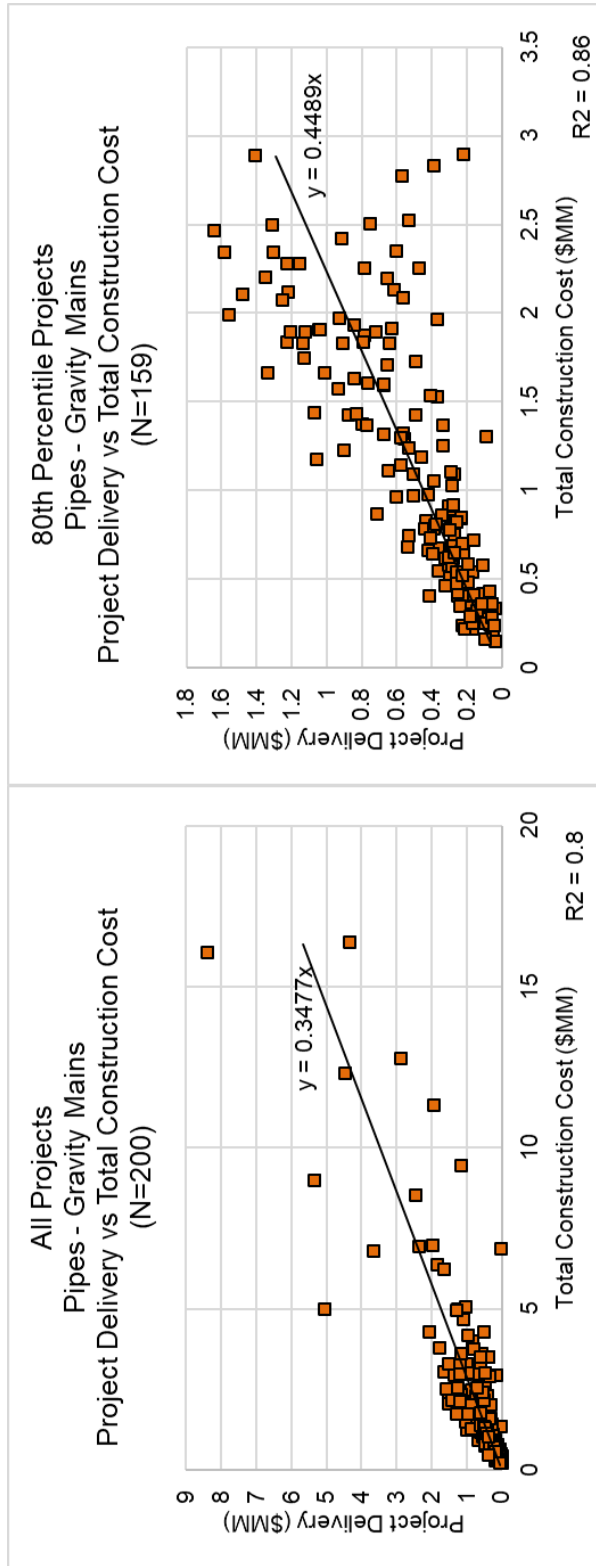


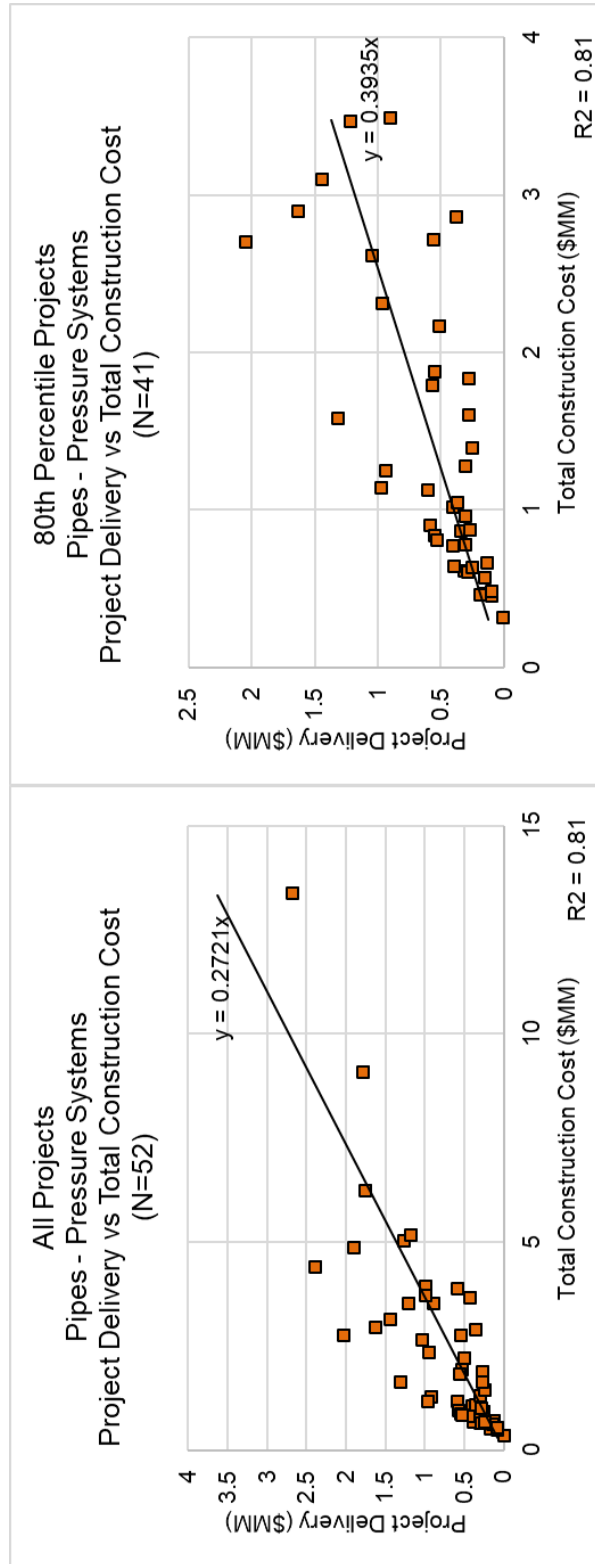




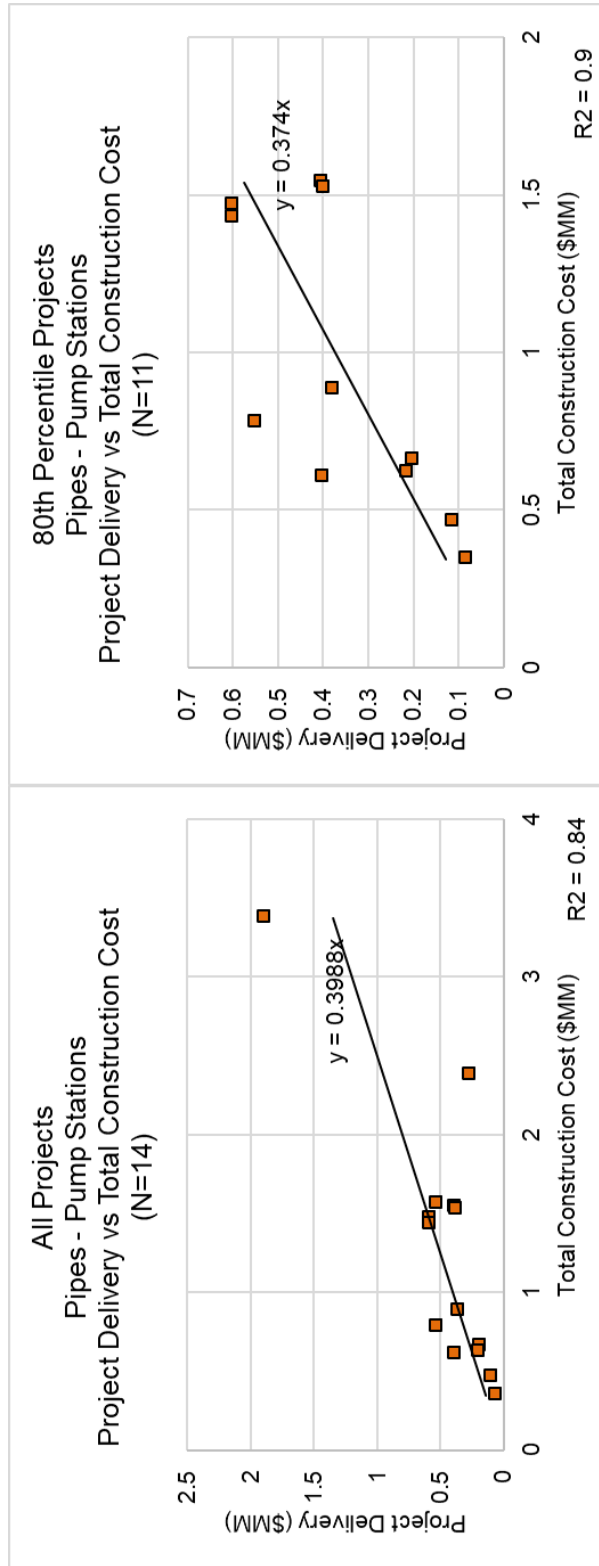


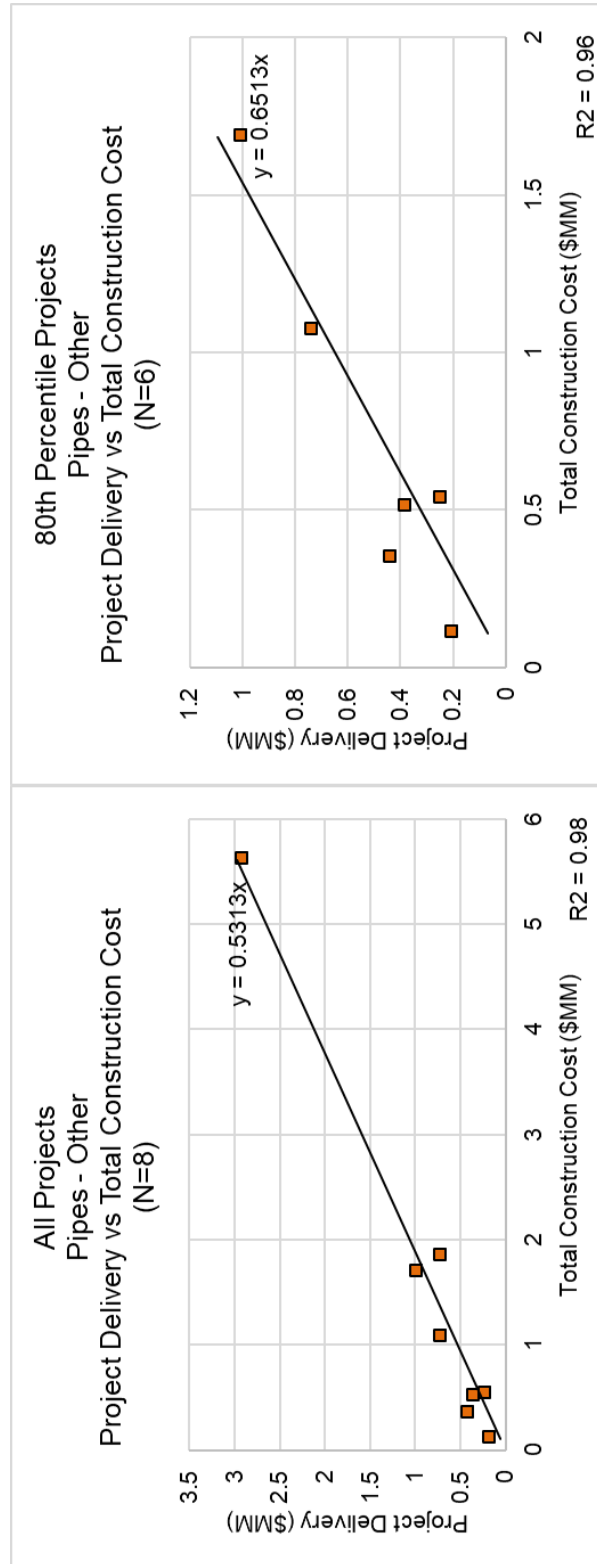


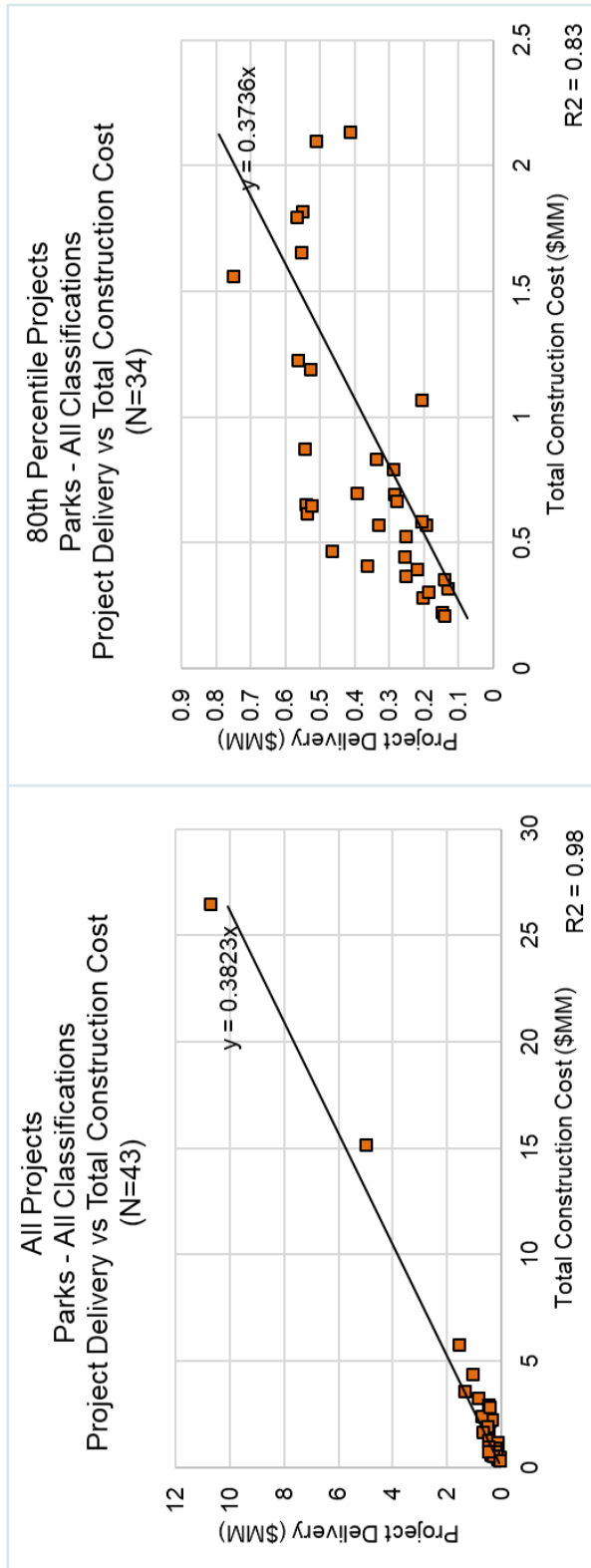


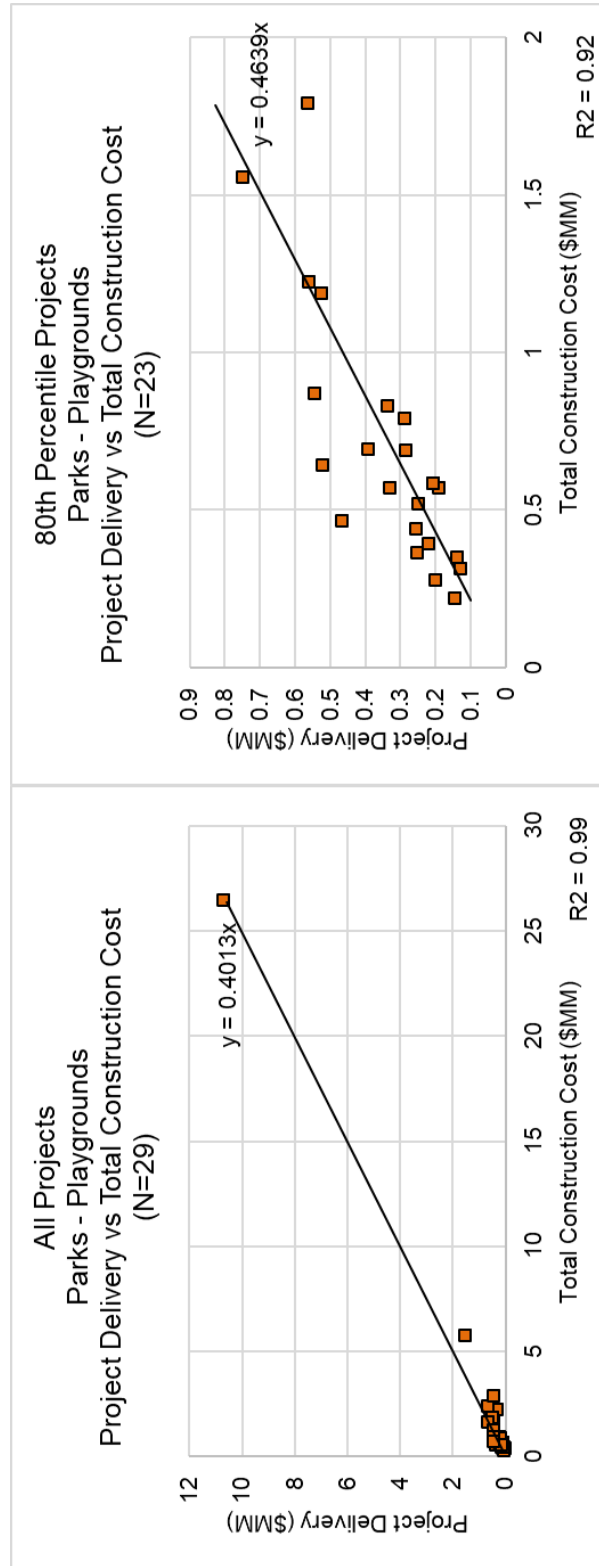


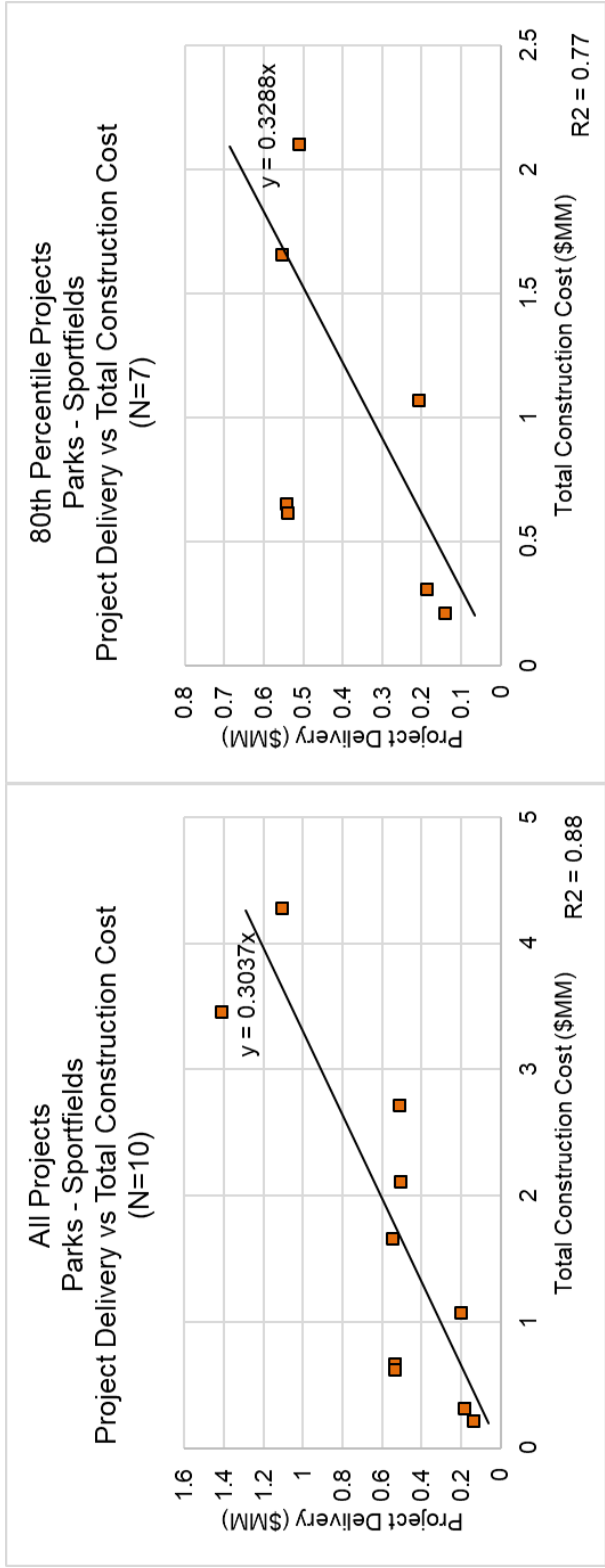


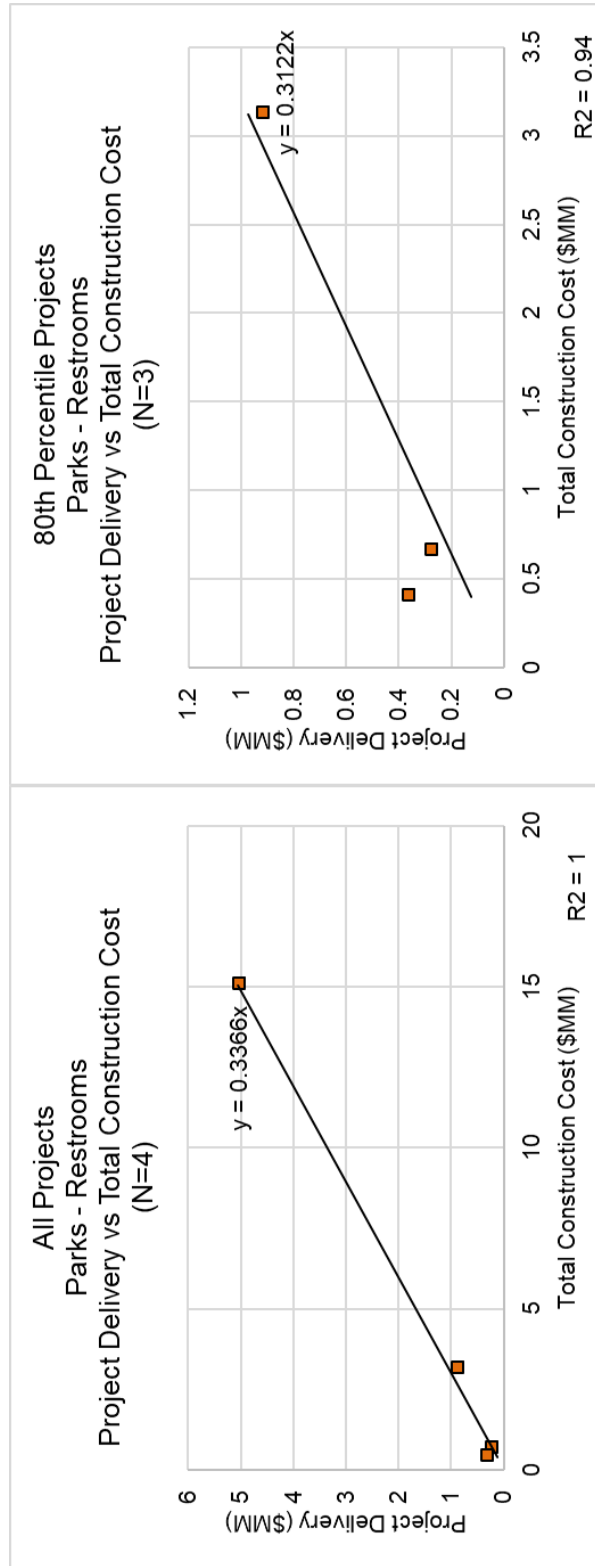


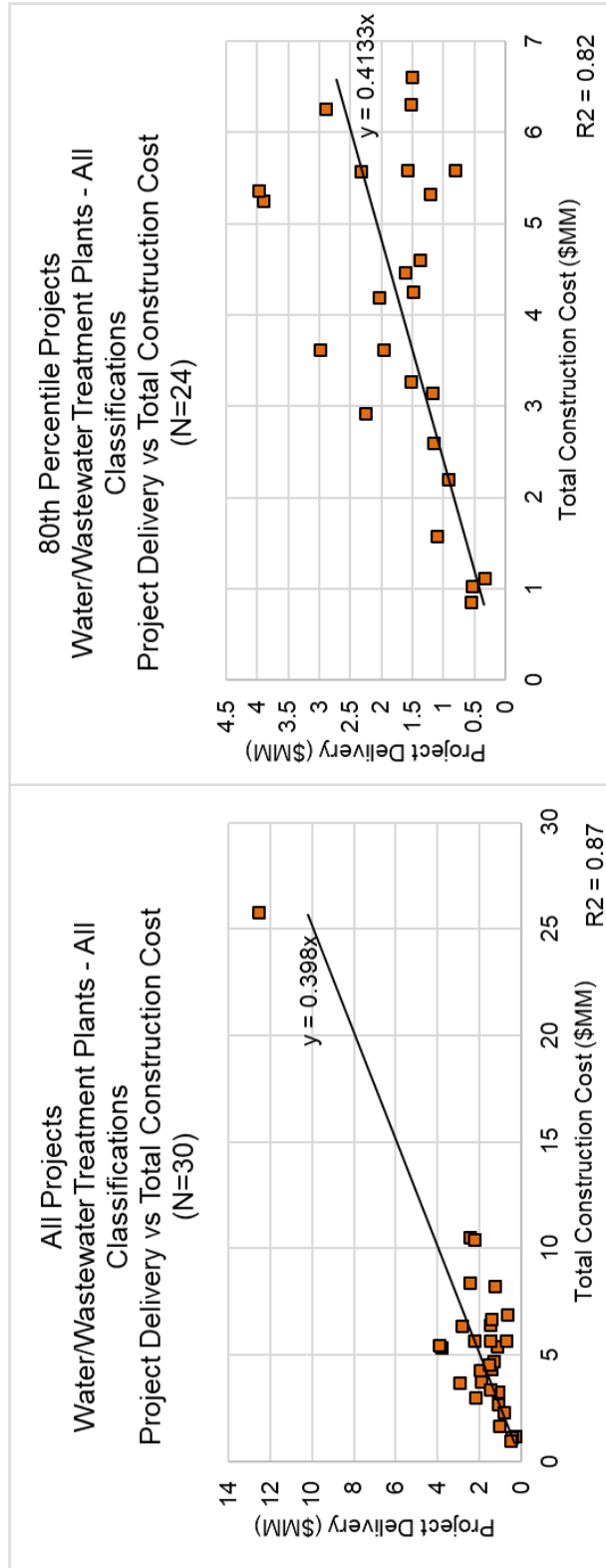














A topographic map of the state of Oklahoma, rendered in shades of blue and grey, showing terrain features like mountains and rivers. The map is set against a light blue gradient background. The title text is overlaid on the right side of the map.

# APPENDIX C INDIRECT RATES

# Indirect Rates

**Table C-1  
Indirect Rates Applied to Capital Projects**

Agency	Fringe Benefits	Compensated Time Off	City Overhead	Department Overhead	Agency Overhead	Indirect Rate Factor <sup>1</sup>
City of Long Beach Department of Public Works <sup>2</sup>	41.92%	19.40%	0%	2.5%	49.21%	149.63%
City of Los Angeles <sup>3</sup> Department of Public Works Bureau of Engineering	40.25%	20.96%	9.48%	16.67%	47.79%	135.08%
City of Oakland <sup>4</sup> Department of Engineering & Construction	71.85%	22.90%	20.22%	29.00%	18.90%	162.87%
City of Sacramento Department of Public Works (FY16 Budgeted) Department of Utilities	41.07%	15.03%	21.71%	11.06%	92.45%	181.32%
	29.26%	18.70%	14.65%	61.16%	42.74%	164.22%
City of San Diego Engineering and Capital Projects	65.68%	16.60%	0%	0%	98.70%	180.98%
City and County of San Francisco Department of Public Works Building Design and Construction Infrastructure Design and Construction	38.22%	24.52%	0%	57.69%	62.19%	182.62%
City of San José Department of Public Works (FY15-16)	68.37%	22.19%	41.13%	14.29%	Included	178.13%

**Notes:**

1. This value may be different from the sum of overhead values since the compounding formula may vary by agency.
2. The City of Long Beach is currently in the process of recomputing its overhead rates. Rates shown in the above table are 2012 rates.
3. Based on averages of all Bureau program overhead rates provided under CAP 37.
4. All costs are captured independently of funding source
5. The City of Oakland has taken a temporary break from the Study and therefore, indirect rates for the agency have not been updated since Update 2016.
6. Component rates for the City of Sacramento's Department of Utilities are from 2017.

Page Intentionally Left Blank



# PARTICIPATING AGENCIES

*City of Long Beach  
Department of Public Works  
Harbor Department Port of Long Beach*

*City of Los Angeles  
Department of Public Works  
Bureau of Engineering*

*City of Oakland  
Public Works Department  
Bureau of Engineering & Construction*

*City of Sacramento  
Department of Public Works  
Department of Utilities*

*City of San Diego  
Engineering & Capital Projects Department*

*City & County of San Francisco  
Department of Public Works  
Building Design & Construction  
Infrastructure Design & Construction*

*City of San Jose  
Department of Public Works  
City Manager's Office*

<http://eng.lacity.org/techdocs/cabm/>