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Change Orders in County Government Construction Projects

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OLO Office of Legislative Oversight

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The Department of General Services (DGS) manages the design and construction of most County Government capital projects. DGS approves change and field orders to modify the work requirements, cost, and schedule of facility construction contracts. This report examines the change and field order process for County Government capital facility construction projects.

Change Orders and Field Orders

A change order is a written directive to the contractor directing a change in the work within the general scope of the contract. A change order may adjust the contract cost and/or time. DGS also may direct a change in work by another form of written directive known as a "field order." Two factors distinguish a field order from a change order. First, a field order must be the result of "unforeseen and unanticipated conditions." Second, the unforeseen conditions addressed by a field order must warrant "immediate action to mitigate costs or avoid delays." A field order may not modify the contract price.

Construction contract change and field orders are not inherently beneficial or detrimental to the progress of a capital project. The change order process is a method to respond to changing requirements that arise during the construction phase of a project. When managed well, the change order process can offer substantial benefits to a contract manager.

In the absence of a change order process, the original construction contract likely would require a higher payment amount to compensate the contractor for assuming responsibility for addressing unanticipated work requirements.

However, change orders also may result in undesired cost increases and delays. Once an agency has entered into a contract with a construction firm, an opportunity no longer exists to competitively bid changes to work requirements. Rather, by its very nature, the change order process requires the agency to only consider pricing and staffing offered by the contractor (or through a subcontractor).

Factors that Cause Change and Field Orders

Multiple conditions precipitate the need for a construction contract change or field order.

- Site Conditions: Projects located at redeveloped sites or on previously disturbed land run a higher risk of encountering subsurface problems such as subterranean rock and contaminated soils. In addition, renovation projects present further risk resulting from the integration of newly constructed and older pre-existing elements of the building.
- Errors and Omissions: Facility design plans sometimes include errors and omissions, particularly when the design contractor lacks the specialized expertise to design a complex project.
- Third Party Involvement: Often, facility construction requires coordination with a third party (other than the County and its contractors). Construction progress may be dependent on the performance and requirements of the third party.
- Code Compliance: Regulatory agencies review construction plans and conduct site visits to ensure that the facility is built in compliance with all relevant codes. On occasion, standards change after the completion of construction plans but before the start of facility construction.
- Modified User Requirements: On occasion, the using department will modify the facility requirements after completion of the architectural and engineering plans.

Change and Field Orders in Recent County Projects

OLO reviewed the change and field orders documents for 17 capital projects managed by DGS that reached substantial completion in Calendar Years 2009 through 2013. For these projects, change and field orders had a moderate effect on contract costs. Change and field orders aggregated together for all 17 capital projects resulted in an overall increase in contract costs of 8.0%. Eleven projects experienced a change in contract cost of less than 10%. In fact, change orders for two projects resulted in a reduction in final contract costs. A single project, the Council Office Building Data Center Rehabilitation, incurred change and field order cost increases of greater than 20% of contract costs. With the exception of the Council Office Building Data Center and Takoma Park Fire Station projects, the capital budget appropriations for the projects were sufficient to cover the additional cost incurred by change and field orders.

Field orders had a substantially greater effect on contract costs than did change orders. For the 17 projects, field orders had a substantially greater effect on contract costs than did change orders. On average change orders added about $37,400 (or 0.5%) to contract costs. In contrast, field orders added about $569,900 (or 7.5%) to contract costs on average.

For the overall capital program managed by DGS, change orders had a significant effect on the construction schedules. In the aggregate, change orders for the 17 projects studied increased the overall construction time by 30.3%. Of the 17 projects, just under half (47%) had increases in contract time resulting from change orders of less than 10%. For two projects, change orders extended the contract time by 10% to 20%. For the remaining seven projects, change orders extended contract time by more than 20%. Two projects (COB Data Center and Mid-County Community Recreation Center) experienced delays that more than doubled the construction time period.

Foreseeable and Unforeseeable Risk

Change and field orders are caused by a variety of factors, some of which are unforeseeable and uncontrollable. In several recent projects managed by DGS, the cost increases and delays were the result of unforeseeable conditions and uncontrollable events, including:

- a large and experienced construction contractor declared that it would cease business operations while working on an ongoing project;
- a previously reliable supplier delivered improperly manufactured building materials; and,
- a local utility modified code requirements while a capital project was under construction.

In each of these cases, the unforeseen condition or uncontrollable event necessitated execution of change and field orders to allow project construction work to proceed.

With some adverse conditions cannot be foreseen, one can anticipate that certain types of projects are particularly susceptible to plan modifications during the construction phase. Projects with complex or specialized design requirements bear a higher risk of cost increases and delays. Of the 17 projects studied, the one that experienced the greatest cost increase and time delay was a project unlike any other County project, the COB Data Center Rehabilitation. Design of this project was performed initially by an architectural and engineering contractor that lacked the specialized expertise. As a result, the construction phase of the project required a substantial extension of time (more than a year) to correct design errors.

DGS recently began to compile and maintain project-specific data on the effects of change and field orders on changes contract cost and time. At the outset of this study, DGS did not maintain project-specific data on the effect of change and field orders on contract cost and time. Concurrent with the OLO study, DGS began to develop and maintain project-specific change and field order data. The availability of this data may help identify factors that raise the risk of project cost increases and delays.

Risk Assessment and Mitigation

Some jurisdictions require government agencies to conduct a risk assessment before constructing a capital project. A capital construction risk assessment may include an evaluation of potential variables that could necessitate change orders and affect project cost and time. Through the risk assessment process, the government identifies pre-construction measures that mitigate the government's exposure to factors that could produce unanticipated expense and delay. Risk mitigation strategies include:

- Unit Pricing: A government can control the cost risk of change orders by specifying unit costs for labor and materials in the original construction contract. Establishing fixed unit prices for potential change order work removes price volatility from the process.
- Evaluation of Site Conditions: Sub-surface testing provides vital information necessary for facility construction. Conducting extensive pre-construction site testing reduces the risk that change orders will be necessary but adds cost to the planning and design phase of a project.
- Design Review: Design review is a process of evaluating architectural and engineering plans to identify errors, omissions, and other problems. Extensive review can increase the time and cost of the planning phase of a capital project but can also yield greater time and cost savings during the construction phase. In one type of design review, third-party reviewers examine design specifications and suggest revisions to improve the product, reduce costs, or save time. Building Information Modeling is a computer-based tool that converts design plans into a virtual model that allows reviewers to better identify and correct design problems.
- Alternative Procurement Practices: In "design-build" contracting, a government enters into a single contract for both the design and construction of a capital project. The design-build approach may prevent unexpected cost increases and delays by requiring the contractor to assume the financial risk for changes in project design. In "construction management at risk" contracting, the government hires a firm to consult on project development and to assume the risk of constructing the project for a pre-determined guaranteed maximum price. These procurement methods reduce cost risk to the government but may prompt bidders to request greater compensation to account for assuming a higher level of risk.

Office of Legislative Oversight Recommendations

OLO offers the following three recommendations for Council action.

1. ***Request that DGS establish a capital project risk assessment process.***

The Council should request that DGS establish a process to assess and rate the relative cost and scheduling risk of pending capital projects based on the presence or absence of known risk factors such as those listed above. The purpose of this assessment is to identify projects with especially high risk of cost increases and delays at the outset of the contracting process.

2. ***Request that DGS selectively employ alternative procurement and contracting methods as necessary to mitigate the cost and schedule uncertainty of high risk projects.***

The Council should request DGS adjust procurement and contracting methods as necessary to mitigate the cost and schedule uncertainty for high risk projects. DGS should selectively employ risk mitigation strategies commensurate with the risk level of the project. While risk mitigation measures may increase the time and cost of the planning phase, these strategies nonetheless help moderate project uncertainty and can yield greater time and cost savings during the construction phase.

3. ***Encourage DGS to continue to collect and monitor project-specific change and field order data to track trends and to identify factors that raise the risk of cost increases and schedule delays.***

The Council should encourage DGS to continue to compile and monitor change and field order data for each capital project. This data could help identify change order risk factors.

CHANGE ORDERS IN COUNTY GOVERNMENT CONSTRUCTION PROJECTS

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CHAPTER I. AUTHORITY, SCOPE, AND ORGANIZATION

A. Authority

Council Resolution 17-830, *FY 2014 Work Program for Office of Legislative Oversight*, adopted July 30, 2013.

B. Scope, Purpose, and Methodology

The Montgomery County Government contracts with private firms to design and to construct public facilities such as fire stations, libraries, and recreation centers. The Department of General Services (DGS) manages the design and construction of most non-transportation capital projects. As authorized by County Procurement Regulations, DGS executes change and field orders that modify the work requirements, cost, and time of a capital facility construction contract.

This OLO report examines the change and field order process for County Government capital facility construction projects. The report describes the regulatory framework and practices that govern change and field orders. In addition, the report provides case studies detailing the change and field orders for six recently completed facilities. Finally, the report identifies methods used by state and local governments to assess and mitigate the risk associated with capital project construction contract change orders.

C. Organization of Report

Chapter II, From Concept to Construction, traces the process that begins with a proposal to create a capital project for a new or renovated County Government facility and concludes with the execution of a construction contract for that capital project;

Chapter III, Change Orders and Field Orders, provides an overview of the change order and field order processes for facility construction projects;

Chapter IV, Causes for Change and Field Orders, summarizes the conditions and factors that lead to the need for change and field orders;

Chapter V, Change and Field Orders in Recent Capital Projects, provides an overview of change and field orders executed in recent capital projects managed by the Department of General Services. In addition, the chapter quantifies the affect of change and field orders on the cost and schedule of the capital project program;

Chapter VI, Case Studies, provides detail about the change order and field order activity for six recent capital projects managed the Department of General Services;

Chapter VII, Managing Risk and Cost, describes methods used by state and local governments to assess and mitigate the risk associated with capital project construction contract change orders. The chapter also discusses change order spending limits;

Chapter VIII summarizes the report's key **Findings** and **Recommendations** for Council action; and

Chapter IX includes Executive Branch comments on the final draft of the report.

D. Acknowledgements

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CHAPTER II. FROM CONCEPT TO CONSTRUCTION

This chapter outlines the process that begins with a proposal to create a capital project for a new or renovated County Government facility and concludes with the execution of a construction contract for that capital project. The chapter includes four sections:

- Section A. Facility Planning and Program of Requirements
- Section B. Capital Improvements Program
- Section C. Architectural and Engineering Services
- Section D. Facility Construction Contracts

A. Facility Planning and Program of Requirements

The first step in the process of constructing a new County Government building is a conceptual planning phase known as "facility planning." Facility planning is a process to define the need and scope of a proposed capital project. The facility planning process culminates in the development of a "program of requirements," or "POR."

A POR is a detailed written description of the structural and functional requirements of a facility. The Department of General Service (DGS) prepares the POR in conjunction with the department that requested the new facility, the Office of Management and Budget (OMB), and the Department of Technology Services (DTS).

A POR establishes building design objectives and identifies site constraints. A central element of a POR is the specification of facility space and equipment requirements. The document identifies square footage, access, configuration, equipment, and usage requirements for all rooms and other areas in the building. A POR also includes other facility design requirements, including those for:

- electrical, plumbing, heating, air conditioning, and ventilation systems;
- technology and telecommunications systems;
- elevators and stairways;
- doors, walls, flooring, and ceilings;
- roofing and exterior design;
- vehicular and pedestrian access;
- parking;
- indoor and outdoor lighting;
- signage; and
- environmental standards.

In addition, the facility planning process generates a preliminary cost estimate for the proposed project. The project POR and preliminary cost estimate form the foundation for developing a project description form (PDF) to compete for possible inclusion in the six-year Capital Improvements Program. Completion of facility planning and development of a POR does not guarantee project funding.

B. Capital Improvements Program

The Capital Improvements Program (CIP) is a six-year plan that presents cost estimates, funding sources, and program data for the construction of public facilities. Following the completion of the facility planning process, a department may submit a proposed project to the Office of Management and Budget (OMB) for possible inclusion in the CIP. OMB evaluates competing CIP project proposals using three general criteria:

- Need: An assessment of the need for a capital project based on community demands, demographic trends, and land use plans.

- Readiness: An assessment of the adequacy of the preliminary planning and cost estimates of a proposed capital project.

- Affordability: An assessment of the government's ability to fund a project given available resources and competing needs.

Following the OMB analysis, the County Executive reviews the proposed capital projects. On or before January 15 of even-numbered calendar years, the County Executive transmits to the County Council a recommended comprehensive CIP for the upcoming six fiscal years. The County Council then holds public hearings on the recommended CIP. At public worksessions, the Council considers the need, readiness, and affordability of proposed capital projects. On or before June 1 of even-numbered calendar years, the County Council approves a comprehensive six-year CIP. The County Council may amend the approved CIP at any time (with a supermajority vote of six Councilmembers).

Once a project is funded in the approved CIP, DGS may begin work to develop design plans for facility construction.

C. Architectural and Engineering Services

The design stage of a capital project requires the development of detailed architectural and engineering plans. DGS contracts with private firms to provide these services.

1. Architectural and Engineering Contracts

DGS contracts with architectural and engineering service providers for the design, permitting, and construction administration of capital projects. DGS retains the services of multiple architectural and engineering contractors to prepare design plans for new and renovated public

facilities. At present, DGS holds eight architectural and engineering service contracts, with two contracts in each of the four following categories:

- Public Safety Facilities (police stations, fire stations, and correctional facilities).
- Library and Recreation Facilities (public libraries and recreations centers).
- Other Facilities (office buildings, vehicle maintenance facilities and depots, warehouses, and other facilities).
- Small Projects (projects with design costs of no greater than $250,000 and estimated construction costs no greater than $2,000,000).

Architectural and engineering service contracts generally have a term of three years. During the contract term, firms are available to perform design services on an as-needed basis. In effect, these firms are kept on "retainer" by DGS to conduct architectural and engineering work for newly funded capital projects. Retaining contractors on an as-needed basis eliminates the need to issue a separate solicitation for architectural and engineering services for each new capital project. DGS staff estimate that this practice reduces the planning and design time for a typical project by approximately six months.

2. Architectural and Engineering Task Orders

When a capital project is first included in the approved CIP, DGS sends a "request for task order proposal" to one of the two architectural and engineering firms under contract to design that type of facility. In response, the contractor submits a proposal that includes the names and qualifications of personnel to be assigned to the task order and hourly compensation rates and estimated hours for all personnel. DGS then negotiates compensation with the contractor before executing the task order. The executed task order includes a fixed lump sum payment amount as well as a required schedule for completion of work.

Should DGS and the contractor fail to reach an agreement, then DGS may offer the task order to the other architectural and engineering firm under contract for that type of facility. Each subsequent task order is first offered to the contractor not receiving that most recently executed task order; that is, DGS alternates task orders between the two contractors in each facility type category.

The task order charges the contractor with preparing complete drawings, specifications, and technical standards to safely construct and properly operate the facility. Common task order deliverables include drawings, specifications, and technical standards relating to:

- site surveying;
- architectural design;
- structural and civil engineering;
- interior design;

- electrical, plumbing, heating, air conditioning, and ventilation systems engineering;
- technology, equipment, and hardware selection;
- life safety engineering;
- lighting design and acoustical engineering;
- Leadership in Energy and Environmental Design (LEED); and
- landscaping design.

In addition, task orders require that all final design documents comply with the *Montgomery County Manual for Planning, Design, and Construction of Sustainable Buildings*. This manual is prepared by DGS and summarizes the expectations, standards, and guidelines for the design of new and renovated County public facilities.

3. Special Projects

The County has built or renovated multiple fire stations, libraries, and other similar facilities in recent years. For these recurring project types, DGS utilizes the services of architectural and engineering firms on contract retainer with the County. On occasion, however, the County constructs facilities that are dissimilar to other recently completed buildings. These facilities have unique design requirements requiring specialized architectural and engineering expertise.

Periodically, DGS issues a stand-alone solicitation for architectural and engineering services for a special project with unique design requirements. The solicitation for special project architectural and engineering services takes the form of a request for proposal that allows DGS to select a contractor based, in part, on the firm's expertise and experience related to the specific facility type. Recent examples of projects requiring specialized architectural and engineering services include the Dennis Avenue Health Clinic and the Multi-Agency Service Park.

4. Quality Control Process

The architectural and engineering services contractor must submit a quality control plan to DGS within 30 days of receiving a notice to proceed from the County. A group of DGS staff, known as the "Quality Control and Support Services Section" (QCSSS), reviews and assesses the contractor's quality control plan. The QCSSS consists of staff trained in different engineering and construction related disciplines and includes an architect, structural engineer, mechanical engineer, electrical engineer, civil engineer and energy/LEED engineer, and scheduler. Staff from this unit participates in the selection of the architectural and engineering services contractor. After DGS awards the contract, the QCSSS:

- reviews conceptual planning and schematic design documents;
- evaluates the specifications for major functional elements and systems;
- assesses the life cycle cost of proposed building systems;
- evaluates the completeness of construction documents;
- reviews construction contract bid documents; and
- participates in the selection of the construction contractor.

According to DGS, the mission of the QCSSS is to "build quality County facilities on time, within budget, and in compliance with approved program of requirements." More specifically, the goals of the unit include improving the quality of project design and construction, refining project cost estimates, and reducing project risk. One of the stated objectives of this process is to reduce the number of change orders in construction contracts.[1]

5. Construction Administration

The architectural and engineering contractor also is responsible for construction administration. Under the construction administration provision, the architectural and engineering contractor is charged with assuring that the construction contractor completes the project according to all plans and specifications (including those in change orders) on time and at cost. The architectural and engineering contractor interprets and clarifies plan documents and must approve the specific product and material selections made by the construction contractor. In addition, the County hires third-party consultants to inspect and test the quality of construction work, heating, ventilation, and air conditioning (HVAC) systems, and electrical systems as well as to assure compliance with code requirements including the Americans with Disabilities Act (ADA).

In some particularly complex or costly facility projects, DGS will hire a separate firm (other than the architectural and engineering contractor) to provide construction management services.

D. Facility Construction Contracts

The construction phase of a capital project begins with the award of a contract to construct or renovate the facility.

1. Facility Construction Contracting Process

DGS uses the design documents submitted by the architectural and engineering contractor to produce a solicitation for capital project construction. The initial construction contract solicitation takes the form of a request for expression of interest (REOI). An REOI is a type of contract solicitation wherein the awarding department evaluates proposals from prospective contractors based on pre-determined selection criteria set forth in the solicitation. Through this evaluation, the department develops a short list of firms who then are eligible to receive and respond to a subsequent solicitation (such as an invitation for bid).

In the case of capital facility construction, DGS solicits potential contractors through an REOI that includes selection criteria to evaluate respondents' expertise and experiences in constructing specific facility types. For example, a common selection criterion in facility construction REOIs requires respondents to provide evidence of the qualifications and experience of key personnel in successfully completing similar projects.

Through the REOI process, DGS produces a short list of qualified firms who are eligible to bid for award of the facility construction contract. These pre-qualified firms are the only firms that

[1] Department of General Services, *Quality Control Management Plan*, October 27, 2008.

receive an invitation to bid for the project. DGS awards the construction contract to the pre-qualified firm that submits the lowest responsive and responsible bid.

2. Construction Project Price and Time

Capital facility construction contracts specify the amount the County will pay the contractor as well as the amount of time allotted for the contractor to complete the project.

- Price: The County enters into "fixed price" contracts for capital project construction. A fixed price contract specifies an exact payment amount that is not subject to any variable factors (such as hours worked or cost of materials). Under a fixed price contract, the contractor bears the full responsibility for profit or loss.

- Time: Under the terms of construction contracts, the contractor must achieve "substantial completion" of work within a specified number of days after the County issues a notice to proceed. Substantial completion is the stage at which: (a) the contractually required work is sufficiently complete to allow occupancy of the building for its intended use; and (b) all items remaining to be completed or corrected can be accomplished within thirty days.

- Liquidated Damages: County facility construction contracts also include a "liquidated damages" provision. Liquidated damages refers to the amount the contractor must pay the County for each day of unexcused delay in achieving substantial completion of work. The amount of liquidated damages is stated explicitly in the contract document.

CHAPTER III. CHANGE ORDERS AND FIELD ORDERS

Change orders and field orders are contract management instruments that authorize modifications to the required work performed by a contractor. This chapter provides an overview of the change order and field order processes for facility construction projects, and includes three sections:

- Section A. Change Orders
- Section B. Field Orders
- Section C. Advantages and Disadvantage of Change Orders

A. Change Orders

The County may modify the work performed by the contractor under a facility construction contract through the change order process. All facility construction contracts include General Conditions of Construction Contract (hereafter, "General Conditions") that specify the process for executing a contract change order. The General Conditions define a change order as:

> "a written directive by the owner [the County] to the contractor directing a change in the work which is within the general scope of the contract and which may increase or decrease the contract time and/or the contract sum issued with or without the consent of the contractor." [1]

As mentioned in the definition, the work required by a change order must fall "within the general scope" of the original contract. DGS interprets the phrase "within the general scope" as including all work that is consistent with the project description included in the approved CIP. DGS would have to execute a contract amendment to require the contractor to perform work that is outside the scope of the initial contract.

The definition also states that the County may execute a change order without the consent of the contractor. DGS reports that it rarely executes a change order unilaterally; almost all change orders result from a negotiated agreement between the County and the contractor.

1. Changes to Contract Price

The General Conditions permit a change order to modify the amount the County pays the construction contractor.[2] A change may affect an adjustment in the contract payment amount through one of the following methods:

- Fixed Amount: a fixed price agreed to by the County and contractor; or
- Unit Price: payment based on agreed-upon unit prices for labor and materials; or

[1] General Conditions of Construction Contract, Section 12.2.1.
[2] General Conditions of Construction Contract, Section 12.2.2.

- Data-Supported Cost Estimate: an itemized cost estimate of labor, materials, supplies, and equipment that is substantiated by data (plus a fixed fee for profit and overhead); or

- Time and Materials: payment of the verified actual cost of labor, materials, supplies and equipment (plus a fixed fee for profit and overhead).

If the County and the contractor do not agree upon a method for calculating payment for a change order, then the payment amount will be based on either the Unit Price or the Data-Supported Cost Estimate method, whichever results in the lower cost to the County.

DGS reports that the Data-Supported Cost Estimate is the most prevalent method for establishing change order pricing.

2. Changes to Construction Schedule

The General Conditions permit a change order to modify the designated time period for the construction contractor to achieve substantial completion of the project.[3]

B. Field Orders

The General Conditions also allow for the County to direct a change in work within the scope of a construction contract by means of a "field order." The General Conditions define a change order as:

> "a written instruction issued by the owner [the County] to the contractor directing a change in the work when unforeseen and unanticipated conditions arise which require immediate action to mitigate costs or avoid delays."[4]

Two factors distinguish a field order from a change order. First, a field order must be the result of "unforeseen and unanticipated conditions." The General Conditions specify no such limitation for change orders. Second, the unforeseen conditions addressed by a field order must warrant "immediate action to mitigate costs or avoid delays." The change order definition does not mention any need for immediate action.

1. Purpose and Permitted Use of Field Orders

The field order process allows the County to modify construction contract work requirements when an unexpected situation arises that requires immediate attention. DGS designates the Contract Administrator to authorize field orders as needed to prevent cost increases or project delays.[5] The field order process provides DGS a means to modify the work requirements in a more expedited manner than would be allowed through the change order process.

[3] General Conditions of Construction Contract, Sections 11.2.2 and 12.2.3.
[4] General Conditions of Construction Contract, Section 12.3.1.
[5] The DGS Director must approve any field order in excess of $25,000.

However, field orders are intended for use only in certain circumstances. County Procurement Regulations restrict the use of field orders:

> "Field orders are used only in the following limited situations:
>
> 1. To direct work when unforeseen and unanticipated conditions arise which require immediate action to mitigate costs or avoid delay claims, and there is insufficient time to process a change order;
>
> 2. To order a minor change in the work not involving an adjustment in the contract sum or an extension of the contract time, not inconsistent with the intent of the contract documents;
>
> 3. To provide a written interpretation, including drawings, necessary for the proper execution or progress of the work consistent with and reasonably inferable from the contract documents if the interpretation does not adjust the contract sum or the contract time."[6]

Moreover, the Procurement Regulations explicitly states that "field orders are not permitted if there is sufficient time to process a change order, a contract amendment, or, if appropriate, a new procurement to satisfy the County's needs."[7]

2. Field Order Compensation

The General Conditions allow a field order to provide additional compensation to the contractor. The amount paid to the contractor for field order work is determined by the same methods utilized for change orders (see Section A.1. above). However, in contrast to a change order, a field order does not modify the contract price. As specified in the General Conditions, compensation provided as a result of a field order is outside of the terms of the contract and is not considered a change to the contract price.[8]

3. Construction Time Period

Unlike a change order, a field order may not be used to modify the construction contract time period.[9] Any modification to the amount of time specified in the contract for the contractor to achieve substantial completion of the project must be authorized through a change order.

[6] Code of Montgomery County Regulations, Chapter 11B, Section 11.3.1.
[7] Code of Montgomery County Regulations, Chapter 11B, Section 11.3.3.
[8] General Conditions of Construction Contract, Section 12.3.1.
[9] General Conditions of Construction Contract, Sections 11.2.2 and 12.2.3.

4. Financial Accounting

As mentioned above, a field order does not modify the contract price. Rather, DGS pays for field orders through an encumbrance[10] from the capital budget appropriation that is separate from the construction contract encumbrance. In effect, DGS pays field orders from contingency funds included in the capital budget appropriation. As stipulated in the Procurement Regulations and General Conditions, a field order encumbrance is intended solely to pay for remediation of unforeseen conditions that require immediate attention.

Under internal DGS operating procedures, a project manager may encumber an amount equal to ten percent of a contract's value to cover the costs of possible field orders. In many cases, project managers encumber the maximum ten percent at the outset of the construction phase in order to reserve funds to address any field order requirements that may arise. Departmental procedures require the Director's approval to encumber an amount greater than ten percent of contract value for field orders.

While not recorded as a contract cost, payments for field orders are expenses that are integrally related to the cost of a capital project. Field orders correct construction site conditions that impede the progress of contract work. Therefore, the total cost of a construction project includes both the contract cost plus field order payments.

C. Advantages and Disadvantages of Change Orders

Construction contract change orders[11] are not inherently beneficial or detrimental to the progress of a capital project. The change order process is a procurement tool that, when managed properly, can offer substantial benefits to a contract manager. Conversely, when poorly managed, change orders may result in undesired cost increases and delays.

The change order process may help control the cost and schedule of capital projects. Capital project architectural and engineering designers cannot foresee every eventuality that may arise during the construction phase nor can they anticipate each minute building specification required by the using department. The change order process is a method to respond to changing requirements that arise during the construction phrase of a project. In the absence of a change order process, the original construction contract likely would require a higher payment amount to compensate the contractor for assuming responsibility for addressing unanticipated work requirements. Alternatively, without the change order process, time consuming contract amendment negotiations would be necessary to address unanticipated conditions that arise during construction.

[10] An encumbrance is the reservation of appropriated funds to provide for payment of County contract obligations. Encumbering funds from a capital budget appropriation reduces the remaining spending authority for that project.

[11] In researching the procurement practices outside of Montgomery County, OLO did not find any jurisdiction that employed the term, "field order." As such, this section uses the single term "change order" to include all contract modifications allowed by either a change order or a field order under Montgomery County procurement regulations.

Executing change orders also introduces risk to construction contracting. Once an agency has entered into a contract with a construction firm, an opportunity no longer exists to competitively bid changes to work requirements. Rather, by its very nature, the change order process requires the agency to consider pricing and staffing offered by the contractor (or through a subcontractor). The contract manager bears the burden of assuring that change order pricing is reasonable and that work is performed by qualified labor in a timely manner. Chapter VII of this report discusses methods to manage and risk and cost of change orders.

CHAPTER IV. CAUSES FOR CHANGE AND FIELD ORDERS

In examining recent facility construction contracts, OLO found multiple causes that prompted the Department of General Services (DGS) to issue change and field orders. This chapter summarizes the conditions and factors that brought about the need for change and field orders. The chapter includes two sections:

- Section A. Factors that Cause Change and Field Orders
- Section B. Foreseeable versus Unforeseeable Causes

A. Factors that Cause Change and Field Orders

There are multiple conditions or circumstances that precipitate the need for a construction contract change or field order. In the course of preparing this report, OLO identified five categories of factors that prompted DGS to issue change and field orders.

1. Site Conditions

One of the responsibilities of the architectural and engineering contractor is to identify site conditions that will affect the construction of the facility. The architectural and engineering contractor conducts soil borings and other testing to determine sub-surface conditions. In general, projects located at redeveloped sites or on previously disturbed land run a higher risk of encountering subsurface problems such as subterranean rock, contaminated soils, and underground storage tanks. Moreover, at a previously developed site, a project is necessarily affected by pre-existing conditions including the location of utility lines and other underground structures, stormwater drainage patterns, and surrounding vehicle and pedestrian networks. Facility construction plans must take into account these site conditions.

Some site conditions are extremely localized; that is, conditions may vary markedly over short distances. For example, pre-construction soil borings may determine the depth of underground rock at one site location while excavation performed during facility construction may strike rock at a different depth just a few yards away from the boring location. Localized sub-surface conditions are particularly difficult to determine in redevelopment projects where existing structures occupy a portion of the site. In these cases, there is limited opportunity to perform soil borings and other underground tests below the footprint of an existing structure.

In addition, renovation projects present further risk resulting from the integration of newly constructing and older pre-existing elements of the building. Renovation projects often encounter deficiencies in the materials and systems retained from the original building.

In some cases, DGS has executed change or field orders to modify the work specified in the construction contract to address site conditions that differ from those anticipated in the architectural and engineering documents. The Colesville Salt Barn is an example of a project for which DGS issued change and field orders to address unanticipated site conditions (see pages 48 - 50).

2. Errors and Omissions

The architectural and engineering contractor prepares drawings, specifications, and technical standards for construction of the facility. For most projects, these documents altogether include tens of thousands of individual construction requirements. Given the large number of requirements, construction documents at times include errors and/or omissions that do not become known until the construction phase of the project. On occasion, errors and omissions result from the architectural and engineering contractor lacking the specialized expertise to properly design a complex project. Change and field orders are the project management tools used to correct design errors and omissions in the construction requirements.

The Council Office Building Data Center is an example of a project that required change and field orders to correct errors and omissions in construction design plans (see pages 42 - 45).

3. Third Party Involvement

Often, facility construction requires coordination with a third party (other than the County and its contractors). Third-party entities include local utilities, the Maryland-National Capital Park and Planning Commission, and the Maryland State Government. DGS may issue a change or field order directing the construction contractor to modify its work to address existing conditions or design requirements of third parties. The Gaithersburg Library project is an example of a project for which DGS issued change and field orders to account for underground utility lines that were found to be too close to the surface to allow planned construction of a sidewalk (see page 51).

4. Code Compliance

During the facility construction process, staff from the County Department of Permitting Services, the Washington Suburban Sanitary Commission, and other regulatory enforcement entities review construction plans and conduct site visits to ensure that the facility is built in compliance with all relevant codes. For example, plan reviewers and field inspectors verify that the facility conforms to all building, structural, electrical, mechanical, fire-safety, energy conservation, and accessibility codes and standards. In some projects, a change or field order is necessary so as to bring the facility into code compliance.

On occasion, utility standards change after the completion of construction plans but before the start of facility construction. In such cases, DGS could execute a change or field order to modify the construction work requirements as necessary to meet the latest utility standards. For example, DGS issued a field order for the Mid-County Community Recreation Center project to assure compliance with WSSC permit requirements (see page 47).

5. Modified User Requirements

As described in Chapter II, the facility planning process begins with the development of a program of requirements (POR) that details the structural and functional requirements of the new or renovated facility. The POR specifies square footage, access, configuration, equipment, and usage requirements for all rooms and other areas in the building. On occasion, the using

department will modify the facility requirements after completion of the architectural and engineering plans. In such cases, a change order would be necessary to ensure that the work performed by the construction contractor meets the updated needs of the facility user. For the Gaithersburg and Olney Library projects, DGS issued change orders to delete user requirements (see pages 50 - 54).

In addition, many low cost field orders resulted from small design modifications (such as changes to lighting fixtures or building signage) requested by the using department.

B. Foreseeable versus Unforeseeable Causes

Within the factors that precipitate the need for change and field orders described above, some conditions or circumstances were foreseeable, others were not. By definition, field orders are intended exclusively for "unforeseen and unanticipated conditions" (see Chapter III). In practice, change orders also generally result from some condition or occurrence that was not foreseen when the architectural and engineering firm prepared the design plans.

Often, the ability to anticipate conditions that might raise the cost or delay a project is a function of pre-construction risk assessment. For example, in some cases, site conditions may be ascertained through pre-construction testing. As mentioned above, soil borings and other sub-surface testing can provide vital information necessary for facility construction to proceed on time and within budget. Of course, site condition testing is not without cost. In effect, a decision regarding the extent of site testing is a type of risk assessment. More testing at the outset requires greater expenditure of project funds but also reduces the risk that change and field orders will be necessary during the construction phase.

For some projects, the very nature of the facility itself may increase the risk of construction delays and cost increase. Projects with complex or specialized architectural and engineering requirements often involve additional risk of unanticipated change. Unforeseen events are more likely to occur when designing and constructing facilities which are dissimilar to other facilities previously built by the County. Despite diligent plan review by DGS and its contractors, the risk of plan errors and omissions may rise when a facility design involves a level of complexity and specialization that is unlike other projects.

However, in some cases, change and field orders result from events that were completely unforeseeable. For example, DGS cannot control changes in utility code requirements that may occur following completion of facility design plans. In addition, DGS cannot foresee that a large and experienced construction contractor would declare its plans cease business operations prior to completing an ongoing project. Similarly, one could not expect DGS to anticipate a situation where a previously reliable supplier delivered improperly manufactured building materials.

The examples cited in the above paragraphs each represent an actual case that occurred with recent construction projects managed by DGS. These cases are detailed in Chapter VI of this report.

CHAPTER V. CHANGE AND FIELD ORDERS IN RECENT CAPITAL PROJECTS

This chapter provides an overview of change and field orders executed in recent capital projects managed by the Department of General Services (DGS). In addition, the chapter quantifies the affect of change and field orders on the cost and schedule of the capital project program. The chapter includes three sections:

- Section A. Recent Capital Projects
- Section B. Project Overviews
- Section C. Summary of Change and Field Order Activity

A. Recent Capital Projects

DGS is responsible for planning, designing, and constructing new and renovated County Government buildings.[1] DGS managed a total of 17 capital projects that had an original contract cost greater than $1 million and reached the "substantial completion" stage of construction during Calendar Years 2009 through 2013.[2] As described in Chapter II, substantial completion is the stage at which: (a) the contractually required work is sufficiently complete to allow occupancy of the building for its intended use; and (b) all items remaining to be completed or corrected can be accomplished within thirty days. At this stage of a project, no modifications are made to contract work requirements and DGS ceases to execute change and field orders.

DGS was created in July 2008. Prior to this date, the then Office of Procurement and the then Department of Public Works and Transportation were responsible for the solicitation and management of contracts to construct County buildings. Some projects described in this chapter were originally managed by the former Office of Procurement and Department of Public Works and Transportation before DGS assumed responsibility for these projects in July 2008.

The table on the following page lists the 17 capital projects managed by DGS that had an original contract cost greater than $1 million and reached substantial completion during Calendar Years 2009 through 2013.

[1] The County Department of Transportation oversees the planning, design, and construction of roads and other linear transportation facilities. This report focuses solely on change and field orders in building projects.

[2] This count excludes The Fillmore music venue and the Stoney Creek stormwater management pond on the campus of the National Institutes of Health. The Fillmore was planned and developed as part of a public-private partnership between the County and Lee Development Group (LDG). LDG managed the architectural and engineering contract for the facility while DGS managed the construction contract. The Stoney Creek stormwater pond was a special project managed by DGS for the Department of Environmental Protection (DEP). DGS no longer manages the design and construction of stormwater management facilities.

Capital Projects Managed by DGS that Reached Substantial Completion
Calendar Years 2009 through 2013

	Name of Capital Project	Substantial Completion Date
1	West Germantown Fire Station	January 2009
2	Executive Office Building / Judicial Center Emergency Power System Upgrade	November 2009
3	Equipment Maintenance & Transit Operations Center Indoor Air Quality Improvements	March 2010
4	Civic Building at Veteran's Plaza	July 2010
5	East Germantown Fire Station	August 2010
6	Takoma Park Fire Station	October 2010
7	Council Office Building Data Center Rehabilitation	October 2010
8	Mid-County Community Recreation Center	December 2010
9	Bethesda Fire Station HVAC, Electrical & Roof Improvements	September 2011
10	401 Hungerford Drive Garage Restoration	December 2011
11	Brookville Service Park (Part II)	December 2011
12	White Oak Community Recreation Center	March 2012
13	Plum Gar Recreation Center	May 2013
14	Colesville Salt Barn	October 2013
15	Gaithersburg Library	December 2013
16	Animal Shelter	December 2013
17	Olney Library	December 2013

B. Project Overviews

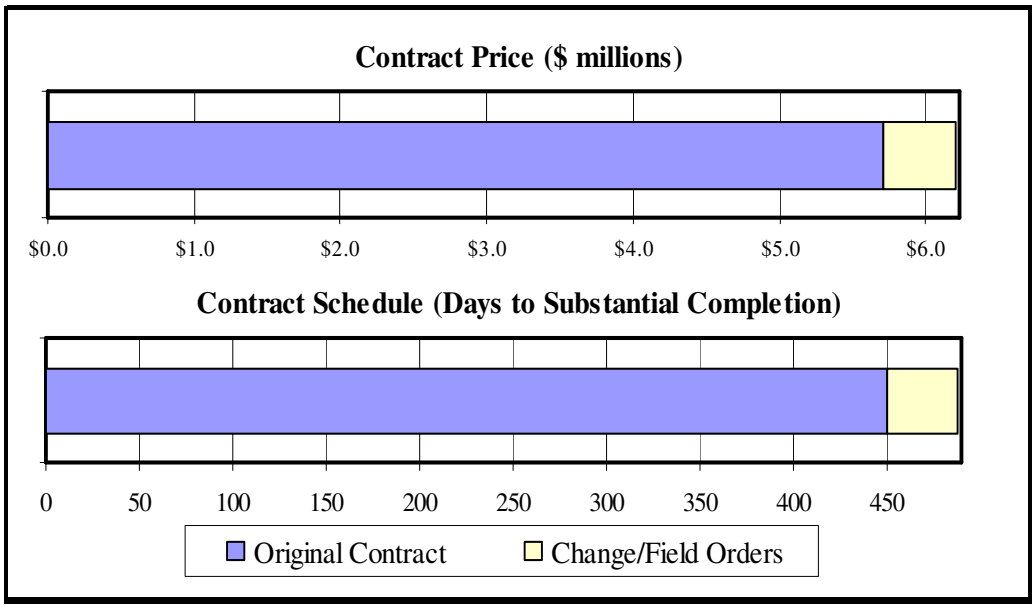
OLO reviewed the contract, change order, and field order documents for each of the 17 capital projects listed in the above table. This section presents a series of one-page overviews that summarize how change and field orders modified the construction contract cost and schedule for each project. The one-page overviews begin on the next page.

Note regarding data collection: DGS compiled all the project data, information, and documents requested by OLO, including the retrieval of many contract documents from archives. OLO notes that at the outset of this study, DGS did not maintain project-specific data on the effect of change and field orders on contract cost and time. Concurrent with the OLO study, DGS began to develop and maintain project-specific change and field order data. DGS plans to consolidate the data into a master file to help identify factors that cause project cost increases and delays.

PROJECT #1: WEST GERMANTOWN FIRE STATION
Completed: January 2009

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$5,714,397	450 days
All Change and Field Orders	+$475,384	+38 days
Contract with Change and Field Orders	$6,189,781	488 days
Percent Change	+8.3%	+8.4%



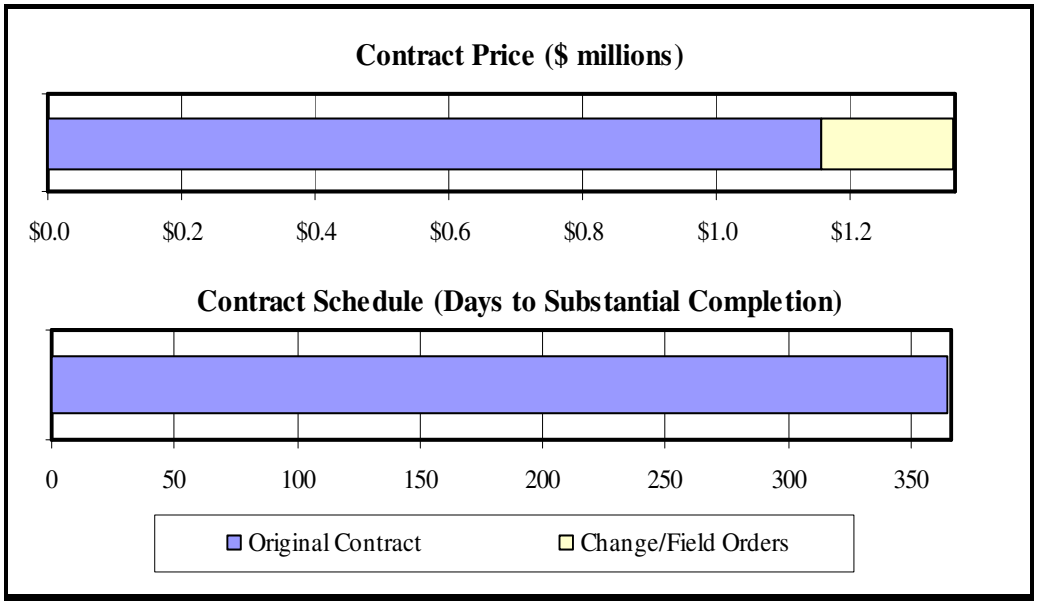
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	2	44
Cost	Total Cost	+$78,361	+$397,023
Cost	Average Cost Per Order	+$39,181	+$9,023
Cost	Range of Cost Per Order	$0 to +$78,361	+$619 to +$41,961
Schedule	Total Additional Time	+38 days	N/A
Schedule	Average Additional Time Per Change Order	+19 days	
Schedule	Range of Time Added Per Change Order	+7 to +31 days	

PROJECT #2: EXECUTIVE OFFICE BUILDING / JUDICIAL CENTER EMERGENCY POWER SYSTEM UPGRADE
Completed: November 2009

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$1,157,249	365 days
All Change and Field Orders	+$198,278	0 days
Contract with Change and Field Orders	$1,355,627	365 days
Percent Change	+17.1%	0.0%



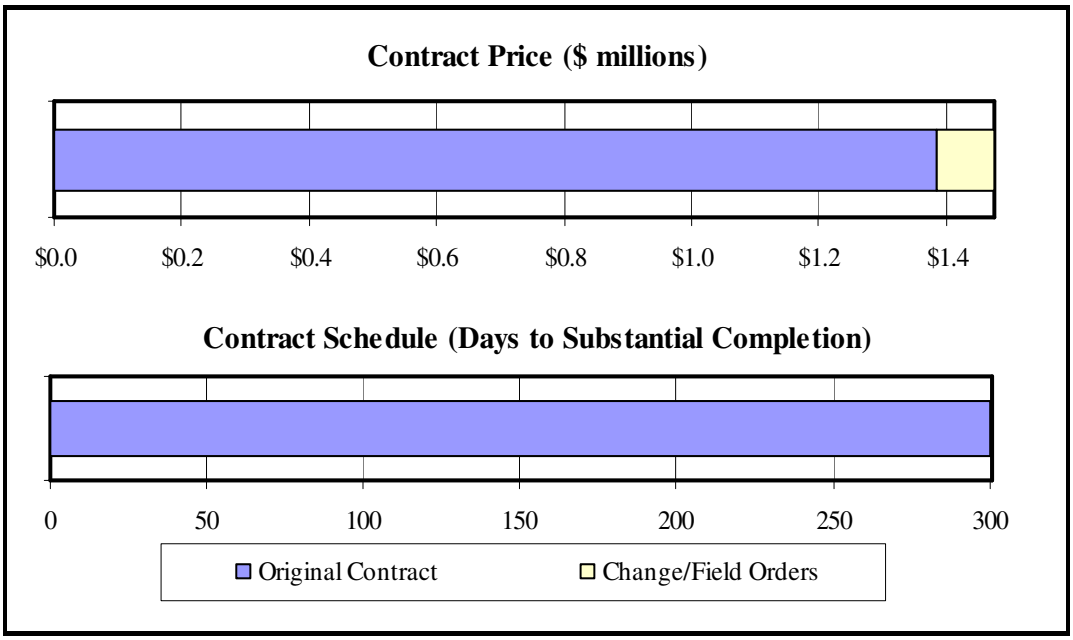
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	0	19
Cost	Total Cost	N/A	+$198,378
Cost	Average Cost Per Order	N/A	+$10,436
Cost	Range of Cost Per Order	N/A	+$301 to +$43,508
Schedule	Total Additional Time	N/A	N/A
Schedule	Average Additional Time Per Change Order	N/A	
Schedule	Range of Time Added Per Change Order	N/A	

PROJECT #3: EQUIPMENT MAINTENANCE & TRANSIT OPERATIONS CENTER INDOOR AIR QUALITY IMPROVEMENTS
Completed: March 2010

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$1,384,000	300 days
All Change and Field Orders	+$90,975	0 days
Contract with Change and Field Orders	$1,474,975	300 days
Percent Change	+6.6%	0.0%



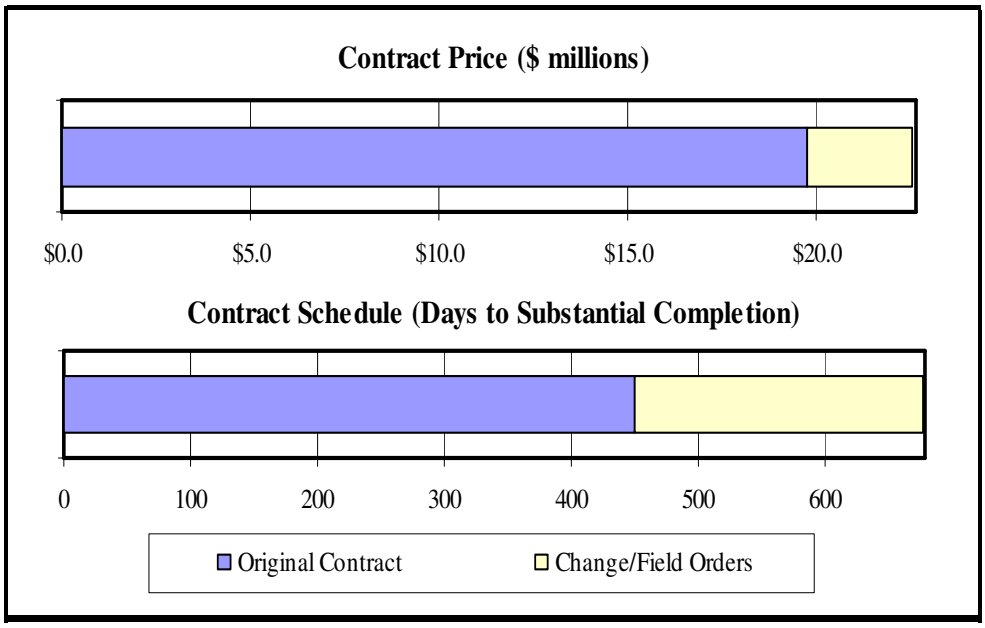
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	0	15
Cost	Total Cost	N/A	+$90,975
Cost	Average Cost Per Order	N/A	+$6,065
Cost	Range of Cost Per Order	N/A	+$247 to +$51,385
Schedule	Total Additional Time	N/A	N/A
Schedule	Average Additional Time Per Change Order	N/A	
Schedule	Range of Time Added Per Change Order	N/A	

PROJECT #4: CIVIC BUILDING AT VETERAN'S PLAZA
Completed: July 2010

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$19,778,000	450 days
All Change and Field Orders	+$2,834,198	+226 days
Contract with Change and Field Orders	$22,612,198	676 days
Percent Change	+14.3%	+50.2%



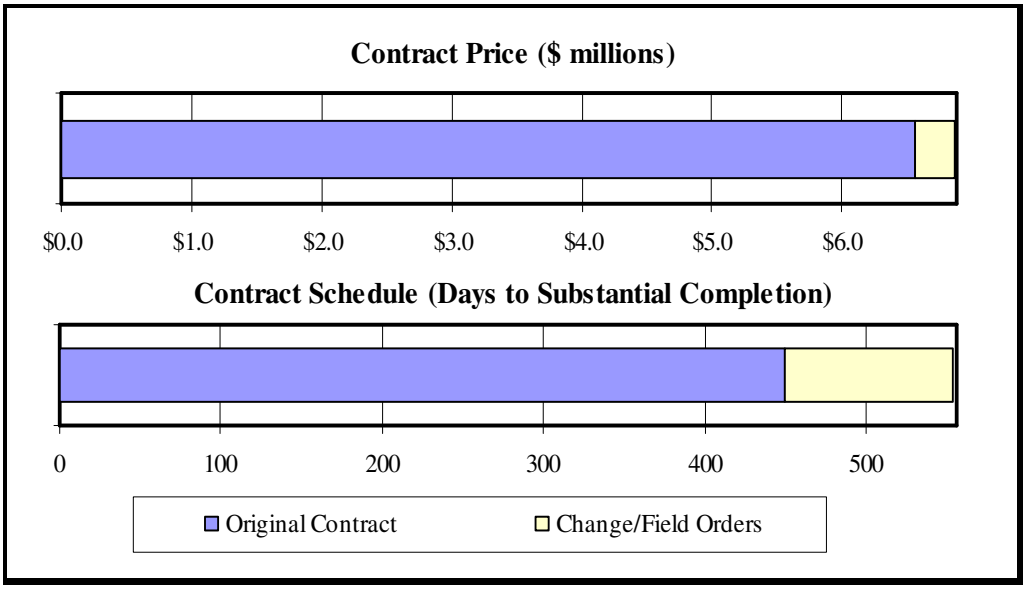
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	4	215
Cost	Total Cost	+$822,609	+$2,011,589
Cost	Average Cost Per Order	+$205,652	+$9,356
Cost	Range of Cost Per Order	$0 to +$434,450	+$406 to +$156,559
Schedule	Total Additional Time	+226 days	N/A
Schedule	Average Additional Time Per Change Order	+57 days	
Schedule	Range of Time Added Per Change Order	0 to +90 days	

PROJECT #5: EAST GERMANTOWN FIRE STATION
Completed: August 2010

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$6,560,000	450 days
All Change and Field Orders	+$309,455	+104 days
Contract with Change and Field Orders	$6,869,455	554 days
Percent Change	+4.7%	+23.1%



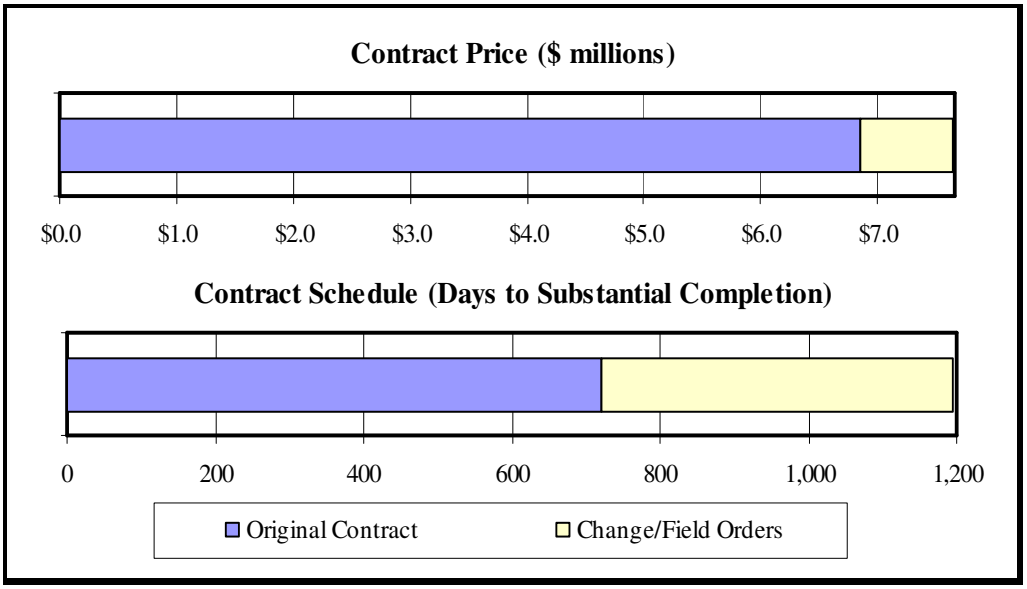
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	2	36
Cost	Total Cost	-$143,559	+$453,014
Cost	Average Cost Per Order	-$71,780	+$12,584
Cost	Range of Cost Per Order	-$151,000 to +$7,441	+$467 to +$84,740
Schedule	Total Additional Time	+104 days	N/A
Schedule	Average Additional Time Per Change Order	+52 days	
Schedule	Range of Time Added Per Change Order	+14 to +90 days	

PROJECT #6: TAKOMA PARK FIRE STATION
Completed: October 2010

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$6,844,518	720 days
All Change and Field Orders	+$792,164	+476 days
Contract with Change and Field Orders	$7,636,682	1,196 days
Percent Change	+11.6%	+66.1%



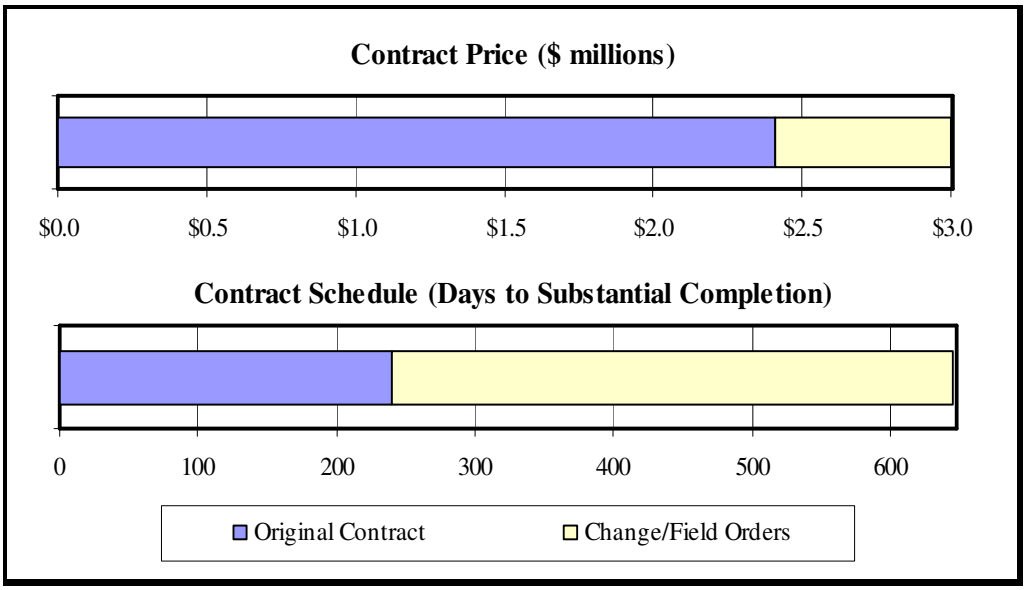
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	5	86
Cost	Total Cost	+$157,585	+$634,579
Cost	Average Cost Per Order	+$31,517	+$7,379
Cost	Range of Cost Per Order	$0 to +$132,440	+$363 to +$55,594
Schedule	Total Additional Time	+476 days	N/A
Schedule	Average Additional Time Per Change Order	+95 days	
Schedule	Range of Time Added Per Change Order	+5 to +212 days	

PROJECT #7: COUNCIL OFFICE BUILDING DATA CENTER REHABILITATION
Completed: October 2010

Summary of Contract Cost[3] and Schedule

	Cost	Schedule
Initial Contract	$2,409,000	240 days
All Change and Field Orders	+$589,958	+405 days
Contract with Change and Field Orders	$2,998,958	645 days
Percent Change	+24.5%	+168.8%



Summary of Change and Field Orders

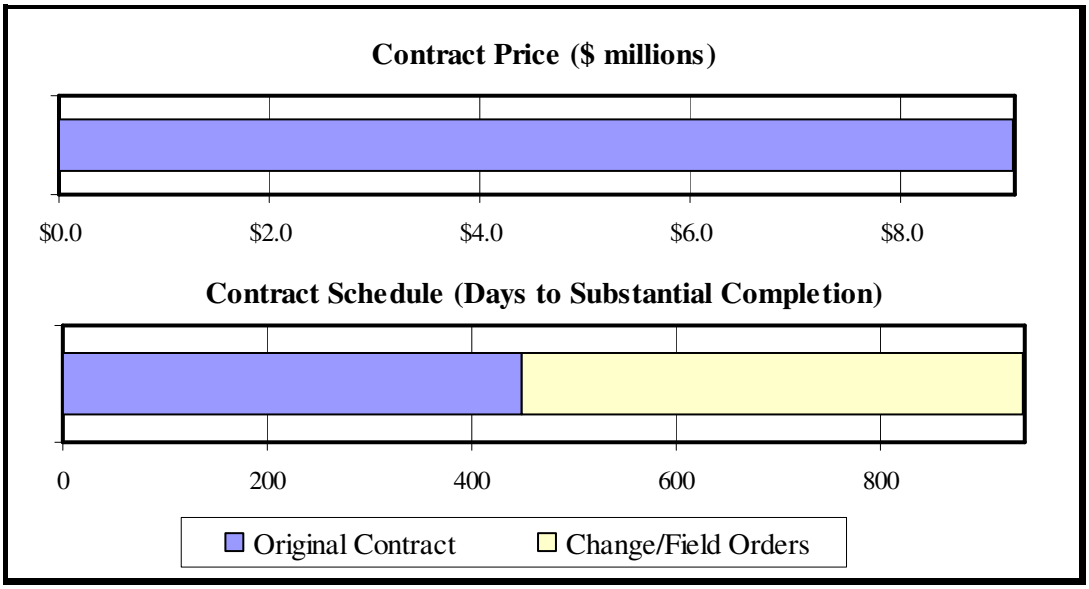
		Change Orders	Field Orders
	Number of Change/Field Orders	1	14
Cost	Total Cost	+$156,585	+$433,373
Cost	Average Cost Per Order	N/A	+$30,955
Cost	Range of Cost Per Order	N/A	+$4,976 to +$114,981
Schedule	Total Additional Time	+405 days	N/A
Schedule	Average Additional Time Per Change Order	N/A	
Schedule	Range of Time Added Per Change Order	N/A	

[3] This project incurred additional post-contract expenses of $510,324, raising the total cost to $3,509,282 or 45.7% higher than the original contract amount (for details, see Chapter VI.)

PROJECT #8: MID-COUNTY COMMUNITY RECREATION CENTER
Completed: December 2010

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$9,061,000	450 days
All Change and Field Orders	-$103,247	+490 days
Contract with Change and Field Orders	$8,957,753	940 days
Percent Change	-1.1%	+108.9%



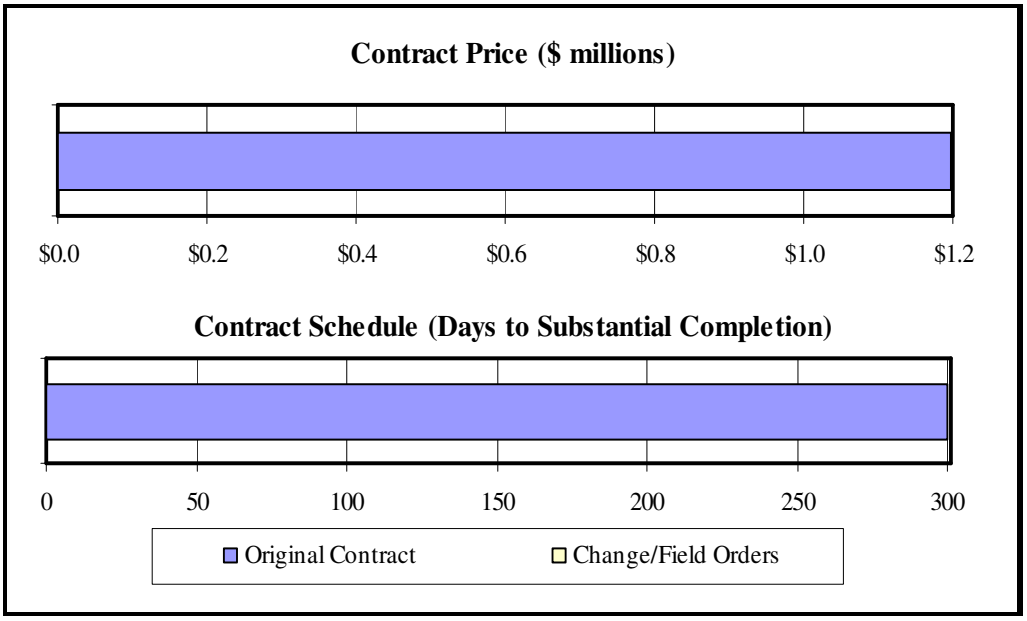
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	2	25
Cost	Total Cost	-$361,481	+$258,234
Cost	Average Cost Per Order	-$180,741	+$10,329
Cost	Range of Cost Per Order	-$427,394 to +$65,913	+$939 to +$47,849
Schedule	Total Additional Time	+490 days	N/A
Schedule	Average Additional Time Per Change Order	+245 days	
Schedule	Range of Time Added Per Change Order	+44 to +446 days	

PROJECT #9: BETHESDA FIRE STATION HVAC, ELECTRICAL & ROOF IMPROVEMENTS
Completed: September 2011

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$1,198,040	300 days
All Change and Field Orders	-$16,592	0 days
Contract with Change and Field Orders	$1,181,448	300 days
Percent Change	-1.4%	0.0%



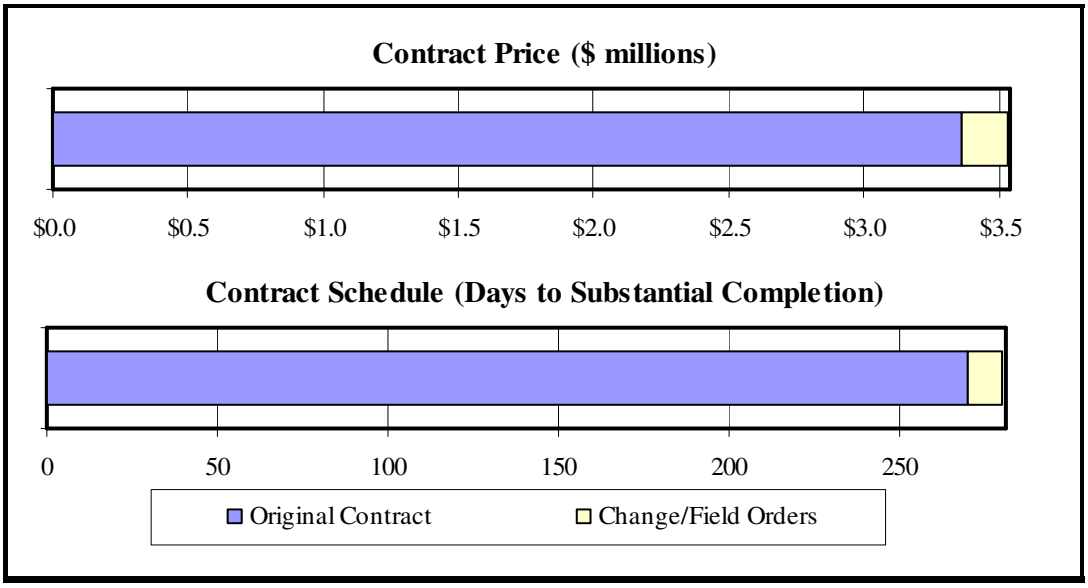
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	1	4
Cost	Total Cost	-$50,000	+$33,408
Cost	Average Cost Per Order	N/A	+$8,352
Cost	Range of Cost Per Order	N/A	+$2,264 to +$15,225
Schedule	Total Additional Time	0 days	N/A
Schedule	Average Additional Time Per Change Order	N/A	
Schedule	Range of Time Added Per Change Order	N/A	

PROJECT #10: 401 HUNGERFORD DRIVE GARAGE RESTORATION
Completed: December 2011

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$3,363,922	270 days
All Change and Field Orders	+$170,793	+10 days
Contract with Change and Field Orders	$3,534,715	280 days
Percent Change	+5.1%	+3.7%



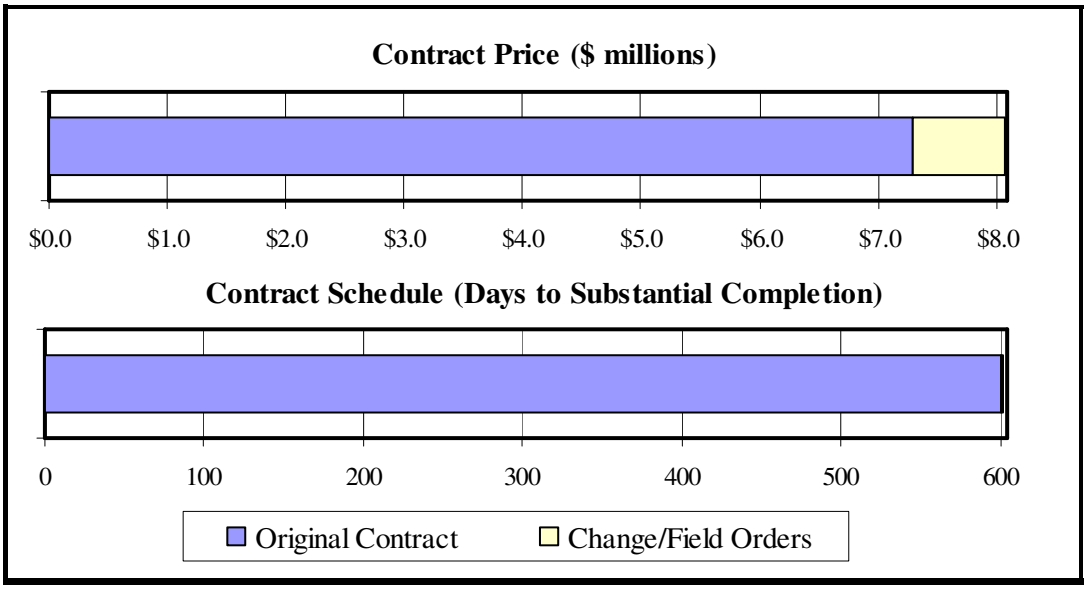
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	3	8
Cost	Total Cost	-$25,159	+$195,952
Cost	Average Cost Per Order	-$8,386	+$24,494
Cost	Range of Cost Per Order	-$21,799 to $0	+$970 to +$117,938
Schedule	Total Additional Time	+10 days	N/A
Schedule	Average Additional Time Per Change Order	+3 days	
Schedule	Range of Time Added Per Change Order	0 to +10 days	

PROJECT #11: BROOKVILLE SERVICE PARK (PART II)
Completed: December 2011

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$7,299,100	600 days
All Change and Field Orders	+$777,688	+2 days
Contract with Change and Field Orders	$8,076,788	602 days
Percent Change	+10.7%	+0.3%



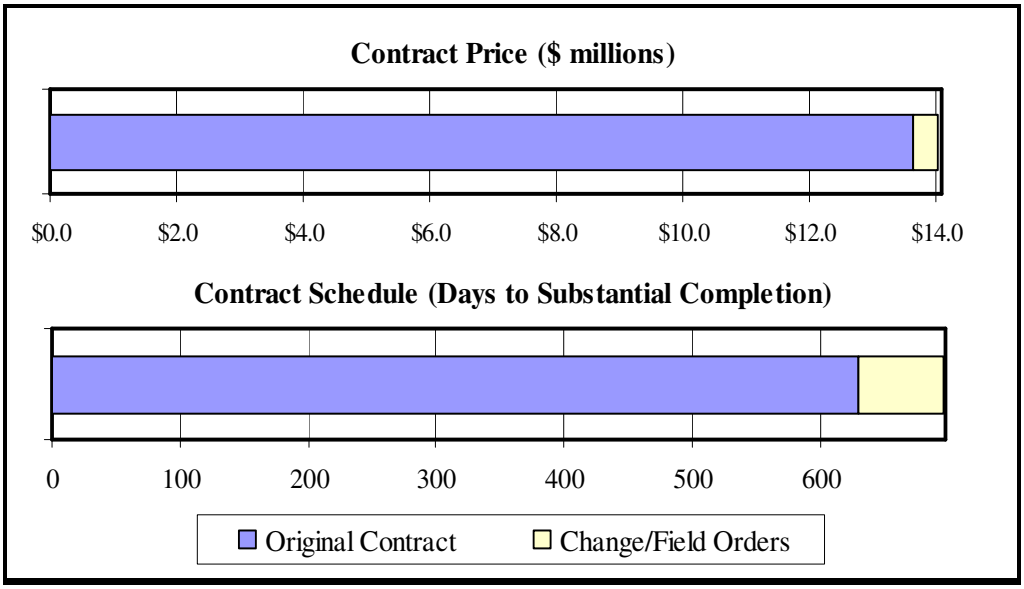
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	3	74
Cost	Total Cost	+$243,462	+$534,226
Cost	Average Cost Per Order	+$81,154	+$7,219
Cost	Range of Cost Per Order	$0 to +$125,131	+$298 to +$112,032
Schedule	Total Additional Time	+2 days	N/A
Schedule	Average Additional Time Per Change Order	+2/3 days	
Schedule	Range of Time Added Per Change Order	0 to +2 days	

PROJECT #12: WHITE OAK COMMUNITY RECREATION CENTER
Completed: March 2012

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$13,647,590	630 days
All Change and Field Orders	+$365,930	+66 days
Contract with Change and Field Orders	$14,013,520	696 days
Percent Change	+2.7%	+10.5%



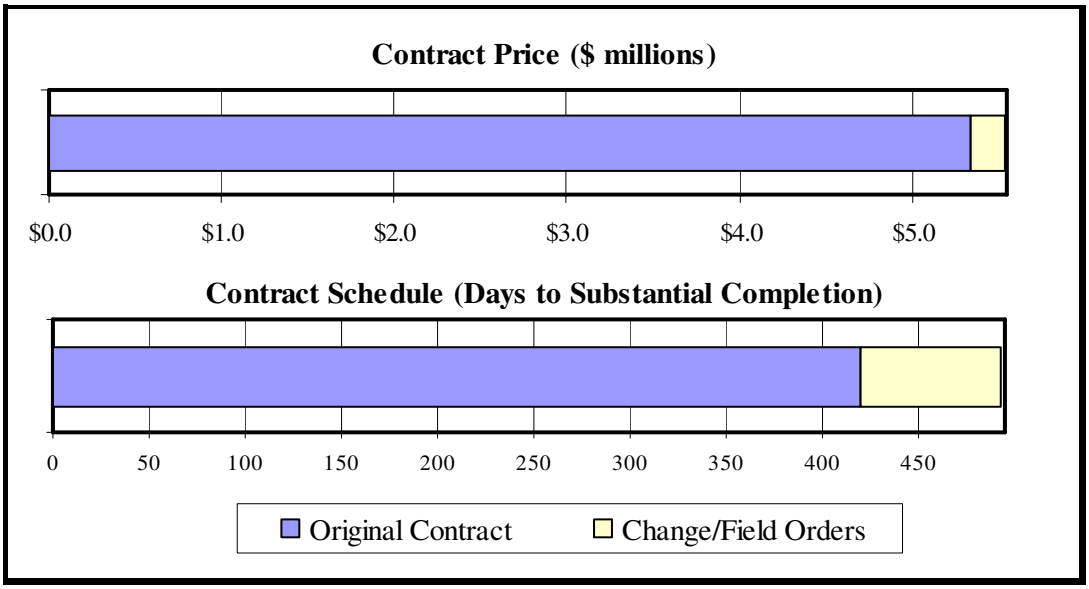
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	4	60
Cost	Total Cost	-$64,496	+$430,426
Cost	Average Cost Per Order	-$16,124	+$7,174
Cost	Range of Cost Per Order	-$51,944 to $24,448	+$357 to +$119,745
Schedule	Total Additional Time	+66 days	N/A
Schedule	Average Additional Time Per Change Order	+17 days	
Schedule	Range of Time Added Per Change Order	0 to +66days	

PROJECT #13: PLUM GAR COMMUNITY RECREATION CENTER
Completed: May 2013

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$5,338,514	420 days
All Change and Field Orders	+$193,053	+73 days
Contract with Change and Field Orders	$5,531,567	493 days
Percent Change	+3.6%	+17.4%



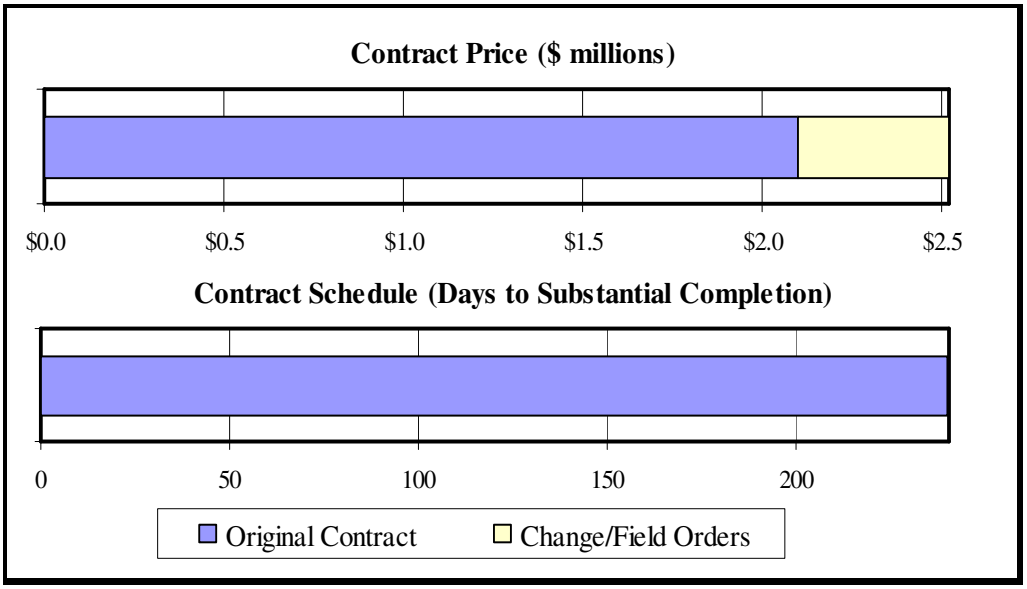
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	1	82
Cost	Total Cost	$0	+$193,053
Cost	Average Cost Per Order	N/A	+$2,354
Cost	Range of Cost Per Order	N/A	+$119 to +$23,616
Schedule	Total Additional Time	+73 days	N/A
Schedule	Average Additional Time Per Change Order	N/A	
Schedule	Range of Time Added Per Change Order	N/A	

PROJECT #14: COLESVILLE SALT BARN
Completed: October 2013

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$2,100,000	240 days
All Change and Field Orders	+$419,002	0 days
Contract with Change and Field Orders	$2,519,002	240 days
Percent Change	+20.0%	0.0%



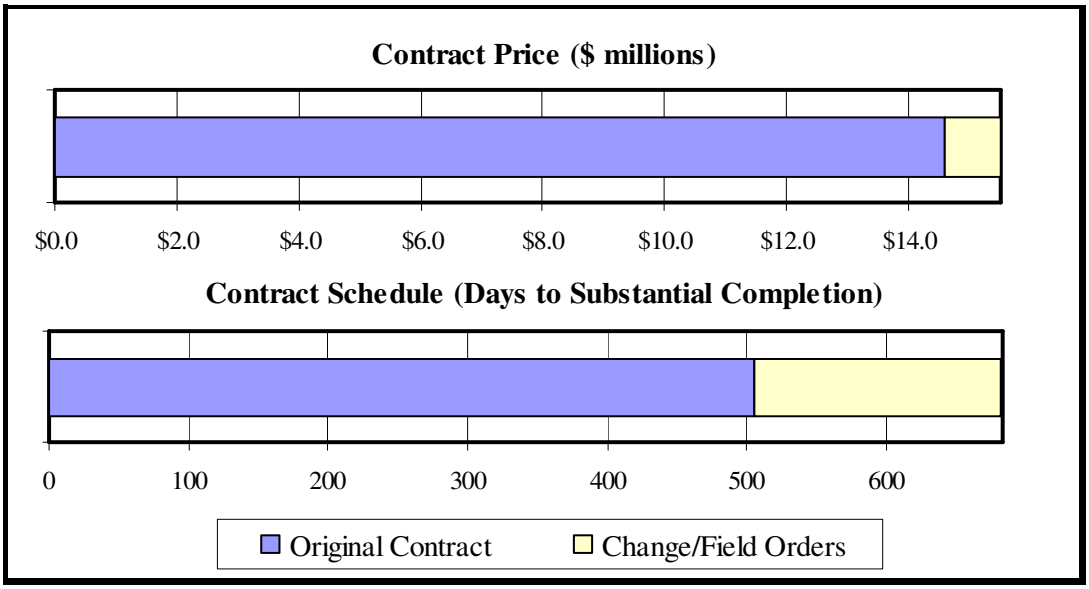
Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	2	9
Cost	Total Cost	+$284,993	+$134,009
Cost	Average Cost Per Order	+$142,496	+$14,890
Cost	Range of Cost Per Order	+$103,848 to +$181,145	+$1,446 to +$51,664
Schedule	Total Additional Time	0 days	N/A
Schedule	Average Additional Time Per Change Order	N/A	
Schedule	Range of Time Added Per Change Order	N/A	

PROJECT #15: GAITHERSBURG LIBRARY
Completed: December 2013

Summary of Contract Cost[4] and Schedule

	Cost	Schedule
Initial Contract	$14,588,000	505 days
All Change and Field Orders	+$913,633	+176 days
Contract with Change and Field Orders	$15,501,633	681days
Percent Change	+6.3%	+34.9%



Summary of Change and Field Orders

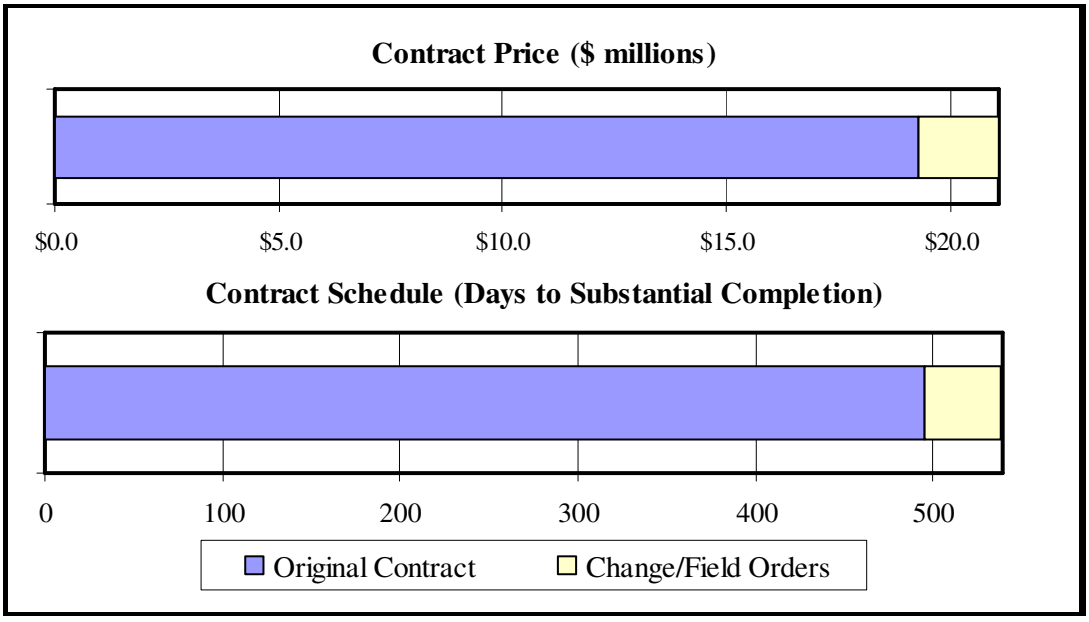
		Change Orders	Field Orders [4]
	Number of Change/Field Orders	2	113
Cost	Total Cost	-$121,754	+$1,035,387
Cost	Average Cost Per Order	-$60,877	+$9,163
Cost	Range of Cost Per Order	-$121,754 to $0	+$228 to +$87,706
Schedule	Total Additional Time	+176 days	N/A
Schedule	Average Additional Time Per Change Order	+88 days	
Schedule	Range of Time Added Per Change Order	+8 to +66 days	

[4] DGS had not finalized all project field orders by the report print date; field order data are maximum estimates as of March 5, 2014. In addition, the construction contractor has requested an additional payment of $700,000 for extended overhead. The payment request had not been resolved at the time this report went to print.

PROJECT #16: ANIMAL SHELTER
Completed: December 2013

Summary of Contract Cost[5] and Schedule

	Cost	Schedule
Initial Contract	$19,301,000	495 days
All Change and Field Orders	+$1,787,047	+43 days
Contract with Change and Field Orders	$21,088,047	537 days
Percent Change	+9.3%	+8.7%



Summary of Change and Field Orders

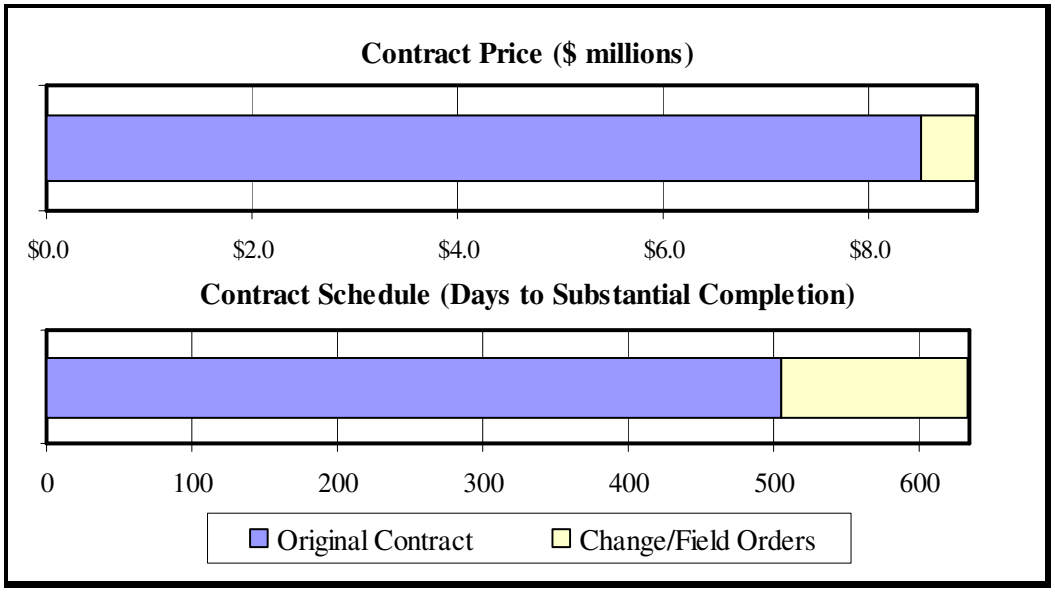
		Change Orders	Field Orders [5]
	Number of Change/Field Orders	6	73
Cost	Total Cost	-$271,195	+$2,058,242
Cost	Average Cost Per Order	+$45,199	+$28,195
Cost	Range of Cost Per Order	-$225,000 to $0	+$268 to +496,791
Schedule	Total Additional Time	+43 days	N/A
Schedule	Average Additional Time Per Change Order	+7 days	
Schedule	Range of Time Added Per Change Order	+0 to +33 days	

[5] DGS had not finalized all project field orders by the report print date; field order data are maximum estimates as of March 5, 2014. In addition, the construction contractor has requested an additional payment of $70,000 for this project. The payment request had not been resolved at the time this report went to print.

PROJECT #17: OLNEY LIBRARY
Completed: December 2013

Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$8,508,000	505 days
All Change and Field Orders	+$526,544	+129 days
Contract with Change and Field Orders	$9,034,544	634 days
Percent Change	+6.2%	+25.5%



Summary of Change and Field Orders

		Change Orders	Field Orders
	Number of Change/Field Orders	3	76
Cost	Total Cost	-$70,051	+$596,595
Cost	Average Cost Per Order	-$35,026	+$7,850
Cost	Range of Cost Per Order	-$7,051 to $0	+$195 to +$67,747
Schedule	Total Additional Time	+129 days	N/A
Schedule	Average Additional Time Per Change Order	+43 days	
Schedule	Range of Time Added Per Change Order	0 to +129 days	

C. Summary of Change and Field Order Activity

As described in Chapter IV, various factors contribute to the need for change and field orders. Some of the projects managed by DGS during the past five years experienced one or more of these factors. Other projects proceeded uneventfully with minimal need for change and field orders. As a result, the number and magnitude of change and field orders varied significantly among the projects summarized in the chapter. This section presents program-level data on the 17 DGS projects that reached substantial completion during Calendar Years 2009 through 2013.[6] (Chapter VI presents as case studies the specific contract, change order, and field order details for six of the projects.)

1. Aggregate Percent Change in Contract Cost and Time

The projects summarized in this chapter varied greatly in cost and time, ranging in original contract cost from $1.2 million to $19.8 million and ranging in original contract time from 240 to 720 days. To account for the variance in project magnitude, OLO aggregated contract cost and time data for the 17 projects to calculate the overall change in cost and time caused by change and field orders (see the tables on the next two pages). Aggregation of project data compensates for the variation in projects by placing greater weight on larger projects and lesser weight on smaller projects.

Comparison of this data shows that change and field orders had a significantly greater effect on contract time than they did on contract costs for the program of capital projects. As displayed in the table on the following page, change and field orders aggregated together for all 17 projects resulted in an overall increase in contract costs of 8.0%.[7] In contrast, as shown in the table on page 38, change orders[8] for the 17 projects increased the overall time for contracts by 30.3%.

This difference between change in contract cost and change in contract time may be explained, in part, by the disparity between the cost and time functions of a change order. DGS executes change orders to either increase or decrease payment to the contractor (that is, contract cost). However, if a contractor achieves substantial completion ahead of schedule, DGS does not issue a change order to reduce the contract time. With regard to contract time, change orders are used exclusively in circumstances when additional time is required to complete the project.

[6] As mentioned at the beginning of this chapter, this study excludes projects that (a) had an initial contract cost of less than $1 million; and (b) were managed, in part, by entities other than DGS.

[7] This calculation is based on the actual change and field order costs for all projects except the Gaithersburg Library and the Animal Shelter. DGS had not finalized all project field orders for the Gaithersburg Library and the Animal Shelter by the report print date. For this calculation, OLO used maximum field order estimates as of March 2014 for these two projects.

[8] Only change orders may modify the amount of time for the contractor to achieve substantial completion; field orders may not modify contract time (see Chapter III).

Contract Costs of Completed DGS Managed Capital Projects
Calendar Years 2009 through 2013

	Project	Initial Contract Cost	Added Cost from Change/Field Orders	Percent Change
1	West Germantown Fire Station	$5,714,397	$475,384	+8.3%
2	Executive Office Building / Judicial Center Emergency Power System Upgrade	$1,157,249	$198,278	+17.1%
3	Equipment Maintenance & Transit Operations Center Indoor Air Quality Improvements	$1,384,000	$90,975	+6.6%
4	Civic Building at Veteran's Plaza	$19,778,000	$2,834,198	+14.3%
5	East Germantown Fire Station	$6,560,000	$309,455	+4.7%
6	Takoma Park Fire Station	$6,844,518	$792,164	+11.6%
7	Council Office Building Data Center Rehabilitation	$2,409,000	$589,958	+24.5%
8	Mid-County Community Recreation Center	$9,061,000	-$103,247	-1.1%
9	Bethesda Fire Station HVAC, Electrical & Roof Improvements	$1,198,040	-$16,592	-1.4%
10	401 Hungerford Drive Garage Restoration	$3,363,922	$170,793	+5.1%
11	Brookville Service Park (Part II)	$7,299,100	$777,688	+10.7%
12	White Oak Community Recreation Center	$13,647,590	$365,930	+2.7%
13	Plum Gar Recreation Center	$5,338,514	$193,053	+3.6%
14	Colesville Salt Barn	$2,100,000	$419,002	+20.0%
15	Gaithersburg Library	$14,588,000	$913,633	+6.3%
16	Animal Shelter	$19,301,000	$1,787,047	+9.3%
17	Olney Library	$8,508,000	$526,544	+6.2%
	AGGREGATE TOTAL	**$128,252,330**	**$10,324,263**	**+8.0%**

Contract Time for Completed DGS Managed Capital Projects
Calendar Years 2009 through 2013

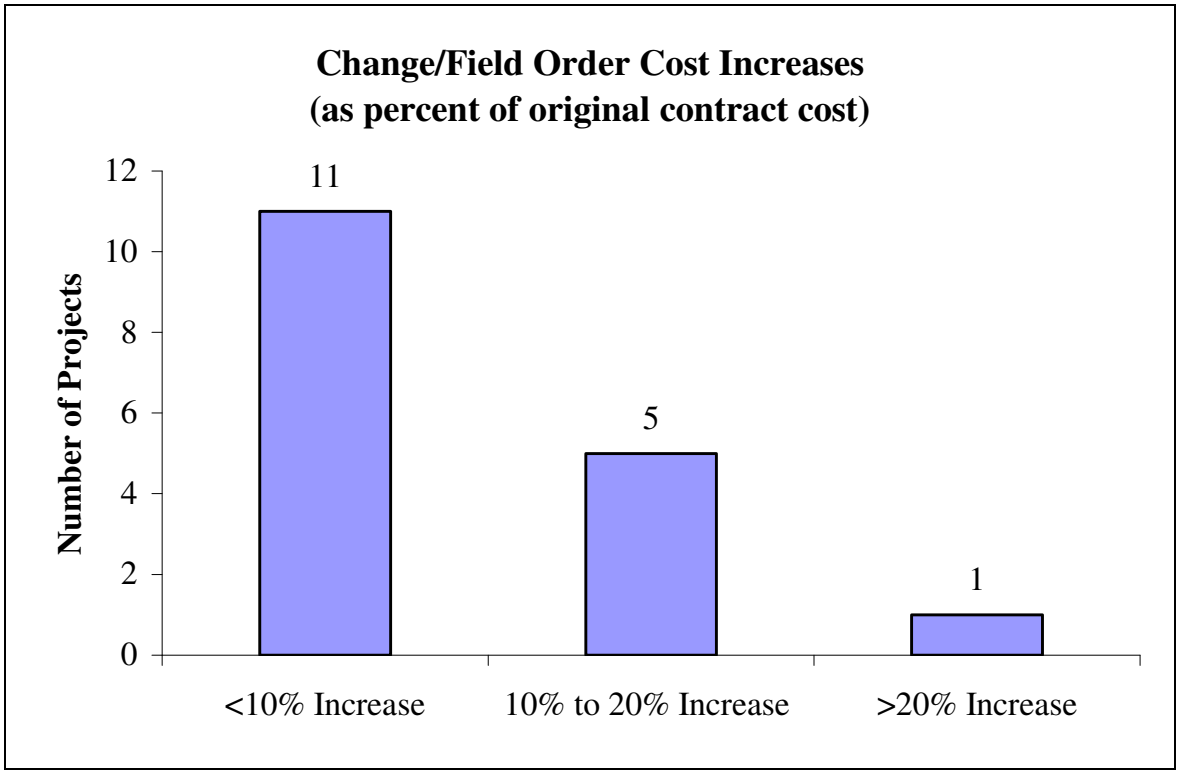
	Project	Initial Contract Time (in days)	Added Time from Change Orders (in days)	Percent Change
1	West Germantown Fire Station	450	38	8.4%
2	Executive Office Building / Judicial Center Emergency Power System Upgrade	365	0	0.0%
3	Equipment Maintenance & Transit Operations Center Indoor Air Quality Improvements	300	0	0.0%
4	Civic Building at Veteran's Plaza	450	226	50.2%
5	East Germantown Fire Station	450	104	23.1%
6	Takoma Park Fire Station	720	476	66.1%
7	Council Office Building Data Center Rehabilitation	240	405	168.8%
8	Mid-County Community Recreation Center	450	490	108.9%
9	Bethesda Fire Station HVAC, Electrical & Roof Improvements	300	0	0.0%
10	401 Hungerford Drive Garage Restoration	270	10	3.7%
11	Brookville Service Park (Part II)	600	2	0.3%
12	White Oak Community Recreation Center	630	66	10.5%
13	Plum Gar Recreation Center	420	73	17.4%
14	Colesville Salt Barn	240	0	0.0%
15	Gaithersburg Library	505	176	34.9%
16	Animal Shelter	495	43	8.7%
17	Olney Library	505	129	25.5%
	AGGREGATE TOTAL	**7,390**	**2,238**	**30.3%**

2. Distribution of Projects by Change in Contract Cost and Time

For most projects, change and field orders had a relatively moderate effect on costs. Of the 17 capital projects studied by OLO, nearly two-thirds (11 projects) experienced a change in contract cost resulting from change and field orders of less than 10%. In fact, change orders for two projects (Mid-County Community Recreation Center and Bethesda Fire Station HVAC, Electrical and Roof Improvements) actually reduced final contract costs.

The cost of change and field orders for five of the projects totaled between 10% and 20% of original contract costs. A single project, the Council Office Building Data Center Rehabilitation, incurred change and field order cost increases exceeding 20% of original contract costs.[9]

With the exception of the Data Center and Takoma Fire Station projects, the capital budget appropriations for all of the projects listed in the chapter were sufficient to cover the additional cost incurred by change and field orders. DGS transferred unspent appropriated funds from other capital projects to cover the additional costs of the Data Center and Takoma Fire Station projects.[10] No supplemental appropriation was required for any of the 17 projects.

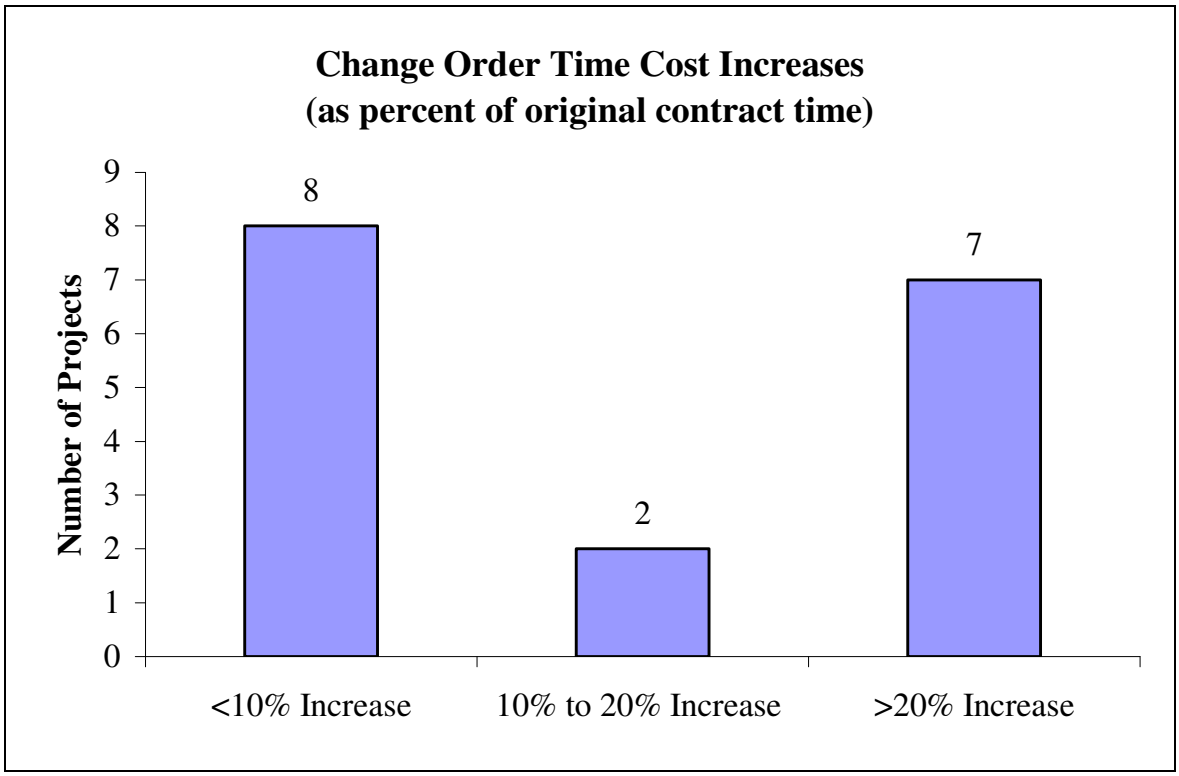


[9] As detailed in Chapter VI, the Council Office Building Data Center Rehabilitation project incurred additional post-contract expenses. The sum of these expenses plus the cost of change and field orders raised the total cost 45.7% higher than the original contract amount.

[10] Section 309 of the County Charter authorizes the County Executive to transfer up to ten percent of a capital project appropriation to another capital project.

Of the 17 projects studied by OLO, just under half (47%) had increases in contract time resulting from change orders of less than 10%. Of those projects, four (Executive Office Building / Judicial Center Emergency Power System Upgrade, Bethesda Fire Station HVAC, Electrical & Roof Improvements, Colesville Salt Barn, and Equipment Maintenance & Transit Operations Center Indoor Air Quality Improvements) required no addition of days to the time specified in the original contract.

For two projects, change orders extended the contract time by 10% to 20%. For the remaining seven projects, change orders extended contract time by more than 20%. Two projects (COB Data Center and Mid-County Community Recreation Center) experienced delays that more than doubled the construction time period.



3. Relative Effect of Change Orders versus Field Orders on Contract Cost

For the 17 projects studied in this report, field orders had a substantially greater effect on contract costs than did change orders. For all the projects combined, the average change order cost about $15,500 while the average field order cost about $10,200.[11] However, on average, the projects experienced only two to three change orders, but required about 56 field orders. As a result, the change orders, on average, added about $37,400 (or 0.5%) to contract costs. By contrast, field orders added, on average, about $569,900 (or 7.5%) to contract costs.

Change and Field Orders
Average Cost per Contract

	Change Orders	Field Orders
Average Number Per Contract	2.4	56.1
Average Cost Per Change/Field Order	$15,510	$10,166
Average Cost Per Contract	$37,406	$569,904
Average Percent Increase in Contract Cost	0.5%	7.5%

[11] This calculation is based on the actual change and field order costs for all projects except the Gaithersburg Library and the Animal Shelter. DGS had not finalized all project field orders for the Gaithersburg Library and the Animal Shelter by the report print date. For this calculation, OLO used maximum field order estimates as of March 5. 2014 for these two projects.

CHAPTER VI. CASE STUDIES

This chapter details the change order and field order activity for six recent capital projects managed by the Department of General Services (DGS). In identifying case studies for this report, OLO selected six projects that illustrate a range of project scopes and that demonstrate the varying outcomes of the capital construction process. This chapter describes the following capital projects.

- Section A. Council Office Building Data Center Rehabilitation
- Section B. Mid-County Community Recreation Center
- Section C. Bethesda Fire Station HVAC, Electrical and Roof Improvement
- Section D. Colesville Salt Barn
- Section E. Gaithersburg Library
- Section F. Olney Library

A. Council Office Building Data Center Rehabilitation

The County Council approved the "Data Center Rehabilitation" project as part of the FY07-FY12 Capital Improvements Program (CIP).

1. Project Description

The County Department of Technology Services (DTS) operates the Data Center on the Third Floor of the Council Office Building (COB) in Rockville. The Data Center is the County Government's central information technology server/system hosting site, and serves as the County Government's main network connections center. The Data Center operates 24 hours a day, seven days a week, and requires a reliable, uninterrupted power supply to support the County's mainframe and other information technology systems.

In 2006, DTS and DGS conducted a study to evaluate the operational status of the Data Center's mechanical and electrical systems. The study found that the existing electrical, HVAC, and fire protection systems were insufficient to maintain services and assure uninterrupted network operation. The study also documented how poor cooling system performance and an inadequate electrical supply had caused unsafe conditions, as well as occasional system failures and shutdowns.

After approval of the Data Center project in the CIP, DGS initiated the process to plan, design, and construct upgrades to the Data Center mechanical and electrical systems based on functional requirements established by DTS.

2. Planning and Design

At the outset of the planning and design phase, the County Government[1] utilized an existing "job order contract" (JOC) with a design firm to prepare the architectural and engineering requirements for the Data Center Rehabilitation project. A JOC is a firm fixed-price contract for routine construction services requested by the County Government on an as-needed basis. Through the JOC process, DGS may issue a task order requesting specific design or construction services. The JOC contractor must perform all specified work within the time period stated in the task order and at a cost as determined by the pricing schedule included in the contract.

In January 2009, the County entered into a contract with Denver-Elek, Inc. for the construction phase of the COB Data Center Rehabilitation project based on the architectural and engineering design plans prepared by the JOC contractor. The initial contract required substantial completion of the project within 240 days for a fixed price of $2,409,000. Soon after project work began, Denver-Elek identified serious deficiencies in the project design plans.

The JOC contractor and subcontractors who prepared the initial architectural and engineering plans was a general construction firm with no particular expertise in specialized data center electrical and climate control requirements. The JOC contractor developed design plans for the project that were inadequate to meet Data Center power supply and cooling system needs. Examples of the design deficiencies include:

- The DTS functional requirements called for two uninterrupted power supply (UPS) units with an output of 600 amps each. The design plan provided input to the UPS units that would have been less than half of the required amperage.
- The original design plan did not include a redundant back-up system to cool the temperature-sensitive Data Center equipment if the primary cooling system failed.
- The JOC contractor ordered UPS units that were too large to fit through existing passageways to their intended location.
- The original implementation plan would have required reconfiguration of the electrical supply to the entire COB, resulting in power not being available in the building for several weeks.

DGS acknowledges that the deficiencies in the project design resulted from selection of an architectural and engineering contractor that lacked the expertise to design a complex facility such as the Data Center.

After identifying the multiple design flaws produced by the JOC contractor, DGS hired an independent, third-party engineering firm experienced in designing specialized electrical and mechanical systems to develop remedial measures to correct the Data Center rehabilitation design flaws. Based on revised requirements prepared by the third-party engineering firm, DGS

[1] The early planning stages of this project preceded the creation of DGS in 2008. The former Office of Procurement and the former Department of Public Works and Transportation issued the original job order contract for this project.

issued field and change orders to the construction contractor to implement the corrective measures needed to properly rehabilitate the Data Center.

3. Change Orders and Field Orders

As summarized on page 24 in Chapter IV, the one change order and 14 field orders to the COB Data Center Rehabilitation construction contract increased the project price from $2,409,000 to $2,999,958 (a 24.9% increase) and extended the time to substantial completion from 240 days to 645 days (a 168.8% increase).

DGS executed the change order and nearly all of the field orders to implement the design changes and corrective measures called for by the third-party engineering firm. The 14 field orders cost a total of $433,373, and included work to:

- provide a new dedicated underground electrical power line to the Data Center;
- relocate electrical panels;
- increase the capacity of electrical circuit breakers;
- reroute electrical cables;
- relocate air conditioning equipment; and
- modify the fire suppression system to meet fire code requirements.

The single change order cost $156,585 and extended the construction period by 405 days to allow additional time to complete the corrective measures needed to remedy deficiencies in the original design. DGS determined that a delay of 195 days was an unavoidable result of the design problems, and therefore compensated the contractor an additional $156,585 ($803 per day for 195 days) to cover overhead costs. DGS determined that the remaining delay of 210 days – although stemming from complications arising from the inadequate design – could have been avoided, and therefore was not eligible for additional compensation. Nonetheless, as the faulty architectural and engineering design was the root cause for even the non-compensated delays, DGS decided not to charge the contractor liquidated damages for the project delay.

After Denver-Elek completed all of the work required by the construction contract as modified by the change and field orders, DGS found a number of items in need of correction to assure reliable operation of the Data Center. DGS issued task orders through existing service contracts with two vendors to improve the backup cooling system and to reconfigure the electrical circuits serving the UPS system. The cost of this additional construction work totaled $510,324.

In total, the change and field orders combined with the additional HVAC work raised the project's cost by about $1.1 million, an increase of about 46% greater than the original contract amount. The capital budget appropriation for this project lacked sufficient funds to cover these costs. To cover the additional project costs, DGS transferred nearly $1 million in unspent funds appropriated to other capital projects.

Council Office Building Data Center Rehabilitation
Summary of Contract Price and Schedule

	Price	Schedule
Initial Contract	$2,409,000	240 days
All Change and Field Orders	+$589,958	+405 days
Contract with Change and Field Orders	$2,998,958	645 days
Percent Change	+24.5%	+168.8%
Additional Post-Contract Work	+$510,324	
Contract with Change and Field Orders and Additional Post-Contract Work	$3,509,282	
Percent Change	+45.7%	

B. Mid-County Community Recreation Center

The 1998 Park, Recreation, and Opens Space Master Plan recommended development of a new recreation center in the Mid-County. The Council approved the "Mid-County Community Recreation Center" project as part of the FY01-FY06 Capital Improvements Program.

1. Project Description

This project provided for the design and construction of a 23,500 net square foot community recreation center on a 10-acre site on Queensguard Road in Silver Spring. The recreation center building included a gymnasium, exercise room, social hall, kitchen, senior/community lounge, arts/kiln room, game room, vending space, conference room, offices, lobby, rest rooms, and storage space. The County Recreation Department operates programs in the building. The Maryland-National Capital Park and Planning Commission maintains the playground, ball fields, tennis courts and other outdoor facilities at the site.

2. Planning and Design

As detailed in Chapter II, DGS retains the services of multiple architectural and engineering contractors to prepare design plans for new and renovated public facilities. Two of these firms have demonstrated experience and expertise in designing public libraries and recreations centers. DGS issued a task order to one of these firms to prepare detailed design and construction plans for the Mid-County Community Recreation Center.

The facility design included concrete block interior walls for many of the rooms in the recreation center. The design also called for installation of an air/moisture barrier inside the concrete walls.

In April 2008, the County entered into a contract with Sigal Construction Corporation to construct the Mid-County Community Recreation Center. The initial contact required substantial completion of the project within 450 days for a fixed price of $9,061,000.

3. Change Orders and Field Orders

As summarized on page 25, the two change orders and 31 field orders to the Mid-County Community Recreation Center construction contract decreased the project price from $9,061,000 to $8,957,753 (a 1.2% decrease) and extended the time to substantial completion from 450 days to 940 days (a 108.9% increase).

The project proceeded through most of the construction phase without major incident. Twelve months into the planned 15-month construction period, DGS had not requested any change orders and only a few very minor field orders. During a routine inspection of the construction during the Spring of 2009, DGS staff examined the condition of the concrete block interior walls. The inspectors detected "spalling" of the concrete on the inside-facing sides of walls. Spalling is a term that refers to the chipping or splintering of surface material. DGS staff observed one-inch to one-and-a-half-inch concrete chips had fallen from the surface of the walls in rooms throughout the building.

An investigation performed by the contractor discovered that the supplier of the concrete blocks had formulated the concrete improperly. The concrete was contaminated by calcium oxide that caused the material to absorb moisture and expand. The concrete blocks were set into place in the early Spring when humidity levels were low. Once more humid weather arrived, the blocks that formed the building walls began to expand causing the spalling.

Testing determined that the concrete spalling did not jeopardize the structural integrity of the building. The walls could be patched and painted to mostly hide the chipped surfaces. However, DGS had concerns about the inwardly-facing side of the walls that could not be visually inspected. As required by the facility design plan, the construction contractor applied a plastic film called an "air/moisture barrier." Migration of water vapor into a structure may damage flooring and building systems and could contribute to growth of mold and mildew. The purpose of an air/moisture barrier is to prevent the infiltration of water vapor into a building.

DGS ordered removal of some of the exterior bricks to determine whether interior spalling had damaged the air/moisture barrier. This testing confirmed that damage to the barrier had occurred. The condition of the barrier could have significantly reduced the useful life of the recreation center building. Therefore, DGS directed the contractor to remove the existing bricks and air/moisture barrier and replace them with new materials at no additional cost to the County.

This change order extended the time for the contractor to achieve substantial completion by 446 days to allow for the repair the spalled brick walls, the replacement of the air/moisture barrier, exterior walls, and insulation, and the repainting and finishing of surfaces. In addition, this change order required the contractor to provide an extended ten-year warranty for the concrete walls as well as warranty bonds for potential future remedial work to building masonry. DGS further negotiated a $427,394 reduction in the contract price in lieu of liquidated damages.

An earlier change order added 44 days to the project schedule to allow the contractor to complete plumbing system modifications required to receive a WSSC permit. This change order also added $65,913 to the contract sum.

Most of the field orders for this project involved relatively small changes to the construction plans. The largest single-item change order cost $22,728 to relocate the driveway entrance to the facility. This modification was undertaken after a resident who lived immediately opposite the Recreation Center notified DGS that headlights from exiting vehicles shone directly into a window of her home. In total, change and field orders reduced the contract cost by about one percent.

Mid-County Community Recreation Center
Summary of Contract Price and Schedule

	Price	Schedule
Initial Contract	$9,061,000	450 days
All Change and Field Orders	-$103,247	+490 days
Contract with Change and Field Orders	$8,957,753	940 days
Percent Change	-1.1%	+108.9%

C. Bethesda Fire Station HVAC, Electrical and Roof Improvement

Since FY85, the CIP has included a capital project for the replacement of roofs at fire and rescue stations. The FY08 appropriation for this project was designated, in part, to fund replacement of the roof at Bethesda Fire Station #6.

1. Project Description

Bethesda Fire Station #6 is located at 6600 Wisconsin Avenue. The scope of work for this project was to replace the station's roof and to renovate the building's HVAC and electrical systems. The project also included repair of walls, ceilings and other incidental structural improvements.

2. Planning and Design

As detailed in Chapter II, DGS retains the services of multiple architectural and engineering contractors to prepare design plans for new and renovated public facilities. Two of these firms have demonstrated experience and expertise in designing public safety facilities. DGS issued a task order to one of these firms to prepare detailed design and construction plans for the Bethesda Fire Station #6 project.

In October 2010, the County entered into a contract with City Construction LLC to renovate Bethesda Fire Station #6. The initial contract required the contractor to achieve substantial completion of the project within 300 days for a fixed price of $1,198,040. The contract included

a $50,000 allowance should the decking that supported the station's roof have been found to be in need of repair.

3. Change Orders and Field Orders

As summarized on page 26, the one change order and four field orders to the Bethesda Fire Station #6 construction contract decreased the project price from $1,198,040 to $1,181,448 (a 1.4% decrease) and added no additional time for the contractor to achieve substantial completion.

The project proceeded through the construction phase without incident. The four field orders issued by DGS resulted in a combined total cost $33,497. The single largest field order cost was $15,225 for the replacement of deteriorated water pipes in the building.

After removing the old station roof, the contractor found that the decking supporting the roof was in good condition and required no repair. DGS issued a change order to remove from the contract the $50,000 allowance that had been designated for potential repairs to the roof decking.

The net effect of the $50,000 change order price reduction and the $33,497 field order price increase was to reduce the overall contract cost by $16,592. The project reached substantial completion within the 300 day contract requirement.

Bethesda Fire Station HVAC, Electrical and Roof Improvement
Summary of Contract Price and Schedule

	Price	Schedule
Initial Contract	$1,198,040	300 days
All Change and Field Orders	-$16,592	0 days
Contract with Change and Field Orders	$1,181,448	300 days
Percent Change	-1.4%	0.0%

D. Colesville Salt Barn

In FY09, the Council created the Environmental Compliance CIP project to implement plans for the abatement and containment of potential pollution sources at County Government facilities including transportation depots. Among the uses of funds from this CIP project is the replacement of salt barns. The FY10 and FY11 appropriations for this project were designated to fund replacement of the salt barn at the Colesville Transportation Depot.

1. Project Description

The Colesville Transportation Depot located on Cape May Road houses roadway maintenance facilities and equipment and serves the southeastern portion of the County. The plan called for construction of a new 160-foot by 80-foot salt storage barn at the Colesville Depot. The barn

floor as well as the access road to the barn required heavy duty pavement to accommodate the large highway maintenance vehicles that operate at the site.

The site identified for the new salt barn was a vacant field that had not been disturbed since the County first constructed the Depot in 1981.

2. Planning and Design

The County retains the services of engineering contractors with specialized expertise in the design of transportation facilities. DGS issued a task order to one of these firms to prepare design plans for the Colesville Salt Barn. One requirement of the task order was for the engineering firm to conduct geotechnical analysis and borings to evaluate the capacity of soils at the project site to support the heavy duty pavement needed for the facility. The contractor took soil borings at multiple project site locations and found no deficiencies or anomalies in soil conditions.

In September 2012, the County entered into a contract with Tech Contracting Company to construct the Colesville Salt Barn. The initial contact required the contractor to achieve substantial completion of the project within 240 days for a fixed price of $2,100,000. The contract also included pre-established unit prices for additional materials and services if requested by the DGS through a change order. Among the items included in the "Schedule of Mandated Unit Prices" were unit costs for the contractor to excavate and haul soil as well as to supply and spread fill materials.

3. Change Orders and Field Orders

As summarized on page 31, the two change orders and nine field orders to the Colesville Salt Barn construction contract increased the project price from $2,100,000 to $2,519,002 (a 20.0% increase) but added no additional time for the contractor to achieve substantial completion.

In preparation for the paving of the salt barn floor and access roadway, the construction contractor tested the soils at the project site. This testing found large amounts of rubble and other debris buried at the site (likely waste materials from the original construction of the depot in 1981). After removing the debris, the contractor tested the clay soil remaining at the site. The soil repeatedly failed trials to verify its ability to bear heavy weight. The soil sheared and rutted under weight and proved unsuitable as sub-grade base for the pavement.

DGS hired a consulting firm that specializes in geotechnical engineering and materials testing to evaluate soil conditions at the salt dome site. Based on the recommendations of the consultant, DGS issued four field orders directing the construction contractor to undertake soil remediation efforts. The field order for the first remediation effort involved introducing asphalt millings to reinforce the clay soil. A subsequent field order directed the construction contractor to add recycled concrete into the soil. However, despite these efforts, the soils continued to fail weight-bearing tests.

As a last resort, DGS issued two change orders directing the contractor to remove the unacceptable soil and to import new fill material to serve as a replacement sub-grade surface. The replacement material produced a sub-surface that was sufficiently firm to bear the necessary weight.

In total, the County paid $378,577 for soil remediation field orders and change orders, an amount equivalent to 18% of the original construction contract cost. As noted above, the original contract included a pre-determined schedule of unit costs for soil excavation and hauling services as well as for the supply and application of fill materials. The presence of this schedule allowed for the contractor to immediately implement change order requests without having to negotiate prices. The contractor performed all change order work in accordance with the established schedule of unit prices.

In total, all change and field orders (including those not related to soil remediation) increased the contract cost by about 20 percent. The capital budget appropriation for this project was sufficient to cover this additional cost without need for a supplemental appropriation. Moreover, the contractor performed all change and field order work without delay to the project.

Colesville Salt Barn
Summary of Contract Price and Schedule

	Price	Schedule
Initial Contract	$2,100,000	240 days
All Change and Field Orders	+$419,002	0 days
Contract with Change and Field Orders	$2,519,002	240 days
Percent Change	+20.0%	0.0%

E. Gaithersburg Library

The County Council approved the "Gaithersburg Library Renovation" project as part of the FY07-FY12 Capital Improvements Program (CIP). The FY08 capital budget included the first appropriation for this project.

1. Project Description

The Gaithersburg Library is a 36,814 square foot structure that opened in 1981. The purpose of this project was to gut and renovate the existing interior space and to add an additional 25,691 gross square feet to the building. The project included roof and window replacement as well as upgrades to the HVAC, lighting, electrical, plumbing, security, fire alarm, and communications systems. In addition, bathrooms were redesigned to meet accessibility requirements. The expanded and reconfigured interior produced more program space for children's and young adult services and provided new space for meeting rooms and a satellite office of the Gilchrist Center.

2. Planning and Design

DGS retains the services of two architectural and engineering contractors to prepare design plans for new and renovated libraries. DGS issued a task order to one of these firms to prepare design plans for the Gaithersburg Library Renovation project. The architectural and engineering contractor prepared the detailed construction plans for this project.

In October 2011, the County entered into a contract with Henley Construction Company to renovate the Gaithersburg Library. The initial contact required the contractor to achieve substantial completion of the project within 505 days for a fixed price of $14,588,000. One contract provision called for installation of pervious concrete in the parking lot as part of the stormwater management plan for the site. The contract also included an $80,000 allowance for the possible installation of building security equipment.

3. Change Orders and Field Orders

As summarized on page 33, the two change orders and 113 field orders to the Gaithersburg Library construction contract increased the project price from $14,588,000 to $15,501,633 (a 6.3% increase) and extended the time to substantial completion from 505 days to 681 days (a 34.9% increase). According to the original contract, the project was to have reached substantial completion by May 2013. However, the project was delayed by 176 days, almost six months. The delay was a product of several causes, including:

- As with all capital projects, the Gaithersburg Library design included multiple features to manage stormwater runoff. One element of the stormwater management plan was installation of pervious concrete in sections of the parking lot. The pervious concrete was intended to allow infiltration of rain water into the soil below to minimize off-site runoff. Early in the construction phase, the contractor noticed that subsurface water was seeping into neighboring properties. To remedy this situation, the facility design plan was amended to reduce the amount of pervious concrete and to install a previously unplanned underground filtration system to capture additional water before it migrated off site.
- The project included major reconstruction of the driveway, sidewalks, and drainage facilities along Christopher Avenue. When work began on replacement of the sidewalk, construction crews encountered electricity lines buried eight inches below the surface.[2] The project could not proceed until PEPCO came to the site and relocated the lines to lower depth. In addition, work along the Christopher Avenue included modifications to existing walkways and curb cuts to comply with the Americans with Disabilities Act. Compliance requirements necessitated revisions to the original design plan.
- Unusually wet weather delayed construction activity by several weeks.
- Facility design specifications required revisions for several important building systems including the elevator and telecommunications connections.

The cumulative effect of the above occurrences resulted in the six month project delay. DGS executed a change order with a revised schedule reflecting the new time requirements.

[2] Standard practice is for electrical lines to be located about 30 inches below the surface.

In total, all change and field orders increased the contract cost by about six percent. Another change order eliminated from the contract the $80,000 allowance that had been designated for building security system equipment.[3] In addition, the same change order eliminated the requirement for the construction contractor to install a book pick up system[4], thereby reducing the project cost by an additional $54,000.

The change order cost reductions were more than offset by the 99 project field orders that totaled a combined $1 million. The highest cost field order was for $87,000 for the purchase of furniture.[5] A $60,000 field order paid for the purchase and installation of the underground filtration system needed to control the stormwater runoff. During construction, work crews found deterioration of the existing library roof deck. DGS approved a $50,000 field order to replace the roof deck of the existing building.

Gaithersburg Library
Summary of Contract Cost[6] and Schedule

	Cost	Schedule
Initial Contract	$14,588,000	505 days
All Change and Field Orders	+$913,633	+176 days
Contract with Change and Field Orders	$15,501,633	681days
Percent Change	+6.3%	+34.9%

F. Olney Library

The County Council approved the "Olney Library Renovation and Addition" project as part of the FY03-FY08 Capital Improvements Program (CIP). The FY08 capital budget included the first appropriation for this project.

1. Project Description

This Olney Library is a 16,825 square foot structure that opened in 1981. This scope of this project included a 4,260 square foot addition, full renovation of the interior space, HVAC replacement, energy efficiency improvements, and stormwater management improvements. The renovation and expansion of the library added space to the children's, young adult and adult areas. In addition, the project added group study and quiet study rooms, improved access to

[3] DGS procured the security system equipment from a different vendor.
[4] The book pick up system originally included as a contract requirement was a post office box style storage system intended to offer patrons self-service pick up of reserved materials.
[5] DGS had originally intended to purchase furniture through a different vendor but instead used the field order process to purchase furniture through the facility construction contract.
[6] DGS had not finalized all project field orders by the report print date; field order data are maximum estimates as of March 5, 2014. In addition, the construction contractor has requested an additional payment of $700,000 for additional time worked on this project. The payment request had not been resolved at the time this report went to print.

meeting rooms and the book drop area, and provided self checkout stations. Construction of the renovated library was in compliance with Silver Leadership in Energy and Environmental Design (LEED) standards.

2. Planning and Design

DGS retains the services of two architectural and engineering contractors to prepare design plans for new and renovated libraries. DGS issued a task order to one of these firms to prepare design plans for the Olney Library Renovation and Addition project. The architectural and engineering contractor prepared the detailed construction plans for this project.

In December 2011, the County entered into a contract with Milestone Construction Services, Inc. to renovate and expand the Olney Library. Milestone was an experienced construction firm in the region and had satisfactorily completed multiple recent capital projects for the County. As with all County capital construction contracts, the Olney Library contract required that the contractor provide a performance bond. The purpose of the performance bond is to provide the County "security for the faithful performance of the contract and as security for the payment of all persons performing labor and furnishing materials in connection with the work." [7] In other words, the contract required Milestone to purchase a bond that would provide funding to the County to complete the project in the event Milestone failed to meet the performance requirements specified in the contract.

The initial contact required the contractor to achieve substantial completion of the project within 505 days for a fixed price of $8,508,000. The contract included a $63,000 allowance for the possible installation of building security equipment.

3. Change Orders and Field Orders

As summarized on page 35, the three change orders and 76 field orders to the Gaithersburg Library construction contract increased the project price from $8,508,000 million to $9,034,544 (a 6.2% increase) and extended the time to substantial completion from 505 days to 634 days (a 25.5% increase).

Construction work on the Olney Library renovation and expansion began in April 2012. The first twelve months of the construction phase progressed mostly uneventfully with only a few relatively minor change and field orders. In May 2013, however, work on the project slowed considerably. DGS field inspectors reported that the construction contractor, Milestone, had reduced the labor force at the construction site to levels that were insufficient to meet the project schedule. Also in May 2013, several project subcontractors reported to DGS that they had not received timely payment for services from Milestone. In late May 2013, DGS contacted Milestone to express concern about the slow pace of project work.

A few weeks later, DGS learned the cause for the work slow down. Milestone had decided to cease business operations by the end of Calendar Year 2013. As of June 2013, Milestone had completed about two-thirds of the required construction work. DGS concluded that Milestone

[7] General Conditions of Construction Contract, Section 17.1.1.

had not performed as required in May and June 2013 and possibly could be found in breach of contract. In early July 2013, DGS met with Milestone and its bonding company to discuss whether the County should find the company in default and whether to call for payment from the construction contract performance bond.

DGS concluded that it was in the best interest of the County not to call the performance bond. Invoking the performance bond would have shifted responsibility for completing the project from Milestone to the bonding company. In such a case, the bonding company could have assigned project work to a new construction contractor which likely would have delayed the project by six months or more. Instead, DGS opted to work with the bonding company to assist Milestone in completing the project. Most notably, the bonding company acquired the services of a management company to oversee the project. Milestone re-engaged in the project and committed to assign a sufficient labor force to accelerate the pace of work. The on-site labor force that had declined to about 20 workers per day in June increased to about 30 workers per day in August and steadily grew to about 60 workers per day by November.

All told, the effect of the contractor's decision to cease business operations and the subsequent slowdown in construction work delayed project completion by about four months. In recognition of this delay, DGS approved a change order that extended the time of the contract by 129 days. Milestone achieved substantial completion of the Olney Library project in late December 2013.

Although the construction contract allowed the County to claim liquidated damages for an "inexcusable delay," DGS concluded that some County actions contributed to the construction delays, and so decided not to pursue liquidated damages.

Other than the change order to extend the project time, the change and field orders for this project involved relatively small changes to the construction plans. One change order eliminated from the contract the $63,000 allowance that had been designated for building security system equipment.[8] Many of the field orders resulted from deficiencies in the materials and systems retained from the original building constructed in 1981. In total, change and field orders increased the contract cost by about six percent. The capital budget appropriation for this project was sufficient to cover this additional cost.

Olney Library
Summary of Contract Cost and Schedule

	Cost	Schedule
Initial Contract	$8,508,000	505 days
All Change and Field Orders	+$526,544	+129 days
Contract with Change and Field Orders	$9,034,544	634 days
Percent Change	+6.2%	+25.5%

[8] DGS procured the security system equipment from a different vendor.

CHAPTER VII. MANAGING RISK AND COSTS

This chapter describes methods used by state and local governments to assess and mitigate the risk associated with capital project construction contract change orders.[1] The last section of the chapter discusses change order spending limits established in some jurisdictions. This chapter includes three sections:

- Section A. Risk Assessment
- Section B. Risk Mitigation
- Section C. Change Order Spending Limits

A. Risk Assessment

Some jurisdictions require government agencies to conduct a risk assessment before constructing a capital project. A capital construction risk assessment may include an evaluation of potential variables that could necessitate change orders and affect project cost and time. Through the risk assessment process, the government agency identifies pre-construction measures that reduce the government's exposure to factors that could produce unanticipated expense and delay.

In 2006, the Washington State Legislature directed the Office of Financial Management (OFM) to report on best management practices for financing and constructing capital projects. OFM issued its final report in January 2008. The final report included the following:

> "The development of a project involves many risks. In construction, issues of risk are closely tied to schedule, site unknowns and budget issues. The agency must understand the risks involved in construction, and make a decision on the allocation of these risks among project participants so that all areas of exposure are properly understood. In considering risk allocation, the agency should assign risks to those parties that exercise control over aspects of the project. For example, the contractor should not be required to correct problems caused by design errors at an extra cost because the contractor generally has little control over the cause or magnitude of design errors."[2]

The risk assessment process allows a government to evaluate the particular requirements, conditions, and circumstances of a pending capital project and to undertake measures to mitigate the risk of cost increases and project delays. The next section of this chapter describes some risk mitigation strategies for construction projects.

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[1] This chapter describes practices in other jurisdictions. In researching the procurement practices outside of Montgomery County, OLO did not find any jurisdiction that employed the term, "field order." As such, this chapter uses the single term "change order" to include all contract modifications allowed by either a change order or a field order under Montgomery County procurement regulations.

[2] *Best Management Practices for Capital Projects, Final Report,* State of Washington Office of Financial Management, January 2008, http://www.ofm.wa.gov/budget/capital/best_management_practices_report.pdf

B. Risk Mitigation

Constructing and renovating capital facilities involves risk. Multiple conditions and factors can arise that necessitate a change in project cost and time (see Chapter IV). This section describes some strategies used by the County and other jurisdictions to mitigate the risk involved in capital project construction.

1. Unit Pricing Specified in Contract

One risk factor associated with change orders involves the method for determining payment to the contractor for work added to the contract requirements. Most contract managers, including DGS, require the contractor to provide documentation justifying the payment amount requested to perform change order work. Nonetheless, when negotiating change order prices, contract managers may find themselves in a disadvantageous position. The contract manager cannot seek competitive bids for change order work and often is hesitant to delay a project to take the time to thoroughly investigate pricing options. One strategy to control the cost risk of change orders is to specify unit costs for labor and materials requested through a change order in the original construction contract. Establishing fixed unit prices for potential change order work removes price volatility from the process and thereby controls costs.

The County Government's General Conditions of Construction Contract (hereafter, "General Conditions") permit DGS to include unit prices for potential change order work in the original construction contract. The General Conditions further authorize DGS to use the fixed unit prices as the method for determining change order payment to a contactor.[3] DGS routinely incorporates fixed unit prices in facility construction contracts (with the exception of projects that include no construction other than building systems replacement).

2. Pre-Construction Evaluation of Site Conditions

Unfavorable site conditions are one of the primary causes for change orders. Facility construction plans must take into account conditions such as weight-bearing ability of local soils as well as the presence of subterranean rock, contaminated soils, buried utility lines, and underground storage tanks. Site conditions may be ascertained through pre-construction testing. Soil borings and other sub-surface testing provide vital information necessary for facility construction but also come at a cost. Conducting extensive pre-construction site testing reduces the risk that change orders will be necessary but also adds cost to the planning and design phase of a project.

[3] As detailed in Section 12.2.2 of the General Conditions, unit pricing is one of five authorized methods for determining change order payment amounts.

In facility construction contracts signed before 2008, the County Government would include an "unwarranted site" provision stating that:

> "subsurface conditions at the site are not warranted by the Owner [the County]... The presence of differing subsurface conditions … does not entitle the Contractor to additional compensation or any extension of time …."

The intent of the above provision was to protect the County from the cost risk of remediating unfavorable site conditions discovered during the construction phase. This provision placed site remediation risks entirely on the construction contractor. However, DGS discontinued use of this contract provision in 2010 based on the guidance from the Office of the County Attorney. The County Attorney advised DGS that the provision was unenforceable and could subject the County to lengthy and costly litigation. In the absence of the unwarranted site provision, pre-construction testing remains the most feasible means to reduce site condition risks.

The level of risk associated with undesirable site conditions is dependent on the development history of the site as well as the type of facility to be constructed at the site. Unstable or contaminated soils as well as buried utility lines and underground storage tanks are more likely to be found under previously developed or disturbed land. In addition, soil conditions are of particular concern for facilities with significant subsurface construction, large paved areas, or the need to bear heavy equipment.

Public facility development standards in some other jurisdictions recognize the importance of site history and facility type in determining the proper level of pre-construction site testing. For example, the Fairfax County, Virginia, Public Facilities Manual (PFM) sets forth the guidelines which govern the design of all public facilities constructed to serve new development. The Fairfax PFM includes guidelines requiring geotechnical investigation to determine the character and physical properties of soil deposits at a public facility construction site.[4] These guidelines recognize that site condition testing must take into account the type of facility to be constructed as well as the history of the site.

> "The type of structure to be built and anticipated geologic and field conditions have a major bearing on the type of investigation to be conducted…. The investigation must, therefore, be planned with a knowledge of intended project size, land utilization and a broad knowledge of the geologic history of the area." [5]

Determining how much time and money to spend on pre-construction site testing involves an assessment of risk. More extensive and costly site testing would be warranted at facility sites with greater risk of unfavorable subsurface conditions.

[4] Chapter 4 of the Fairfax County, Virginia, Public Facilities Manual (PFM) prepared by the Fairfax County Department of Public Works and Environmental Services and adopted by the Fairfax County Board of Supervisors, Feb. 29, 2012; http://www.fairfaxcounty.gov/dpwes/publications/pfm/chapter4.pdf

[5] Ibid., Sections 4-0302.1 and 4-0302.2

3. Design Review

Design review is a process of evaluating architectural and engineering plans to identify and reduce errors, omissions, and other potential problems that could cause project cost increases or delays.[6] Extensive design review can increase the time and cost of the planning and design phase of a capital project but can yield greater time and cost savings during the construction phase. This section describes two types of design review that could mitigate change order risks.

a. Constructability Review / Value Management

A constructability review is a structured evaluation of project design documents by an independent third-party. The purpose of a constructability review is to refine design elements to better assure that a building can be constructed as intended.

> "A design is a unique, one time endeavor requiring scores of individuals making hundreds of decisions on thousands of building components. It does not have the benefit of product testing. A perfect design will not result." [7]

In a constructability review, third-party reviewers examine construction design specifications to determine the level of difficulty of construction, to identify errors and omissions, and to suggest design revisions that could improve the end product, reduce costs, or save time. This type of review also may evaluate project scheduling elements including anticipated project duration, work day requirements, and seasonal impacts (such as inclement weather, air and ground temperature, and holidays). A study performed by a large national construction management firm found that constructability reviews reduce project change orders and produce between $6 and $27 in savings for each dollar expended.[8]

One type of constructability review is known as "value management." In the value management approach, an independent, third-party design consultant reviews the project during the design phase and offers suggestions on how to improve quality, and/or reduce project time. The value management process encompasses principles of both "value engineering" (looking for ways to provide the same design features or services at a lower cost) and "quality management" (looking for ways to enhance design features or services for the same or a slightly higher cost).

DGS has engaged in value management review on recent projects including the Silver Spring Library.

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[6] For a detailed description of the DGS design review process, please see OLO Report 2013-8, Managing the Design and Construction of Public Facilities: A Comparative Review, July 30, 2013.
[7] Pyles, Troy and Barger, Jim, *Reducing Project Costs through Effective Constructability Reviews: A Pre-Construction Best Management Practice,* presented at the Northwest Construction Consumer Council Conference, November 8, 2006. http://www.nwccc.org/upload/vanir.pdf.
[8] Ibid.

b. Building Information Modeling

Building Information Modeling (BIM) is a computer-based project management tool that helps identify potential design errors and oversights before the project reaches the construction phase. A project manager inputs two-dimensional datasets of architectural, mechanical, electrical, and other design components into the BIM software. The software converts this information into three-dimensional form to create a virtual model of the proposed building. Design reviewers can then view the building model and conduct an analysis to find and correct design problems, conflicts, or omissions that would occur if the building were constructed as designed. For example, the model would show if a structure as designed has a water pipe that would run through ductwork.

DGS has employed BIM software on several recent projects including the Animal Shelter.

4. Alternative Procurement Practices

As mentioned in Chapter II, DGS awards separate contracts for architectural and engineering design and for construction of capital facility projects. This contracting approach is commonly referred as "design-bid-build" contracting. This section describes contracting alternatives used in other jurisdictions.[9]

a. Design-Build

One alternative to the design-bid-build approach is known as "design-build" contracting. In design-build contracting, a government enters into a single contract for both the design and construction of a capital project. In this approach, the same firm that designs a capital facility is also responsible for building the facility.

Design-build contracts may shorten project duration by allowing some overlap of the design and construction phases of a project. With a single contractor performing both functions, construction may begin before final design is complete. In addition, design-build contracts hold a single party accountable for cost and schedule. The design-build approach may prevent unexpected cost increases and delays by requiring the contractor to assume the financial risk for changes in project design. In other words, the single design and construction contractor bears the responsibility for change orders necessitated by errors or omissions. However, design-build does not preclude cost increases or delays resulting from government decisions to change project requirements.

There are other potential disadvantages to the design-build approach. Bidders may request greater compensation for design-build contracts to account for their higher level of risk. In addition, design-build contracting offers the government less control over the project.

[9] The State of Massachusetts employs both the design-build and construction management at risk contracting methods, see http://www.mass.gov/ig/publications/manuals/dcmanual.pdf.

b. Construction Management at Risk

In the "construction management at risk" contracting method, the government hires a firm early in the design stage to serve as the construction manager of the project. During this preconstruction period, the construction management firm advises the government on project budget, schedule, and design. At a predetermined point during design development, the government and the construction management firm agree on a guaranteed maximum price for the construction work. During the construction stage, the construction management firm takes on the role of the project general contractor and assumes the risk of constructing the project in accordance with the design specifications for an amount not to exceed the guaranteed maximum price.

The American Institute of Architects has identified several advantages of the construction management at risk method, most notably, that this approach reduces the time needed for the project by strengthening coordination between the architect/engineer and the construction manager.[10] As with design-build, the construction management at risk method may prompt bidders to request greater compensation to account for the higher level of risk.

C. Change Order Spending Limits

Procurement regulations in some jurisdictions establish "not to exceed" limits on change orders. In other words, the regulations authorize the contract manager (or other government official) to approve change orders only up to a pre-determined dollar amount. Typically, the spending limit covers the cumulative cost of all change orders and is set as a percentage of the original contract amount. In several jurisdictions that employ change order spending limits, the procurement regulations allow approval of change orders in excess of the spending limit by special action of the legislature or a senior government manager.

For example, the Pima County, Arizona, Procurement Code authorizes the Procurement Director to approve a single change order to a construction contract for an amount up to 25 percent of the total contract value, or $100,000, whichever is less. In addition, Pima County Code prohibits the Procurement Director from approving change orders for a single contract that exceed a cumulative total of $250,000. Change orders in excess of these limits must be approved by the County Board of Supervisors.[11]

[10] American Institute of Architects, *Construction Manager at-Risk State Statute Compendium, 2005,* http://www.aia.org/aiaucmp/groups/aia/documents/pdf/aias078883.pdf.
[11] Pima County Procurement Code, Chapter 11.16, http://www.pima.gov/procure/procode.htm#pc1104020.

CHAPTER VIII. FINDINGS AND RECOMMENDATIONS

This chapter presents OLO's major findings and recommendations in two sections:

- Section A. Major Findings
- Section B. OLO Recommendations

A. Major Findings

This report includes eight major findings:

Finding #1: Construction contract change orders are not inherently beneficial or detrimental to the progress of a capital project.

The change order process is a procurement tool that, when managed properly, can offer substantial benefits to a contract manager. The change order process is a method to respond to changing requirements that arise during the construction phase of a project. In the absence of a change order process, the original construction contract likely would require a higher payment amount to compensate the contractor for assuming responsibility for addressing unanticipated work requirements.

However, change orders also may result in undesired cost increases and delays. Once an agency has entered into a contract with a construction firm, an opportunity no longer exists to competitively bid changes to work requirements. Rather, by its very nature, the change order process requires the agency to only consider pricing and staffing offered by the contractor (or through a subcontractor).

Finding #2: For the overall capital program managed by DGS, change and field orders had only a moderate effect on contract costs.

Change and field orders aggregated together for all 17 capital projects studied by OLO resulted in an overall increase in contract costs of 8.0%. Of the 17 projects, nearly two-thirds (11 projects) experienced a change in contract cost resulting from change and field orders of less than 10%. In fact, change orders for two projects resulted in a reduction in final contract costs. A single project, the Council Office Building Data Center Rehabilitation, incurred change and field order cost increases of greater than 20% of contract costs. With the exception of the Council Office Building Data Center and Takoma Park Fire Station projects, the capital budget appropriations for the projects were sufficient to cover the additional cost incurred by change and field orders.

Finding #3: For the projects studied, field orders had a substantially greater effect on contract costs than did change orders.

For the 17 projects studied in this report, field orders had a substantially greater effect on contract costs than did change orders. On average change orders added about $37,400 (or 0.5%) to contract costs. In contrast, field orders added about $569,900 (or 7.5%) to contract costs on average.

Finding #4: For the overall capital program managed by DGS, change orders had a significant effect on the construction schedules.

In the aggregate, change orders for the 17 projects studied by OLO increased the overall construction time by 30.3%. Of the 17 projects, just under half (47%) had increases in contract time resulting from change orders of less than 10%. For two projects, change orders extended the contract time by 10% to 20%. For the remaining seven projects, change orders extended contract time by more than 20%. Two projects (COB Data Center and Mid-County Community Recreation Center) experienced delays that more than doubled the construction time period.

Finding #5: In several projects, the cost increases and delays approved through change and field orders were the result of unforeseeable conditions and uncontrollable events.

Change and field orders are caused by a variety of factors, some of which are unforeseeable and uncontrollable. The projects reviewed included cases in which:

- a large and experienced construction contractor declared that it would cease business operations while working on an ongoing project;
- a previously reliable supplier delivered improperly manufactured building materials; and,
- a local utility modified code requirements while a capital project was under construction.

In each of these cases, the unforeseen condition or uncontrollable event necessitated execution of change and field orders to allow project construction work to proceed.

Finding #6: Certain types of capital projects are particularly susceptible to plan modifications during the construction phase and as a result bear a higher risk of cost increases and delays.

Projects with complex or specialized architectural and engineering requirements often involve additional risk of unanticipated change. Unforeseen events are more likely to occur when designing and constructing facilities which are dissimilar to other facilities recently built by the County. The risk of plan errors and omissions may rise when a facility design involves a level of complexity and specialization that is unlike other projects.

The County has encountered the risk associated with complex, specialized projects. Of the capital projects studied in this report, the one that experienced the greatest cost increase and time delay was a specialized project unlike most other County projects, the COB Data Center Rehabilitation. Design of this project was performed initially by an architectural and engineering contractor that lacked the expertise to design a complex facility such as the Data Center. As a result, the construction phase of the project required a substantial extension of time (more than a year) to correct design errors.

Conditions at the construction site constitute another potential risk factor. In general, projects located at redeveloped sites or on previously disturbed land run a higher risk of encountering subsurface problems such as subterranean rock, contaminated soils, and underground storage tanks. Moreover, when performing construction at a previously developed site, a project is necessarily affected by pre-existing conditions including the location of utility lines and other underground structures, stormwater drainage patterns, and surrounding vehicle and pedestrian networks.

Undetected adverse site conditions have affected County capital projects. The Colesville Salt Barn project incurred a large cost increase after the construction contractor found rubble and other debris buried at the previously disturbed site. Routine pre-construction soil borings did not discover the subsurface debris.

In addition, renovation projects present further risk resulting from the integration of new construction with pre-existing elements of the building. Renovation projects often encounter deficiencies in the materials and systems retained from the original building. For example, in both the Gaithersburg Library and Olney Library renovation projects, construction crews encountered deteriorated sections of the existing buildings that necessitated unplanned repair work.

Finding #7: Methods exist to mitigate the risk associated with change orders. These methods commonly involve higher expenditures at the outset of a project in order to contain costs during the construction phase.

Some jurisdictions require government agencies to conduct a risk assessment before constructing a capital project. A capital construction risk assessment may include an evaluation of potential variables that could necessitate change orders and affect project cost and time. Through the risk assessment process, the government identifies pre-construction measures that mitigate the government's exposure to factors that could produce unanticipated expense and delay. Risk mitigation strategies include:

- Unit Pricing: One strategy to control the cost risk of change orders is to specify unit costs for labor and materials requested through a change order in the original construction contract. Establishing fixed unit prices for potential change order work removes price volatility from the process and thereby controls costs.

- Evaluation of Site Conditions: Unfavorable site conditions (such as poor or contaminated soils, buried utility lines, and underground storage tanks) are one of the primary causes for change orders. Soil borings and other sub-surface testing provide vital information necessary for facility construction but also come at a cost. Conducting extensive pre-construction site testing reduces the risk that change orders will be necessary but adds cost to the planning and design phase of a project.

- Design Review: Design review is a process of evaluating architectural and engineering plans to identify errors, omissions, and other problems. Extensive review can increase the time and cost of the planning phase of a capital project but can also yield greater time and cost savings during the construction phase. In one type of design review, third-party reviewers examine design specifications and suggest revisions to improve the product, reduce costs, or save time. Another form of design review, Building Information Modeling, is a computer-based project management tool that converts design plans into three-dimensional form to create a virtual model of the proposed building. Design reviewers can then view the building model and correct design problems, conflicts, or omissions that would occur if the building were constructed as designed.

- Alternative Procurement Practices: DGS awards separate contracts for architectural and engineering design and for construction of capital projects ("design-bid-build" contracting). In "design-build" contracting, a government enters into a single contract for both the design and construction of a capital project. The design-build approach may prevent unexpected cost increases and delays by requiring the contractor to assume the financial risk for changes in project design. In "construction management at risk" contracting, the government hires a firm in the pre-construction stage to consult on project budget, schedule, and design. During the design phase, the government and the contractor agree on a guaranteed maximum price for the construction work. The contractor assumes the risk of constructing the project as designed for an amount not to exceed the guaranteed maximum price. These alternative procurement methods reduce cost risk to the government but may prompt bidders to request greater compensation to account for assuming a higher level of risk.

Finding #8: DGS recently has begun to compile and maintain project-specific data on the effects of change and field orders on changes contract cost and time.

DGS provided all requested contract, change order, and field order data requested by OLO. For many projects, DGS retrieved many contract documents from archives. At the outset of this study, DGS did not maintain project-specific data on the effect of change and field orders on contract cost and time. Concurrent with the OLO study, DGS began to develop and maintain project-specific change and field order data. DGS plans to consolidate the data into a master file to help identify factors that cause project cost increases and delays.

B. OLO Recommendations

Based on the findings of this report, OLO offers the following three recommendations for Council action.

Recommendation #1: Request that DGS establish a capital project risk assessment process.

As discussed in Finding #6, certain types of capital projects are particularly susceptible to plan modifications during the construction phase and bear a higher risk of cost increases and delays. Risk factors include:

- complex or specialized architectural and engineering requirements dissimilar to those of other facilities recently built by the County;
- project location at a redeveloped site or on previously disturbed land; and
- integration of new construction with pre-existing building elements.

OLO recommends that the Council request that DGS establish a process to assess and rate the relative cost and scheduling risk of pending capital projects based on the presence or absence of known risk factors such as those listed above. The purpose of this assessment is to identify projects with especially high risk of cost increases and delays at the outset of the contracting process.

Recommendation #2: Request that DGS selectively employ alternative procurement and contracting methods as necessary to mitigate the cost and schedule uncertainty of high risk projects.

OLO recommends that the Council request DGS to adjust procurement and contracting methods as necessary to mitigate the cost and schedule uncertainty for high risk projects. As outlined in Finding #7 (and described in detail in Chapter VII), a variety of strategies exist to mitigate exposure to factors that could produce unanticipated expense and delay. DGS should selectively employ these strategies commensurate with the risk level of the project. For example, a specialized and complex project dissimilar to other County facilities may carry a high risk of design errors and omissions, and so, may be a worthy candidate for an alternative procurement approach such as design-build contracting. While risk mitigation measures may increase the time and cost of the planning phase, nonetheless, these strategies help moderate project uncertainty and can yield greater time and cost savings during the construction phase.

Recommendation #3: Encourage DGS to continue to collect and monitor project-specific change and field order data to track trends and to identify factors that raise the risk of cost increases and schedule delays.

Concurrent with this OLO project, DGS began to compile and maintain project-specific data on the effects of change and field orders on contract cost and time. OLO recommends that the Council encourage DGS to continue to compile and monitor change and field order data for each capital project. Analysis of this data may help identify factors that raise the risk of project cost increases and schedule delays. As discussed in the previous recommendation, recognition of cost and schedule risk factors is a vital prerequisite to selecting the most appropriate procurement and contracting practices for a construction project.

CHAPTER IX. AGENCY COMMENTS

The Office of Legislative Oversight circulated a final draft of this report to the Chief Administrative Officer and the Department of General Services. OLO appreciates the time taken by Executive Branch staff to review the draft report and provide comments. The final report incorporates technical corrections provided by the Executive Branch.

The written comments received from the Chief Administrative Officer begin on the next page.

OFFICE OF THE COUNTY EXECUTIVE

Isiah Leggett
County Executive

Timothy L. Firestine
Chief Administrative Officer

MEMORANDUM

March 7, 2014

TO: Chris Cihlar, Director, Office of Legislative Oversight

FROM: Timothy Firestine, Chief Administrative Office Timothy L. Firestine

SUBJECT: OLO Draft Report No. 2014-6, Change Orders in County Government Construction Projects

I am in receipt of your draft report No. 2014-6, dated February 10, 2014, detailing the review conducted by your office of the Department of General Services' Construction Projects Change Orders. Your assessment of this issue has been thorough and well documented. I am pleased that your review resulted in a generally favorable impression of County practices.

In response to the report's Findings and Recommendations, I offer the following comments:

OLO Finding #1: Construction change orders are not inherently beneficial or detrimental to the progress of a capital project.
CAO Response: We agree with this conclusion and note that change orders are an unavoidable circumstance of construction contracting. The Federal Government recognizes this and includes the change order process under the Changes Clause in the Federal Acquisition Regulations, the intent being to reach an "equitable adjustment" in cost between the government and contractor.

OLO Finding #2: For the overall capital program managed by DGS, change and field orders had only a moderate effect on contract costs.
CAO Response: We generally agree with this conclusion. It should be noted that this is well within a standard construction contingency that DGS recommends, consistent with most jurisdictions and the General Services Administration.

OLO Finding #3: For the projects studied, field orders had a substantially greater effect on contract costs than did change orders.
CAO Response: We agree with this finding. Field orders are routinely used on all projects as a means to avoid delay.

OLO Finding #4: For the overall capital program managed by DGS, change orders had a significant effect on the construction schedules.
CAO Response: We agree with this conclusion at face value but would clarify. Procurement regulations require that change orders must be used to extend the time of the contract; field orders cannot be used. Therefore, it is inherent that increases to contract schedules would be associated with change orders.

OLO Finding #5: In several projects, the cost increases and delays approved through change and field orders were the result of unforeseeable conditions and uncontrollable events.
CAO Response: We agree with this finding. Unknowns are one of the fundamental reasons for change orders. Again, this is consistent with the DGS recommended standard construction contingency.

OLO Finding #6: Certain types of capital projects are particularly susceptible to plan modifications during the construction phase and as a result bear a higher risk of cost increases and delays.
CAO Response: We agree with this finding in principle and have taken specific actions to mitigate the related impact. DGS routinely issues a specific RFP for specialized architectural expertise if a project is recognized to be of a special nature. DGS routinely employs third party value management to achieve the highest possible quality in projects. Further, DGS will determine sub-surface characteristics of sites to the maximum extent possible in an effort to forecast deficient soils conditions and other complications.

OLO Finding #7: Methods exist to mitigate the risk associated with change orders. These methods commonly involve higher expenditures at the outset of a project in order to contain costs during the construction phase.
CAO Response: The first three examples in the OLO report – unit pricing, evaluation of site conditions, and design review – are included because these are examples of routine emphasis that DGS places on its projects. These interventions also involve minimum cost. Value management, as mentioned, is also an example of design enhancement in order to mitigate construction risk. We do not agree, however, that design-build contracts are a prudent investment to achieve this result. Please see the response to Recommendation #2.

OLO Finding #8: DGS recently has begun to compile and maintain project-specific data on the effects of change and field orders on changes (to) contract cost and time.
CAO Response: We agree and have made the monthly updates of this information part of the Monthly CIP Report and the CAO Report.

OLO Recommendation #1: Request that DGS establish a capital project risk assessment process.
CAO Response: We acknowledge that every project carries a certain amount of risk. As DGS employs the techniques described in Findings #6 and #7 to mitigate risks, we believe there is no additional benefit to attempting to categorize the risks, when doing so would likely only be an approximation.

OLO Recommendation #2: Request that DGS selectively employs alternative procurement and contracting methods as necessary to mitigate the cost and schedule uncertainty of high risk projects.
CAO Response: We recognize the advantages of the design-build mechanism in certain situations. Usually this is used to save time by the design/construction overlap mentioned. However, these contracts are always awarded at a cost premium necessary to mitigate risk, whether that risk is present or not. In some cases, circumstances warrant these cost premiums and a design-build scenario.

We prefer to mitigate risk through many of the other techniques indicated, including a focus on high quality design documents and an exacting evaluation of site conditions. This is evidenced by the ongoing DGS programs of constructability review, 3rd party Value Management on the majority of projects, and the use of Building Information Modeling.

OLO Recommendation #3: Encourage DGS to continue to collect and monitor project-specific change and field order data to track trends and to identify factors that raise the risk of cost increases and schedule delays.
CAO Response: We agree with this recommendation. Prior to this OLO project, DGS began to compile and maintain project-specific data on the effects of change and field orders on contract cost and time. In addition, we have made the monthly updates of this information part of the Monthly CIP Report and the CAO Report. DGS intends to routinely capture and record this information.

If you have questions or need additional information please contact Fariba Kassiri, Assistant Chief Administrative Officer. Again, I thank the Office of Legislative Oversight for its detailed work on this program.

TLF:go

cc: Fariba Kassiri, Assistant Chief Administrative Officer
David Dise, Director, Department of General Services