PMOC REPORT

2016 Risk Refresh

Honolulu Rail Transit Project
Honolulu Authority for Rapid Transportation (HART)
City and County of Honolulu
Honolulu, HI

June 2016 (FINAL)

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Appendix A: List of Acronyms

1.0 EXECUTIVE SUMMARY

1.1 Introduction

The Honolulu Authority for Rapid Transportation (HART) continues to advance development of its Honolulu Rail Transit Project ("Project") in accordance with the Federal Transit Administration (FTA) New Starts requirements.

FTA assigned Jacobs as a Project Management Oversight Contractor (PMOC) on September 24, 2009, for the purpose of monitoring the Project and providing FTA with "information and well-grounded professional opinions regarding the reliability of the project scope, cost, and schedule" of the Project. That effort continues with this update report, which represents the PMOC's assessment of Risk and Contingency Management.

It should be noted that this effort is an update of the assessment that was completed in advance of the Full Funding Grant Agreement (FFGA) in 2012 and a Risk Refresh that was performed in April 2014. The PMOC reviewed any Project changes that may affect the management capacity and capability of the grantee as well as changes associated with Project's current FFGA scope, schedule, cost estimate, and risk and contingency management.

1.2 PMOC Review

This report represents an update of the PMOC's assessment at the time of FFGA of HART's management capacity and capability as well as an assessment of the Project's current FFGA scope, schedule, cost estimate, and risk and contingency management. This assessment is governed by the following FTA Oversight Procedures (OP):

- OP 21 – Management Capacity and Capability Review
- OP 32C – Project Scope Review
- OP 32D – Project Delivery Method Review
- OP 33 – Capital Cost Estimate Review
- OP 34 – Project Schedule Review
- OP 40 – Risk and Contingency Review

1.3 Findings/Recommendations

Based on the outcome of the reviews that have been completed, the PMOC recommends the following:

- The revised Revenue Service Date (RSD) should be no earlier than December 2024, which represents the 75% confidence level in the Schedule Risk Model.
- The predicted FTA model outcome at the p50 level is $7.338 billion (excluding $393 million in finance costs).
- The predicted FTA model outcome at the p65 level is $7.623 billion (excluding finance costs). HART's current Estimate at Completion (EAC) falls short of the p65 predicted FTA model outcome by $1.189 billion ($661 million in recommended adjustments plus $528 million in additional recommended contingency).

It should be noted that some of the findings and recommendations included in this report are similar to those findings and recommendations that were included in the 2014 Risk Refresh Report. It is critical that HART give serious consideration to each recommendation in this report to help strengthen the overall management of the program.

1.3.1 Management Capacity and Capability (MCC) Review

HART has gone through numerous organizational changes since the FFGA was executed in December 2012. One of the key recommendations from the 2014 Risk Refresh was that HART hire a Project Director. HART did hire a Project Director in the fall of 2014, which has resulted in some positive changes in the way the Project is managed. However, the most significant concern regarding HART's Management Capacity and Capability remains its ability to retain experienced key staff (internal and consultant) on the Project.

HART should review its staffing with a goal of streamlining the organization and becoming more efficient in its decision making. HART does not have an effective process in place to preserve critical technical capabilities during any significant reduction in force. The PMOC has witnessed a recent trend of staff departures from the Program Management Support Consultant (PMSC), which may allow HART to transition key positions from consultants to its own organization, resulting in the agency having greater ownership and control of the project.

There is a sense that critical decisions continue to be rendered "by committee" within the Project Management organization, although this process appears to be less pervasive than it had been. However, it must be eliminated altogether since it is not an effective means for management on a capital program of this magnitude.

There are a number of positions that HART should consider staffing either through existing resources or new resources including:

- Senior Construction Claims Specialist
- Deputy Director of Rail Operations
- Transit Planning Manager
- Fleet Manager
- Rail Activation/System Testing & Integration Manager

<u>Recommendations</u>

(1) Complete the update of the Project Management Plan (PMP).
(2) Identify and document a permanent Risk Manager in the PMP and RCMP.
(3) Reevaluate the Staffing Plan to be more effective and fill any gaps in technical capability of the organization.
(4) HART must strive to transition the key management positions currently occupied by the PMSC and General Engineering Consultant (GEC) to HART, in order to have greater ownership and stronger control of the project.
(5) Update management plans/procedures to incorporate any organizational changes that are proposed or already accomplished.
(6) Actively monitor the management of the program to ensure that project staff and all consultants/contractors implement the approved plans and procedures.

(7) Develop an effective process to preserve critical technical capabilities during any significant reduction in force.
(8) Provide training to key existing staff members through the National Transit Institute (NTI) or other similar organizations to enhance their transit project management skills.
(9) HART Chief Financial Officer (CFO) must develop strict budgetary controls in order to contain costs.
(10) HART's Project Director, Deputy Directors, Project Managers, PMSC, GEC, and Construction Engineering & Inspection (CE&I) consultants must focus more heavily on cost management of the project.

1.3.2 Project Scope and Project Delivery Review

The general scope of the project has remained largely intact since the FFGA, although changes to the method of contracting and outside influences on the execution of the scope have been great. While the West Oahu-Farrington Highway Guideway (WOFH), Kamehameha Highway Guideway (KHG), and Maintenance & Storage Facility (MSF) Design Build (DB) Contracts are in construction and have been making mixed progress, the Airport Guideway and Stations (AGS) and the City Center Guideway and Stations (CCGS) DB Contracts have now been repackaged, replacing the traditional Design-Bid-Build (DBB) contracts that were originally envisioned. The AGS and CCGS contracts will be delivered as DB contracts in order to combine the design and construction of the stations with that of the guideway, progress any minimally-defined parts of the scope (e.g., Ala Moana Station), and address the relocation of the Hawaiian Electric Company (HECO) transmission lines along Dillingham Boulevard.

The following observations were made with regard to the project scope review:

- Scope is adequately defined, except for the City Center stations and the undergrounding of HECO high-voltage lines.
- Level of completion varies across contract packages, with the Airport and City Center segments needing rework to accommodate recent repackaging.
- There are still a number of outstanding issues:
  - Several third-party agreements have yet to be finalized.
  - Final operational analysis must be completed by Ansaldo Honolulu Joint Venture (AHJV).
  - A number of design issues that affect the interface with other contracts, including the Core Systems Contract (CSC), must be resolved.
  - HART's Contract Packaging Plan (CPP) will continue to require significant management effort to ensure proper interface coordination.
  - A lack of definition of various elements of the CCGS Request for Proposals (RFP) may lead to higher bids on that contract.
  - HECO's imposition of further restrictions on work near high-voltage lines, including requirements for undergrounding them, may cause further delays and costs. HART must memorialize requirements in an Agreement with HECO to control costs and avoid scope creep.
  - Detailed cost estimates have not yet been prepared for a number of potential Contract Change Orders (CCO).

- Real estate acquisition to support construction in the City Center Segment will continue to require significant coordination and effort by HART.
- The amount of rework that will be needed to bring the Airport and City Center designs to completion may be considerably more extensive than HART anticipated, since the new DB contractors will likely plan on using only the concept designs; their responsibility for the final design may mean that they will not be able to use any of the essentially-complete elements of the earlier DBB packages.
- HART must interface with the new HDOT State Oversight Agency (SOA) and meet the HDOT Safety and Security Program Plan requirements for start-up activities.

The following observations were made with regard to the project delivery review:

- The change in strategy for the Airport and City Center Segments has had a significant impact on the Master Program Schedule (MPS) and has contributed to the erosion of any remaining schedule contingency.
- Any delay to the CCGS DB Contract now has a direct impact on the target RSD and could severely impact the project cost.
- HART's CPP will continue to require significant management effort to ensure proper interface coordination.
- There is concern whether bidding competition for the remaining packages will be strong enough to assure pricing within budget.

<u>Recommendations</u>

(1) Improve definition of work to replace HECO high-voltage overhead lines through addenda to the RFP for the City Center DB contract.
(2) Push to resolve regulatory issues that are impeding progress on ongoing construction projects (e.g., night work restrictions on WOFH and KHG).
(3) HART must take a more proactive approach to getting contractors to establish and meet schedules.
(4) Site access and permitting issues must be resolved early to avoid delays and extras.
(5) Continue to review and vet all potential CCOs. Prepare detailed cost estimates for any potential CCOs that cannot be eliminated at this time.
(6) Continue to review all post-Record of Decision (ROD) changes to ensure they do not have an impact on the environmental documentation, the project scope, project cost, project schedule, or future operations.
(7) Prioritize resolution of required third-party agreements, real estate acquisitions, and coordination between various contractors and designers.

1.3.3 Project Schedule Review

The PMOC reviewed HART's Master Program Schedule (MPS) with a Data Date of January 29, 2016. The following observations were made with regard to the schedule review:

- HART MPS consists of the master schedule connected to multiple "feeder" construction contractor schedules. HART's MPS is summarized and did not include the detailed construction contractor schedules when transmitted to the PMOC for review.

- The current MPS contains more logic density and schedule-compression than previous updates. HART has acknowledged that achieving the FFGA RSD is no longer possible.
- The risk events (threats) used by the PMOC in the schedule risk analysis model are the same as used in previous risk assessments. In some cases, the PMOC combined several risk events to simplify the model without adversely affecting the data source protocol and modeling.

Summary of PMOC Findings

(1) FFGA RSD: January 31, 2020
(2) HART MPS RSD: December 21, 2022 ***(NO CONTINGENCY)***
(3) PMOC Adjusted MPS RSD: December 21, 2022 (No change)
(4) MPS contains multiple calendars due to inconsistency with construction contractor imported files (5-day w/holidays & 7-day calendar).
(5) An incomplete Basis of Schedule (BOS) was transmitted to PMOC. The BOS lacked definition and content from the previous BOS submitted to the PMOC. Moreover, the BOS that was submitted contradicted information regarding time contingency that was provided by HART during the risk refresh workshop in March 2016.
(6) No quantification of potential/known time impact analyses and claims was provided.
(7) Work Breakdown Structure (WBS) appears incomplete and is not intuitive.
(8) Schedule Analytical and Maturity Integrity Check:
    a. numerous mechanical corrections
    b. Excessive use of constraint dates/non-standardization of input data
(9) HART did not clean up the MPS after removing logic connections from the feeder construction contractor schedules.
(10) HART provided the PMOC a copy of the "comprehensive" MPS inclusive of all feeder construction contractor schedules on March 31, 2016. The PMOC performed an analytical schedule integrity check and found that the "comprehensive" MPS possesses a large number of warnings and errors, exceeding that of the MPS used to perform the schedule risk analysis.

Recommendations

(1) Develop and provide an updated Basis of Schedule (BOS) to the PMOC.
(2) Re-evaluate management capacity and capability within its project controls organization and consider adding more schedule management expertise to its project controls staff, as it seems HART has been unable to provide all deliverables requested by the PMOC in accordance with HART's project control procedures. This was evident in the poor quality of the MPS used to perform the risk refresh and the absence of a revised BOS.
(3) Reconcile, revise, and align the Basis of Estimate (BOE) with the BOS. This includes accounting for HART and consultant staff projections beyond the RSD for contract and comprehensive project closeout efforts.
(4) Require all construction contractors and third party scheduling parties to consistently apply calendars (5-day, 6-day, or 7-day) according to HART procedures. These should be included in an overarching MPS architecture

process document (procedure) that describes all of the schedule standardization and template requirements necessary to ensure that project schedules can be efficiently and effectively rolled up into the MPS.

(5) Review staffing plan to ensure that schedule compression has not caused excessive staff requirements during peak demand.

(6) HART should withhold partial or full payment of contractor monthly pay applications if the contractors continue failing to submit timely and acceptable Critical Path Method (CPM) project schedule updates.

(7) Request that each construction contractor provide a separate grouping of activities specific to its construction contract punchlist and closeout and related activities that typically extend beyond substantial completion and RSD in order to provide a more realistic extension of construction services and consultant and HART staffing project management. This should be done especially for the Airport and City Center construction contracts once underway and for interface with the testing and start-up activities with the CSC.

(8) Reduce the number of constraint dates in the MPS.

(9) Develop an overall MPS "schedule architecture" of standards and templates that all scheduling parties (contractors, suppliers, and consultants) should use in order to ensure that Level 4-5 schedules are able to roll-up into the Level 1-2 MPS. Calendar libraries used by the various construction contractors should match.

1.3.4 Schedule Risk Analysis

The Revenue Service Date (RSD) identified in the FFGA is January 31, 2020. HART's current target date for the start of full revenue operations is December 2022 (per MPS with Data Date of January 29, 2016). However, the MPS contains no contingency.

The Impacted Risk Model (IRM) distribution range for project completion ranges from the 0% to 100% confidence levels, spanning a 973 calendar day period. The probability percentage points for the IRM are:

- 20% Confidence level completion date: 27-Aug-23
- 50% Confidence level completion date: 25-Jun-24
- 65% Confidence level completion date: 03-Oct-24
- 75% Confidence level completion date: 09-Dec-24
- 90% Confidence level completion date: 14-Apr-25
- 100% Confidence level completion date: 08-Dec-25

OP 40 states that a confidence level of at least 65% of reaching the proposed RSD should be considered. Accordingly, the PMOC recommends that a 75% confidence level be used when determining the proposed RSD. When evaluating the likelihood of the proposed RSD, the PMOC considered factors including source data validation, duration sensitivity, criticality index, risk events, management capacity and capability, political environment, and governance. Some of the specific concerns that affected the recommended confidence level include:

- Consideration that schedule risks identified in 2014 are essentially the same now with little mitigation having occurred.

- Lack of certainty with regard to progression of HECO-related activities in CCGS.
- Schedule compression that will occur will lead to inefficiencies that have not been fully identified.
- Concerns with effective management of DB contracts
- Remaining AGS and CGS DB contracts will be constructed in the project's most congested and complicated areas, and there is uncertainty associated with the base schedule assumptions incorporated into the MPS for these contracts.
- The number of large construction projects occurring in Honolulu that will compete for labor and material resources with HART's project.
- Any uncertainty with timely receipt of funding could have significant impact on the schedule.
- There is concern that the MPS has not adequately accounted for the number of right-of-way acquisitions needed for AGS and CCGS, including some that may be very complicated and will take more time that initially thought.

Recommendations

(1) The revised Revenue Service Date (RSD) should be no earlier than December 2024, which represents the 75% confidence level in the OP 40 Schedule Risk Model.

(2) HART noted that the latest MPS submitted to the PMOC did not include any time contingency. HART must better document patent and latent time contingencies included in construction contract schedules and do the same within the MPS.

(3) HART should closely monitor the MPS longest critical path and near critical paths not only for each construction project but also for the overall program.

(4) HART should revise its staffing plan to ensure that schedule compression has not caused excessive staff requirements during peak demand of construction.

(5) The PMOC and HART should engage in focused "schedule containment workshops" on a monthly basis to monitor the efforts taken to minimize any delay beyond the FFGA RSD.

(6) HART should institute more aggressive and more consistent risk and contingency management efforts by its project controls department and risk manager. This includes, but is not limited to, alignment of current risk register updates and monitoring and mitigation with the MPS schedule updates and recorded risk and contingency mitigation actions.

1.3.5 Project Cost Estimate

The FFGA Project Budget was $5.122 billion, including $644 million in allocated and unallocated contingency and $173 million in financing costs. HART's current Estimate at Completion (EAC) of $6.827 billion identifies $396.5 million in allocated and unallocated contingency and $393 million in financing cost.

The PMOC had some difficulty in verification of the EAC due to the number of various formats through which the cost information was provided. The major documents provided to the PMOC to support the EAC included:

- February 2016 SCC Spreadsheet

- March 2016 Contract Packaging Plan (CPP)
- February 2016 Forecast

The PMOC coordinated with agency staff and utilized information that was subsequently provided via emails and meetings. The PMOC evaluated the cost estimates for each Standard Cost Category (SCC) for mechanical soundness and consistency. These mechanical checks are used to determine if there are any material inaccuracies within the estimate. Components of the estimate were found essentially to be mechanically correct in the tabulation of the unit cost, application of factors, and translation to an SCC spreadsheet for most of the direct cost and soft cost contracts. However, specific estimate amounts could not be fully validated by the PMOC. The March 2016 CPP, which included allowances of various types for change orders or issues, is the only HART document that summarized all costs for the project with a budget value of $6.827 billion. HART did not update its FTA SCC Workbook with clear traceability for all values included in the CPP. Additionally, HART provided several budget sources for some of the costs, and variances were found between these documents.

<u>Summary of PMOC Findings</u>

The following specific observations were made with regard to the cost estimate review:

- An individual Basis of Estimate (BOE) was updated for the Independent Cost Estimate (ICE) for the AGS and Pearl Highlands Parking Garage DB Contract (PHPG). The CCGS ICE is still being developed. However, there was no uniformity across individual BOEs:
    - The application of markups was inconsistent.
    - The application of the General Excise Tax (GET) varied.
    - Escalation rates varied between contracts.
- Variances were noted between some Contract Amounts as shown in the HART February 2016 SCC Spreadsheet as compared to the March 2016 CPP, the February 2016 EAC, and the various ICE documents. Stated another way, there is no overall document incorporating the cost from lower level details to the current HART CPP summary budget. This creates traceability concerns and the potential for errors or omissions in the budget. The PMOC sent HART an MS Excel spreadsheet comparison of this potential issue in April 2016, and the PMOC is awaiting a response in the form of comments or adjustments to the budget.
- The PMOC reviewed the EAC to expose all contingency:
    - ICE for PHPG – The resulting analysis showed that the ICE included a $35 million contingency in the estimate. However, HART's CPP did not appear to separate out this contingency value. The PMOC reduced the budget for this contract in order to remove the perceived "latent" contingency.
    - The PMOC identified contingency issues for other CPP Contracts similar to PHPG, but the values were smaller. These include the CE&I East Contract, the Project-Wide Arts Contract, and the Owner-Controlled Insurance Program (OCIP) Contract. The contracts in question were identified in the PMOC April 2016 comparison spreadsheet.
    - The total amount of contingency identified in HART's EAC was $528.92 million.
- Some components of the cost estimate must still be revised or updated (e.g. soft costs, right-of-way, CCGS ICE, OCIP, and utilities, including HECO).

- Due to extension of the RSD, there may be some potential costs associated with maintenance of already constructed work. This scope is not specifically included in the current EAC.
- The PMOC performed an in-depth review of the three remaining DB contracts for the project. In general, the PMOC agreed with the unit cost and detailed build-up of the direct cost for all three contracts. However, the PMOC did not agree with the percentages used in each ICE for markups for items such as Engineering costs, GET (tax) application, Escalation, and General Conditions/Overhead. The change in the markups resulted in a significant adjustment for the AGS and CCGS but not for the PHPG.
- There is $168.1 million in forecast or potential Change Orders that had been identified in HART's February 2016 Forecast. These changes are included in HART's March 2016 CPP ($6.827 billion budget), but they are not included in the February 2016 SCC Spreadsheet. The PMOC was required to add the forecasted change order cost to the HART February SCC to capture the true EAC in SCC format.
- The PMOC identified approximately $492.8 million in additive adjustments to the EAC, which are discussed in Section 7.0 of this report.

Following is a summary of the Adjusted Stripped Base Cost Estimate (BCE):

Table 1. Adjusted Stripped BCE

HART Estimate	$5,820.62
Allocated Contingency (PMOC Calculation)	$528.92
Unallocated Contingency	$84.56
Financing	$393.06
TOTAL	**$6,827.16**
Stripped Cost	$5,820.62
HART Forecast Change Orders	$168.11
PMOCC Adjustments	$492.77
Adjusted Stripped BCE	**$6,481.50**
Incurred Costs (as of March 2016)	$1,912.75

All values in $M.

Recommendations

(1) Prepare cost estimates for all identified potential and possible changes (CCOs).
(2) Focus on updates for the AGS and CCGS estimates to allow time for mitigation.
(3) Refresh right-of-way (ROW) estimate to reflect current property costs and include costs for Temporary Construction Easements and impacts from the HECO work.
(4) Prepare an ICE for the remaining (un-awarded) HECO work.
(5) Refresh personnel manpower charts to account for new positions and a refined MPS to verify the cost included in SCC 80 soft costs.
(6) Verify that budgets and any ongoing estimate refreshes include adequate funds for escalation.
(7) Review the March 2016 CPP to confirm that latent contingency is not included in contract values.

(8) Review the March 2016 CPP to confirm that concurrent non-FFGA costs or "Betterments" are not included in the EAC.
(9) Revise any budgets or contracts impacted by the revised RSD as shown in the update to the MPS.
(10) Re-baseline budget following completion of the Risk Refresh activities.

1.3.6 Cost Risk Analysis

The PMOC has performed regular monitoring visits to the project and has refreshed its earlier risk assessment based upon an updated understanding of project risks and updated schedule and cost information provided by HART. In March 2016, the PMOC participated in a risk refresh workshop with HART, the purpose of which was to discuss HART's progress in its risk management efforts and PMOC's observations and reflections from its initial review of HART's updated scope, cost, schedule, and risk information.

For the purposes of its risk refresh, the PMOC considered the project in four separate elements, which are termed here as "risk profiles":

- ***Risk Profile 1*** is associated with contracted direct cost work under construction;
- ***Risk Profile 2*** is associated with recently contracted direct cost work;
- ***Risk Profile 3*** is associated with yet-to-be-contracted direct cost work; and
- ***Risk Profile 4*** is associated with "soft costs."

During the March 2016 risk workshop, information was provided indicating that HART was aware of additional costs that should be included, which the PMOC added along with its own independent estimate adjustments. The PMOC has prepared this risk refresh based upon additional information provided by HART immediately after the workshop.

The PMOC found that HART's risk management effort has decreased substantially since the 2014 Risk Refresh. HART previously implemented a sophisticated method of tracking risk identification and mitigation activities that provided for consolidated reporting of the efforts, which showed the rate of progression of risk management. HART's failure to continue this consolidated reporting hampers the ability for risk managers and executive management to determine whether risk is being removed from the project at an adequate rate. In addition, no evidence was provided that the prior Risk and Contingency Management Plan (RCMP) was updated and the provided risk register did not conform to the level of sophistication of risk registers expected for a project of this complexity.

The PMOC separated the project into four distinct risk profiles to better model the effect of risk upon the project. The cost risk assessment recognized general reductions in risk due to advancement of construction and design. Furthermore, concerns that relate to currently experienced issues of management capability and capacity, market conditions, and construction complexities—especially as the project proceeds toward downtown Honolulu—are factored into the risk analysis.

It is recognized that efforts have been made to recover contingency levels through cost reduction measures, value engineering, and revised project delivery strategies. However, these types of

changes are becoming increasingly less likely and less effective.

Table 1 presents the PMOC Adjusted Stripped Base Cost Estimate (BCE) used for cost risk modeling. With the adjustments identified in this report, the current contingency is reduced to a deficit of $48 million when compared against HART's current EAC. This essentially indicates the project must be increased significantly above its current estimate to provide for contingency requirements for the future project completion.

The predicted FTA model outcome at the p50 level is $7.338 billion (excluding $393 million in finance costs). The predicted FTA model outcome at the p65 level is $7.623 billion (excluding $393 million in finance costs). This includes $1.189 billion in recommended funded contingency (17% of the adjusted, stripped estimate). This amount is higher than other projects at this level of completion due to significant remaining project risks and as evidenced by project experience so far. HART's current EAC falls short of the p65 predicted FTA model outcome by $1.189 billion ($661 million in recommended adjustments plus $528 million in additional recommended contingency). There is an 18.5% difference between HART's project estimate of $6.434 billion and the p65 predicted FTA model outcome of $7.623 billion at p65.

The recommended estimate represents the p65 value from the FTA risk assessment model, when adjusted for the specifics of this project. The historic-trended model indicates 40%-likely to 80%-likely range of $7.174 billion to $8.002 billion.

Although lists of Secondary Mitigation items were presented by HART, these lists did not include analyses at the current level of estimating, scheduling, and scoping of the expected cost reductions in consideration. Evidence was not presented that HART fully evaluated the costs of design changes, the schedule implications, the effects on existing construction contracts, and the political will to entertain any such changes. During the risk workshop, HART noted that most of the secondary measures would be difficult to implement. Therefore, the PMOC questioned the viability of any of the deductive options presented.

The table below presents the comparison of costs by SCC for the FFGA budget, current HART EAC, and PMOC p50 and p65 Targets.

Table 2. Cost Comparison by SCC

SCC	SCC Description	2012 FFGA Budget	2012 FFGA Contingency	2012 FFGA Stripped Budget	2016 HART EAC	2016 PMOC p50 Target	2016 PMOC p65 Target
10	Guideway & Track Elements	$1,275,328,962	$161,023,818	$1,114,305,144	$1,525,966,630	$1,724,110,459	$1,724,110,459
20	Stations, Stops, Terminals, Intermodal	$506,165,689	$84,360,947	$421,804,742	$631,093,687	$689,877,924	$689,877,924
30	Support Facilities: Yards, Shops, Admin. Bldgs	$99,425,456	$6,890,443	$92,535,013	$115,477,626	$116,466,248	$116,466,248
40	Sitework & Special Conditions	$1,103,867,264	$123,297,838	$980,569,426	$1,272,832,497	$1,393,561,182	$1,393,561,182
50	Systems	$247,460,781	$26,176,298	$221,284,483	$357,180,319	$412,050,882	$412,050,882
60	Row, Land, Existing Improvements	$222,188,386	$24,790,439	$197,397,947	$208,798,069	$232,494,652	$232,494,652
70	Vehicles	$208,501,186	$21,672,166	$186,829,020	$191,474,521	$223,757,870	$223,757,870
80	Professional Services	$1,183,826,026	$93,387,212	$1,090,438,814	$1,517,800,455	$1,689,182,536	$1,689,182,536
	Allocated Contingency	(Incl.in above SCCs)	$541,599,161	$541,599,161	-	-	-
	Unallocated Contingency	$101,871,170	$101,871,170	$101,871,170	$613,478,238	$856,847,261	$1,141,465,062
	Sub-Total	$4,948,634,920	$643,470,331	$4,948,634,920	$6,434,102,042	$7,338,349,014	$7,622,966,815
	Financing Cost	$173,058,242	-	$173,058,242	$393,058,242	$393,058,242	$393,058,242
	Total Project Cost	$5,121,693,162	$643,470,331	$5,121,693,162	$6,827,160,284	$7,731,407,256	$8,016,025,057

Notes:

The Financing Cost for the 2016 PMOC EAC is based on the 2016 HART EAC. This value would increase as the overall project cost increases.

The SCC 10-80 values for the 2016 PMOC Targets are the Adjusted, Stripped Base Cost Estimates.

Recommendations

(1) HART's estimate falls short of the p65 predicted FTA model outcome by $1.189 billion ($661 million in recommended adjustments plus $528 million in additional recommended contingency when compared against HART's current estimate at completion). HART should review its project estimate and determine how to reduce costs or increase revenues to close this gap.

(2) The recommended amount of budget increase reflects the condition of no viable Secondary Mitigation being presented.

(3) Independent Risk Management must be instituted on the project. The RCMP must be resurrected and updated to ensure continual risk contingency tracking, custody, and reporting. The RCMP should include a re-baselined budget and contingency draw-down curve that reflects the current contingency balance and more accurate drawdown milestones. Diligence and vigilance must be applied to this effort to avoid another rapid contingency usage that could ultimately leave the project unprotected.

(4) Strong controls must be put in place immediately to avoid future rapid contingency reduction. The frequency and the levels of project management to which these statistics are reported should be improved and monitored monthly.

(5) Independent reporting of project cost and contingency levels should be at a management level and should not be subject to politically-driven bias.

(6) The PMOC and HART should engage in a realistic, focused "cost containment workshop" on a monthly basis to monitor the efforts taken to avoid rapid contingency usage. HART must also perform a similar "cost containment workshop" with consultants to contain costs.

2.0 INTRODUCTION

The Honolulu Authority for Rapid Transportation (HART) continues to advance development of its Honolulu Rail Transit Project ("Project") in accordance with the Federal Transit Administration (FTA) New Starts requirements. The Project is intended to provide improved mobility in the highly-congested east-west corridor along Oahu's south shore between Kapolei and the Ala Moana Center.

FTA assigned Jacobs as a Project Management Oversight Contractor (PMOC) on September 24, 2009, for the purpose of monitoring the Project and providing FTA with "information and well-grounded professional opinions regarding the reliability of the project scope, cost, and schedule" of the Project. That effort continues with this update report, which represents the PMOC's assessment of Risk and Contingency Management.

It should be noted that this effort is an update of the assessment that was completed in advance of the Full Funding Grant Agreement (FFGA) in 2012 and a Risk Refresh that was performed in April 2014. The PMOC reviewed any Project changes that may affect the management capacity and capability of the grantee as well as changes associated with Project's current FFGA scope, schedule, cost estimate, and risk and contingency management.

2.1 Project Sponsor

The City and County of Honolulu ("City") is the overarching FTA grantee. The City's Department of Transportation Services (DTS) and HART have executed a Memorandum of Understanding, which delineates each agency's roles and responsibilities so as not to jeopardize the City's standing as an FTA grantee. HART is responsible for the New Starts grants for the Project and may share responsibilities with DTS for grants using Section 5307 or other FTA funding sources.

2.2 Project Description

The Project is an approximately 20-mile elevated fixed guideway rail system along Oahu's south shore between East Kapolei and Ala Moana Center. The alignment is elevated, except for a 0.6-mile at-grade portion at the Leeward Community College station. The proposed investment includes 21 stations (20 aerial and 1 at-grade), 80 "light metro" rail transit vehicles, administrative/operations facilities, surface and structural parking, and maintenance facilities. HART plans to deliver the Project in four guideway segments:

- Segment I (West Oahu/Farrington Highway) – East Kapolei to Pearl Highlands (7 miles/6 stations)
- Segment II (Kamehameha Highway) – Pearl Highlands to Aloha Stadium (4 miles/3 stations)
- Segment III (Airport) – Aloha Stadium to Middle Street (5 miles/4 stations)
- Segment IV (City Center) – Middle Street to Ala Moana Center (4 miles/8 stations)

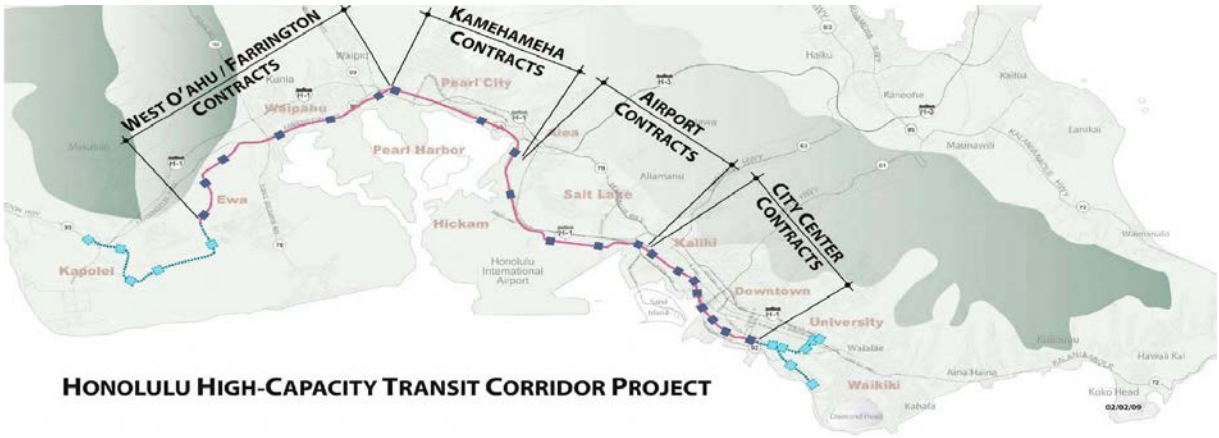

Figure 1. Project Line Segments

Additional Project information:

- **Additional Facilities:** Maintenance & Storage Facility (MSF) and parking facilities
- **Vehicles:** 80 vehicles, supplied by the Core Systems Contractor (CSC), which is also responsible for systems design, construction, and operations. The CSC is a Design-Build-Operate-Maintain (DBOM) contract.
- **Ridership Forecast:** Weekday boardings – 104,300 (2020); 119,600 (2030)
- **FFGA Budget:** $5,121,693,163
- **FFGA Revenue Service Date (RSD):** January 31, 2020

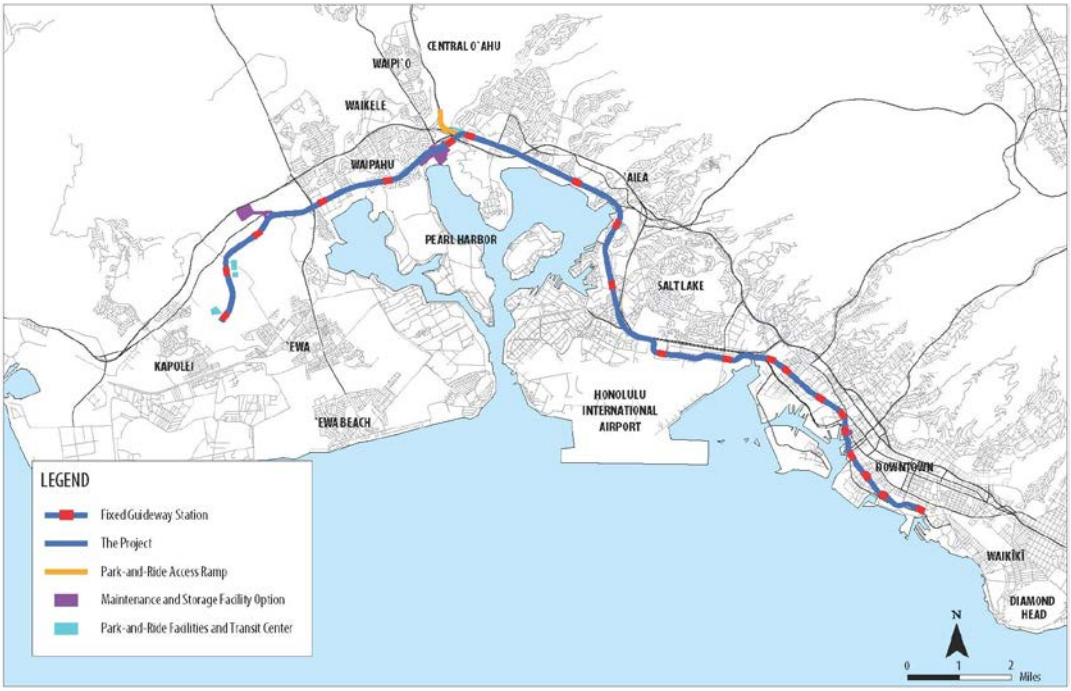

Figure 2. Project Map

2.3 Project Status

The FFGA was executed on December 19, 2012. Construction activities are well under way in the West Oahu/Farrington Highway (WOFH) and Kamehameha Highway (KHG) segments and the Maintenance & Storage Facility (MSF). Design under the Core Systems DBOM Contract is nearing completion, and the first two railcars have been delivered to the MSF. HART has begun procurement for the Airport Guideway and Stations (AGS) Design-Build (DB) Contract and the City Center Guideway and Stations (CCGS) DB Contract. Award of these contracts is anticipated in mid-2016 (AGS) and early 2017 (CCGS).

2.4 Project Budget

The FFGA Project Budget is $5.122 billion in Year-of-Expenditure (YOE) dollars, including $644 million in allocated and unallocated contingency and $173 million financing costs.

HART's current Estimate at Completion (EAC) is $6.827 billion, including $396.5 million in allocated and unallocated contingency and $393 million in financing cost.

Through March 2016, HART had expended $1.913 billion.

Table 3. 2016 Adjusted Base Cost Estimate

SCC	Description	HART Current Budget[1]	Allocated Contingency[2]	Total w/o Contingency[1]	Adjustments[2]	Adjusted BCE
10	**Guideway & Track Elements**	**1,659,417,095**	**133,450,465**	**1,525,966,630**	**198,143,828**	**1,724,110,458**
10.02	Guideway: Aerial At-Grade semi exclusive	20,025	2,647	17,378	0	17,378
10.04	Guideway: Aerial structure	1,485,428,679	122,668,368	1,362,760,311	182,001,432	1,544,761,743
10.08	Guideway: Retained cut or fill	6,436,833	577	6,436,256	511,118	6,947,374
10.09	Track: Direct fixation	163,254,024	10,730,090	152,523,934	15,249,892	167,773,826
10.11	Track: Ballasted	2,698,117	242	2,697,875	214,245	2,912,120
10.12	Track: Special (switches, turnouts)	1,579,417	48,541	1,530,876	167,142	1,698,018
20	**Stations, Stops, Terminals, Intermodals**	**713,116,630**	**82,022,942**	**631,093,688**	**58,784,237**	**689,877,925**
20.01	At-grade station	0	0	0	0	0
20.02	Aerial station	587,015,719	67,310,367	519,705,352	54,784,237	574,489,590
20.06	Automobile parking multi-story structure	70,018,197	9,612,576	60,405,621	0	60,405,621
20.07	Elevators, escalators	56,082,714	5,100,000	50,982,714	4,000,000	54,982,714
30	**Support Facilities: Yards, Shops, Admin.**	**115,802,075**	**324,449**	**115,477,626**	**988,622**	**116,466,248**
30.02	Light Maintenance Facility	7,813,952	21,893	7,792,059	66,709	7,858,768
30.03	Heavy Maintenance Facility	43,329,204	121,398	43,207,806	369,909	43,577,715
30.04	Storage or Maintenance of Way Building	8,641,341	24,211	8,617,130	73,773	8,690,903
30.05	Yard and Yard Track	56,017,578	156,947	55,860,631	478,231	56,338,862
40	**Sitework & Special Conditions**	**1,376,959,277**	**104,126,780**	**1,272,832,497**	**120,728,684**	**1,393,561,181**
40.01	Demolition, Clearing, Earthwork	132,455,807	14,297,735	118,158,071	18,740,556	136,898,628
40.02	Site Utilities, Utility Relocation	526,547,287	52,198,676	474,348,612	51,319,526	525,668,137
40.03	Haz. material, contaminated soil removal/mitig	153,430	4,342	149,088	14,934	164,022
40.04	Environmental mitigation	16,926,040	368,368	16,557,672	1,677,505	18,235,177
40.05	Site structures (retaining walls, sound walls)	15,471,477	823,150	14,648,328	838,662	15,486,989
40.06	Pedestrian / bike access, landscaping	26,563,013	2,243,320	24,319,692	1,482,016	25,801,708
40.07	Automobile, bus accessways (roads, parking)	197,207,337	22,508,684	174,698,653	3,580,132	178,278,785
40.08	Temporary Facilities/other indirect costs	461,634,887	11,682,506	449,952,381	43,075,354	493,027,735
50	**Systems**	**390,646,373**	**33,466,054**	**357,180,319**	**54,870,561**	**412,050,880**
50.01	Train control and signals	115,420,717	9,057,021	106,363,696	17,933,332	124,297,028
50.02	Traffic signals and crossing protection	113,307,021	13,035,321	100,271,700	17,577,822	117,849,522
50.03	Traction power supply: substations	33,339,898	2,519,092	30,880,806	5,086,942	35,967,748
50.04	Traction power distribution	34,032,586	1,003,475	33,029,111	2,052,791	35,081,902
50.05	Communications	63,142,965	4,450,050	58,692,915	8,831,253	67,524,168
50.06	Fare collection system and equipment	27,595,300	3,107,000	24,488,300	2,806,098	27,294,398
50.07	Central Control	3,747,886	294,095	3,453,791	582,323	4,036,114
	CONSTRUCTION SUBTOTAL (10 - 50)	**4,255,941,450**	**353,390,690**	**3,902,550,759**	**433,513,933**	**4,336,066,692**

SCC	Description	HART Current Budget[1]	Allocated Contingency[2]	Total w/o Contingency[1]	Adjustments[2]	Adjusted BCE
60	**ROW, Land, Existing Improvements**	**239,957,094**	**31,159,024**	**208,798,069**	**23,696,583**	**232,494,652**
60.01	Purchase or lease of real estate	204,601,706	24,990,221	179,611,485	18,142,606	197,754,091
60.02	Relocation of existing households/businesses	35,355,387	6,168,803	29,186,584	5,553,977	34,740,562
70	**Vehicles**	**207,778,851**	**16,304,330**	**191,474,521**	**32,283,348**	**223,757,869**
70.01	Light Rail	197,263,038	14,694,461	172,568,577	29,095,732	201,664,309
70.06	Non-revenue vehicles	14,135,777	1,109,229	13,026,548	2,196,327	15,222,875
70.07	Spare parts	6,380,035	500,639	5,879,396	991,289	6,870,685
80	**Professional Services**	**1,645,864,844**	**128,064,391**	**1,517,800,453**	**171,382,083**	**1,689,182,536**
80.01	Preliminary Engineering	130,437,729	2,217,117	128,220,612	7,060,497	135,281,109
80.02	Final Design	375,273,108	38,035,705	337,237,402	33,131,591	370,368,993
80.03	Project Management for Design/Construction	530,965,635	37,620,719	493,344,915	37,912,246	531,257,161
80.04	Construction Administration & Management	318,691,947	18,949,093	299,742,854	38,775,833	338,518,687
80.05	Professional Liability/Non-Construction Insurance	85,276,526	10,021,624	75,254,902	32,279,989	107,534,891
80.06	Legal; Permits; Review Fees by other agencies	69,847,703	8,055,108	61,792,595	9,058,892	70,851,487
80.07	Surveys, Testing, Investigation, Inspection	53,067,673	6,073,640	46,994,033	2,163,647	49,157,680
80.08	Start up	82,304,524	7,091,384	75,213,140	10,999,388	86,212,528
	SUBTOTAL (10 - 80)	**6,349,542,238**	**528,918,435**	**5,820,623,803**	**660,877,946**	**6,481,501,749**
90	**Unallocated Contingency**	**84,559,803**	**84,559,803**	**0**	**0**	**0**
90	**Latent Contingency**	**0**	**0**	**0**	**0**	**0**
	SUBTOTAL (10 - 90)	**6,434,102,041**	**613,478,238**	**5,820,623,803**	**660,877,946**	**6,481,501,749**
100	**Finance Charges**	**393,058,242**	**0**	**393,058,242**	**0**	**393,058,242**
	TOTAL PROJECT COST (10 - 100)	**6,827,160,283**	**613,478,238**	**6,213,682,045**	**660,877,946**	**6,874,559,991**

[1]*Based on data provided by HART as of March 2016.*
[2]*Includes both HART Forecast Change Orders ($168.1 million) and PMOC Recommended Adjustments ($492.8 million).*

2.5 Project Schedule

The Revenue Service Date (RSD) identified in the FFGA is January 31, 2020. HART's current target date for the start of full revenue operations is December 2022. HART intends to begin partial revenue service from East Kapolei Station to Aloha Stadium Station in 2019.

2.6 Project Timeline

The following table presents some of the key events that have occurred since the 2014 Risk Refresh that have impacted the projected EAC and RSD for the project.

Table 4. Key Project Events

Date	Event
April 2014	Risk Refresh Workshop
April 2014	HECO clearance issue discussed at Quarterly Meeting
May 2014	Invitation for Bids (IFB) issued for Westside Stations Group Contract (WSSG)
June 2014	IFB issued for Airport and City Center Guideway and Utilities Contract
August 2014	Receive bids for WSSG
September 2014	HART provides response to 2014 Risk Refresh recommendations
September 2014	HART acknowledges that under-grounding of the HECO overhead power lines may be required along limited lengths of the guideway.
October 2014	Cancel procurement of WSSG
November 2014	Procurement Airport and City Center Guideway and Stations Contract suspended
December 2014	HART indicates project cost will exceed FFGA Budget
December 2014	IFB for Farrington Highway Station Group (FHSG) Construction issued
March 2015	Bids received for FHSG Contract
April 2015	RFP Part I issued for Airport Guideway and Stations DB Contract (AGS)
April 2015	IFB for West Oahu Stations Group Construction (WOSG) issued.
May 2015	Hawaii State Legislator passed House Bill 134 extending General Excise Tax (GET)
July 2015	Governor signed House Bill 134 extending GET
June 2015	Bids received for WOSG Contract
August 2015	RFP Part I issued for City Center Guideway and Stations DB Contract (CCGS)
August 2015	IFB for Kamehameha Highway Stations Group Construction (KHSG) issued.
September 2015	HART cancelled procurement of Pearl Highlands Parking Structure DB Contract and began discussion on Public Private Partnership (PPP)
October 2015	HART indicates project cost will approach $6.5 Billion and RSD will be 4Q2021
November 2015	Bids received for KHSG Contract
January 2016	City Council approved Bill 23 to extend collection of the GET
January 2016	HART indicates project cost will approach $6.8 Billion and RSD will be 4Q2022
March 2016	First rail passenger vehicles arrive in Honolulu
March 2016	Risk Refresh Workshop
April 2016	Proposals received for AGS

2.7 Project Management Oversight Contractor (PMOC)

This report represents an update of the PMOC's assessment at the time of FFGA of HART's management capacity and capability as well as an assessment of the Project's current FFGA scope, schedule, cost estimate, and risk and contingency management. This assessment is governed by the following FTA Oversight Procedures (OP):

- OP 21 – Management Capacity and Capability Review
- OP 32C – Project Scope Review
- OP 32D – Project Delivery Method Review
- OP 33 – Capital Cost Estimate Review
- OP 34 – Project Schedule Review
- OP 40 – Risk and Contingency Review

2.8 Evaluation Team

The following table presents the PMOC Evaluation Team and their respective roles associated with the assessment of the Project.

Table 5. PMOC Evaluation Team

Name	Firm	Role
Tim Mantych	Jacobs	Program Manager
Bill Tsiforas	Jacobs	Task Order Manager
Keith Konradi	Jacobs	Rail Engineering
Allan Zreet	Jacobs	Architect
Charles Neathery	Jacobs	Construction Management, Project Controls, Schedule Risk Assessment
Tim Morris	Jacobs	Cost Estimating
Steve Renschen	Jacobs	Cost Estimating
Alvin Nakamura	Jacobs	Construction Management
Arun Virginkar	Virginkar and Associates	Vehicles, Systems
Bob Merryman	ORC Training LLC	Real Estate
David Sillars	Independent Contractor	Risk Manager

3.0 MANAGEMENT CAPACITY AND CAPABILITY REVIEW

The PMOC reviewed HART's organization, policies and procedures in accordance with *OP 21: Management Capacity and Capability Review* dated September 2013, to determine whether there had been any significant changes that would affect management of the Project.

3.1 PMOC Assessment

HART has gone through numerous organizational changes since the FFGA was executed in December 2012. One of the key recommendations from the 2014 Risk Refresh was that HART hire a Project Director. HART did hire a Project Director in the fall of 2014, which has resulted in some positive changes in the way the Project is managed. However, the most significant concern regarding HART's Management Capacity and Capability remains its ability to retain experienced key staff (internal and consultant) on the Project.

The PMOC had previously expressed the concern that HART experiences difficulty attracting and retaining experienced staff needed for long-term project assignment and permanent HART employment (post-Project) given Hawaii's geographic isolation, salary limits, and high cost of living relative to the mainland. It was recommended that HART update its staffing plan to address transition of staff during the final design and construction phases for positions currently occupied by PMSC staff to HART staff. Staffing plans form a basis for the recruitment, development and deployment of technical personnel in the organization. Career path planning and succession planning are effectively used to facilitate the retention of technically capable personnel. This is still a critical recommendation that HART has yet to fully adopt.

The PMOC also recommended that HART be proactive in transitioning key management positions currently occupied by the Program Management Support Consultant (PMSC) and General Engineering Consultant (GEC) as early as possible. This transition is necessary in order for HART to have more ownership and maintain stronger continuing control of the project.

HART should review its staffing with a goal of streamlining the organization and becoming more efficient in its decision making. HART does not have an effective process in place to preserve critical technical capabilities during any significant reduction in force. The PMOC has witnessed a recent trend of staff departures from the Program Management Support Consultant (PMSC), which may allow HART to transition key positions from consultants to its own organization, resulting in the agency having greater ownership and control of the project.

There is a sense that critical decisions continue to be rendered "by committee" within the Project Management organization, although this process appears to be less pervasive than it had been. However, it must be eliminated altogether since it is not an effective means for management on a capital program of this magnitude.

There are currently several key positions that remain vacant. The most critical positions that HART is diligently working to permanently fill include:

- Architecture and Arts Manager – Open position.
- WOFH/KHG Project Manager (Existing Position) – Candidate identified.
- Chief Financial Officer – Candidate identified.

- Risk Manager – HART has identified an internal candidate. However, the PMOC expressed concern that the candidate may not possess the experience necessary to be effective in this role. HART intends to utilize senior staff from its PMSC to support the proposed Risk Manager, which could be an effective means of staffing this key role.

There are a number of positions that HART should consider staffing either through existing resources or new resources including:

- Senior Construction Claims Specialist
- Deputy Director of Rail Operations
- Transit Planning Manager
- Fleet Manager
- Rail Activation/System Testing & Integration Manager.

HART's update of the management plans must incorporate any organizational changes that have occurred or are proposed. It has become critical that any changes be documented in the various management plans immediately. Project staff has begun updating the project's numerous plans and procedures to reflect these changes, but these documents have not been finalized. HART recently submitted the following management plans and procedures for review:

- Quality Management Plan (dated March 4, 2014)
- Construction Management Plan (dated January 5, 2016)
- Change Management Plan (dated March 7, 2014 and previously identified as Configuration Management Plan)
- Contract Change Procedure 5CA-11 (dated August 24, 2015)
- Contract Packaging Plan
- Construction Safety Plan (dated October 6, 2016)
- Operations and Management Plan (dated June 10, 2015)
- Rail Fleet Management Plan (dated June 10, 2015)
- Real Estate Acquisition and Management Plan (dated September 1, 2015)
- Risk Contingency and Management Plan – update is pending outcome of Risk Refresh
- Safety and Security Management Plan (dated October 6, 2015)
- Safety and Security Certification Plan (dated November 25, 2015)

The PMOC has reviewed these plans/procedures and provided comments to HART. HART is in the process of updating several additional management plans, including its Project Management Plan (PMP). A Draft PMP was submitted to the PMOC for review in July 2015 without detailed budget and schedule information. HART will incorporate this information when it becomes available (tentatively August 2016). PMOC comments on the DRAFT PMP were provided to HART. It is critical that HART actively monitor the management of the program to ensure that project staff and all consultants/contractors implement the approved plans and procedures.

A Decision Milestone Matrix was developed by HART and had been updated on a regular basis. The PMOC continues to hold Cost Containment Workshops with HART on a monthly basis to review the Cost Reduction Measures Matrix and HART's Decision Milestone Matrix. HART must make quick decisions and implement cost reduction measures on existing and future projects. The Chief Financial Officer (CFO) must develop strict budgetary controls in order to

contain costs and the HART Project Director, Deputy Directors, Project Managers, PMSC, GEC, and CE&I consultants must be more concerned with the cost management side of the project's status than any other element of a project's execution. It is imperative that HART maintain control of the project costs and that HART maintain control of elements likely to impose changes to the project that could introduce additional cost.

3.2 PMOC Recommendations

(1) Complete the update of the Project Management Plan (PMP).
(2) Identify and document a permanent Risk Manager in the PMP and RCMP.
(3) Reevaluate the Staffing Plan to be more effective and fill any gaps in technical capability of the organization.
(4) HART must strive to transition the key management positions currently occupied by the PMSC and General Engineering Consultant (GEC) to HART, in order to have greater ownership and stronger control of the project.
(5) Update management plans/procedures to incorporate any organizational changes that are proposed or already accomplished.
(6) Actively monitor the management of the program to ensure that project staff and all consultants/contractors implement the approved plans and procedures.
(7) Develop an effective process to preserve critical technical capabilities during any significant reduction in force.
(8) Provide training to key existing staff members through the National Transit Institute (NTI) or other similar organizations to enhance their transit project management skills.
(9) HART Chief Financial Officer (CFO) must develop strict budgetary controls in order to contain costs.
(10) HART's Project Director, Deputy Directors, Project Managers, PMSC, GEC, and Construction Engineering & Inspection (CE&I) consultants must focus more heavily on cost management of the project.

4.0 PROJECT SCOPE AND PROJECT DELIVERY REVIEW

The PMOC reviewed the Project in accordance with *OP 32C: Project Scope Review* and *OP 32D: Project Delivery Method Review*, both dated September 2013, to determine whether there had been any significant changes regarding the scope or delivery method of the Project.

4.1 PMOC Assessment of Project Scope

The general scope of the project has remained largely intact since the FFGA, although changes to the method of contracting and outside influences on the execution of the scope have been great. While the guideway and MSF DB contracts covering the western portion of the alignment are in construction and have been making mixed progress, the AGS and the CCGS have now been repackaged, replacing the traditional Design-Bid-Build (DBB) contracts that were originally envisioned. The AGS and CCGS contracts will be delivered as DB contracts in order to combine the design and construction of the stations with that of the guideway, progress any minimally-defined parts of the scope (e.g., Ala Moana Station), and address the relocation of the Hawaiian Electric Company (HECO) transmission lines along Dillingham Boulevard. By making this procurement change, HART hopes to control costs, potentially reduce overall time to construct, reduce contract interfaces, and leverage innovation by the DB contractors.

The PMOC primarily focused its scope and cost reviews on those contract packages that have not yet been awarded or have significantly changed since the 2014 Risk Review. These contract packages include:

Table 6. Updated Contract Packages

Contract ID	Contract Description
DB275	Pearl Highlands Parking Garage (PHPG) and H2 Ramp DB
DB450	Airport Section Guideway and Station Group (AGS) DB
DB550	City Center Section Guideway and Station Group (CCGS) DB

The scope of the Project is still well-defined but can no longer be described as being in an appropriate level of completeness. Due to project delays (largely due to legal actions over which the grantee had no control), failures to reach agreements (as with HECO over actions regarding parallel high-voltage power lines), and decisions to repackage contracts, the project is making slow progress toward construction of the easternmost half of the alignment.

The western parts of the Project (WOFH, KHG, and MSF) have been implemented through DB contracts since early in the Project, and are showing significant construction progress, although KHG is lagging due to disappointing production rates and other obstacles such as lack of access. MSF is expected to be complete in the coming months, and WOFH should be completed later this year. The early contracts were delayed by court-ordered injunctions against the project, resuming work in September 2013 following satisfactory completion of the Archaeological Inventory Survey ordered by the Hawaii Supreme Court.

The Airport and City Center sections will be merged with the stations in their respective geographic areas and redesigned and constructed under new DB contracts. The City Center

guideway will have further redesign requirements to accommodate desired changes to the Ala Moana Station and to relocate high-voltage HECO lines underground per a recent understanding with HECO.

The drawings for all four line segments present right-of-way plans, drainage plans and details, demolition plans, guideway plans and profiles, typical cross sections, utility plans, roadway plans, signing and striping plans, maintenance of traffic plans, traffic signal plans, street lighting plans, structural drawings, landscaping plans, station drawings, and contact rail installation plans.

The following observations were made with regard to the project scope review:

- Scope is adequately defined, except for the City Center stations and the undergrounding of HECO high-voltage lines.
- Level of completion varies across contract packages, with the Airport and City Center segments needing rework to accommodate recent repackaging.
- There are still a number of outstanding issues:
  - Several third-party agreements have yet to be finalized.
  - Final operational analysis must be completed by Ansaldo Honolulu Joint Venture (AHJV).
  - A number of design issues that affect the interface with other contracts, including the Core Systems Contract (CSC), must be resolved.
  - HART's Contract Packaging Plan (CPP) will continue to require significant management effort to ensure proper interface coordination.
  - A lack of definition of various elements of the CCGS Request for Proposals (RFP) may lead to higher bids on that contract.
  - HECO's imposition of further restrictions on work near high-voltage lines, including requirements for undergrounding them, may cause further delays and costs. HART must memorialize requirements in an Agreement with HECO to control costs and avoid scope creep.
  - Detailed cost estimates have not yet been prepared for a number of potential Contract Change Orders (CCO).
  - Real estate acquisition to support construction in the City Center Segment will continue to require significant coordination and effort by HART.
  - The amount of rework that will be needed to bring the Airport and City Center designs to completion may be considerably more extensive than HART anticipated, since the new DB contractors will likely plan on using only the concept designs; their responsibility for the final design may mean that they will not be able to use any of the essentially-complete elements of the earlier DBB packages.
  - HART must interface with the new HDOT State Oversight Agency (SOA) and meet the HDOT Safety and Security Program Plan requirements for start-up activities.

4.2 PMOC Assessment of Project Delivery

HART has implemented significant changes to its project delivery strategy since the 2014 Risk Refresh. In August 2014, HART received bids for construction of the Westside Stations Group (WSSG), which included nine stations within the WOFH and KHG segments. The engineer's

estimate was $180 million, and the bids ranged from $294 million to $320 million. HART elected to cancel the procurement and repackage the stations into three DBB contracts:

Table 7. Westside Station Contract Packages

Contract ID	Contract Description
DBB171	West Oahu Station Group (WOSG) Construction
DBB271	Farrington Highway Station Group (FHSG) Construction
DBB371	Kamehameha Highway Station Group (KHSG) Construction

These packages were refined and revised engineer's estimates were developed. The combined value of the engineer's estimate for the three packages was approximately $250 million. The three packages were advertised and bids received in 2015. The combined value of the three awarded packages totaled approximately $248 million, which was $46 million less than the low bid for the WSSG package that was cancelled in 2014.

HART has also significantly revised its strategy for delivery of the utilities, guideway and stations on the east end of the alignment (Airport and City Center Segments). HART had intended to utilize multiple DBB contracts for these elements. HART's consultant advanced the design of the utilities and guideway for the Airport and City Center Segments to near 90%. HART awarded the Airport Section Utility Relocation Contract in July 2014 to complete some advanced utility work prior to award of the Airport and City Center Guideway and Utilities DBB Contract. HART began procurement of the Airport and City Center Guideway and Utilities DBB Contract in mid-2014. The stations within the Airport and City Center Segments were to be built under a separate DBB contract. However, following the opening of the WSSG bids, a thorough review of its Contract Packaging Plan (CPP), and the realization that the engineer's estimate for Airport and City Center Guideway and Utilities DBB Contract was trending significantly higher than budgeted, HART made the decision in 2015 to switch to DB and award two separate contracts:

- Airport Guideway and Stations DB Contract (AGS) – RFP Part II responses (price and technical) were received on April 5, 2016. The proposals are under evaluation.
- City Center Guideway and Stations DB Contract (CCGS) – RFP Part II responses are due in July 2016. However, it is likely this date will be pushed back.

By making this procurement change, HART hopes to control costs, potentially reduce overall time to construct, reduce contract interfaces, and leverage innovation by the DB contractors.

The following observations were made with regard to the project delivery review:

- The change in strategy for the Airport and City Center Segments has had a significant impact on the Master Program Schedule (MPS) and has contributed to the erosion of the remaining schedule contingency.
- Any delay to the CCGS DB Contract now has a direct impact on the target RSD and could severely impact the project cost.
- HART's CPP will continue to require significant management effort to ensure proper interface coordination.

- There is concern whether bidding competition for the remaining packages will be strong enough to assure pricing within budget.

4.3 PMOC Recommendations

(1) Improve definition of work to replace HECO high-voltage overhead lines through addenda to the RFP for the City Center DB contract.
(2) Push to resolve regulatory issues that are impeding progress on ongoing construction projects (e.g., night work restrictions on WOFH and KHG).
(3) HART must take a more proactive approach to getting contractors to establish and meet schedules.
(4) Site access and permitting issues must be resolved early to avoid delays and extras.
(5) Continue to review and vet all potential CCOs. Prepare detailed cost estimates in advance for any potential CCOs that cannot be eliminated at this time.
(6) Continue to review all post-Record of Decision (ROD) changes to ensure they do not have an impact on the environmental documentation, the project scope, project cost, project schedule, or future operations.
(7) Prioritize resolution of required third-party agreements, real estate acquisitions, and coordination between various contractors and designers.

5.0 PROJECT SCHEDULE REVIEW

The PMOC reviewed the Project in accordance with *FTA OP 34: Project Schedule Review* dated September 2013 to assess and evaluate HART's project schedule.

5.1 PMOC Assessment

The PMOC reviewed HART's Master Program Schedule (MPS) with a Data Date of January 29, 2016. The following observations were made with regard to the schedule review:

- The FFGA RSD is January 31, 2020.
- HART's target RSD is December 21, 2022.
- HART's MPS does not include any time contingency/buffer float.
- The adjusted/stripped schedule RSD is December 21, 2022.
- HART MPS consists of the master schedule connected to multiple "feeder" construction contractor schedules. HART's MPS is summarized and did not include the detailed construction contractor schedules when transmitted to the PMOC for review.
- The current MPS contains more logic density and schedule-compression than previous updates. HART has acknowledged that achieving the FFGA RSD is no longer possible.
- The risk events (threats) used by the PMOC in the schedule risk analysis model are the same as previous risk assessments. In some cases, the PMOC combined several risk events to simplify the model without adversely affecting the data source protocol and modeling.

<u>Project Schedule Review</u>
During the Schedule Review process, the PMOC noted several inconsistencies with schedule development and routine progress updating, including poor use of file naming conventions, incomplete information, mechanically unsound practices, poor document transmittals, incomplete submittal packages, and non-compliance with internal project control and quality control procedures.

HART has not maintained consistent monthly progress status updates to the MPS as HART continues to re-evaluate contract packaging strategies (Design-Build, Design-Bid-Build, and Public Private Partnership). HART's construction and Core Systems Contractors (CSC) also have made progress reporting difficult with inconsistent maintenance and transmittal of construction contract schedules, which are rolled up into the MPS. Regardless, these circumstances do not provide reasonable accommodation to excuse HART from its duty and obligation to maintain a master program schedule (work plan).

HART's MPS schedule quality and integrity have diminished over time, partially due to poor construction contractor schedules, nonconformance to HART project control procedures, and deteriorating management capacity and capability on HART's program controls staff. Furthermore, the PMOC believes the PMP and related project control procedural documents require updating to address current operating procedures and functions within the current program organization.

Adjusted Project Schedule (APS)

HART's MPS transmitted to the PMOC on March 9, 2016 is marginally acceptable and required a significant number of adjustments by the PMOC in order to develop the APS, which is used for the schedule risk analysis. This particular MPS is a summary file of a more detailed MPS, which HART maintains. At the request of the PMOC, HART transmitted its most recent "comprehensive" MPS on March 31, 2016. The PMOC generated a schedule integrity analysis of this schedule. It was determined that the "comprehensive" MPS was also marginally acceptable and would require even more adjustments than the summary MPS transmitted on March 9, 2016.

Because HART's Current Project Schedule (CPS/MPS) did not contain any time contingency, and the PMOC adjustments did not adversely impact the longest critical path, the CPS RSD is the same as the APS RSD (December 21, 2022).

The PMOC incorporated the following adjustments to the schedule prior to completing the schedule risk analysis.

- Corrected integrity check issues.
- Removed "buffer" float activities (no contingency existed that required removal).
- Removed three constraint dates.
- Incorporated some logic and relationship/lag adjustments to reduce excessive float.
- Cleaned up Open-Ended Activities (90 predecessor and 70 successor).
- Cleaned up "New Activities" & Zero Duration Activities.
- Estimate Uncertainty Modeling accounted for 5-day/week and 7 day/week calendar assignments.
- Added milestone for 50% construction completion for AGS and CCGS.
- The PMOC did not adjust the calendar library since the estimate uncertainty modeling accounts for activity duration adjustments and inconsistencies with multiple calendar assignments.

The PMOC has assessed that the MPS FFGA RSD milestone date of January 31, 2020 is not achievable. This is implied and expressed in HART's most recent MPS as it now contains a projected RSD of December 21, 2022. Furthermore, considering the MPS does not contain any amount of time contingency, the December 21, 2022 is highly unlikely and improbable. The extended RSD milestone date is attributable to coordination, negotiation, and planning delays associated with utilities, primarily in in the Dillingham corridor. HECO was a significant contributing factor. Much uncertainty remains as HART and HECO have not finalized a clear plan with explicit roles, responsibilities, terms and conditions for work planning and execution for the relocation, installation, temporary shutdown, and related work along the Airport and City Center alignments. The most western construction contracts may also be impacted by said HECO delays. However, the impact would mostly result in contract float depletion, as opposed to further extending the RSD.

Summary of PMOC Findings

(1) FFGA RSD: January 31, 2020
(2) HART MPS RSD: December 21, 2022 ***(NO CONTINGENCY)***
(3) PMOC Adjusted MPS RSD: December 21, 2022 (No change)

(4) MPS contains multiple calendars due to inconsistency with construction contractor imported files (5-day w/holidays & 7-day calendar).

(5) An incomplete Basis of Schedule (BOS) was transmitted to PMOC. The BOS lacked definition and content from the previous BOS submitted to the PMOC. Moreover, the BOS that was submitted contradicted information regarding time contingency that was provided by HART during the risk refresh workshop in March 2016.

(6) No quantification of potential/known time impact analyses and claims was provided.

(7) Work Breakdown Structure (WBS) appears incomplete and is not intuitive.

(8) Schedule Analytical and Maturity Integrity Check:
   a. numerous mechanical corrections
   b. Excessive use of constraint dates/non-standardization of input data

(9) HART did not clean up the MPS after removing logic connections from the feeder construction contractor schedules.

(10) HART provided the PMOC a copy of the "comprehensive" MPS inclusive of all feeder construction contractor schedules on March 31, 2016. The PMOC performed an analytical schedule integrity check and found the "comprehensive" MPS possesses a large number of warnings and errors, exceeding that of the MPS used to perform the schedule risk analysis.

5.2 PMOC Recommendations

(1) Develop and provide an updated Basis of Schedule (BOS) to the PMOC.

(2) Re-evaluate management capacity and capability within its project controls organization and consider adding more schedule management expertise to its project controls staff, as it seems HART has been unable to provide all deliverables requested by the PMOC in accordance with HART's project control procedures. This was evident in the poor quality of the MPS used to perform the risk refresh and the absence of a revised BOS.

(3) Reconcile, revise, and align the Basis of Estimate (BOE) with the BOS. This includes accounting for HART and consultant staff projections beyond the RSD for contract and comprehensive project closeout efforts.

(4) Require all construction contractors and third party scheduling parties to consistently apply calendars (5-day, 6-day, or 7-day) according to HART procedures. These should be included in an overarching MPS architecture process document (procedure) that describes all of the schedule standardization and template requirements necessary to ensure that project schedules can be efficiently and effectively rolled up into the MPS.

(5) Review staffing plan to ensure that schedule compression has not caused excessive staff requirements during peak demand.

(6) HART should withhold partial or full payment of contractor monthly pay applications if the contractors continue failing to submit timely and acceptable Critical Path Method (CPM) project schedule updates.

(7) Request that each construction contractor provide a separate grouping of activities specific to its construction contract punchlist and closeout and related activities that typically extend beyond substantial completion and RSD in order to provide a

more realistic extension of construction services and consultant and HART staffing project management. This should be done especially for the Airport and City Center construction contracts once underway and for interface with the testing and start-up activities with the CSC.

(8) Reduce the number of constraint dates in the MPS.

(9) Develop an overall MPS "schedule architecture" of standards and templates that all scheduling parties (contractors, suppliers, and consultants) should use in order to ensure that Level 4-5 schedules are able to roll-up into the Level 1-2 MPS. Calendar libraries used by the various construction contractors should match.

6.0 SCHEDULE RISK ANALYSIS

The PMOC assessed the Project Schedule in accordance with *FTA OP 40: Risk and Contingency Review* dated September 2013.

6.1 PMOC Assessment

The Schedule Risk Assessment is based on the Master Project Schedule (MPS) with a Data Date of January 29, 2016. The PMOC conditioned the MPS for use in the risk assessment as noted below.

This review focuses on the elements of ***schedule*** uncertainty associated with the effectiveness and efficiency of HART's project implementation, the project scope, and surrounding project conditions.

The OP 40 schedule analysis output data are generated from Oracle's "*Pertmaster*", now referred to as *"Primavera Risk Analysis" (PRA)* software program used by the PMOC. The PMOC risk analysis process conforms to the software user manual and intent of the OP 40 as described below.

There are two kinds of project risk:

- ***Uncertainty risks*** are inherent variability that makes it impossible to predict exactly how long an activity will take. For instance, you can estimate how long it will take within a range of uncertainty, but you can never predict exactly how long.
- ***Risk events*** are events separate from an activity that can disrupt or otherwise impact the activity.

PRA handles risk events by using a Risk Register to enter potential risk events and estimates of the probability and impact of the risks on activity duration, costs, and project quality. Once uncertainty and risk event impact estimates have been entered for all tasks within a project, PRA performs a high number of project simulations using "Monte Carlo" or "Latin Hypercube" sampling of the estimates to select random task duration and cost values for every run-through of the simulation. These simulations generate a range of outcomes that can be used to predict project duration and costs with statistical confidence.

The Critical Path Method (CPM) is the traditional means for determining a project finish date. However, because CPM only determines a single date and does not consider potential risks, results are not always comprehensively reliable. Risk Analysis uses risk inputs to determine a range of project finish dates with more confidence and reliability. The PRA risk analysis is based on the risk management process outlines in Chapter 11 of the Project Management Institute's "*A Guide to the Project Management Body of Knowledge*" and consists of the components shown below. The process is not strictly linear; there may be considerable repetition of certain steps before moving on.

<u>Schedule Review</u>
The purpose of the Schedule Review "Characterization" is to check HART's project schedule, referred to as the Current Project Schedule (CPS) for logic errors, open-ended tasks, negative

lags, start-to-finish links, and other potential problems that could compromise the risk analysis. This step ensures the integrity of the schedule and improves the chances for a meaningful analysis. If mechanical or fundamental revisions are necessary based upon the schedule characterization, the risk management team makes the necessary adjustments and creates a revised schedule file, called the Adjusted Project Schedule (APS).

Pre-Analysis Check

A rudimentary analysis of the schedule is performed to identify activities that drive project duration and costs. These activities merit the closest attention during subsequent detailed risk analysis.

Build a Risk Model

Estimates for duration, cost, and resource uncertainty for each project task are identified by a specific team of experts relying on industry statistics and experience. The estimate uncertainty duration ranges are incorporated into a copy of the project schedule called the Estimate Uncertainty Model (EUM).

The team then brainstorms a list of potential risk events, evaluates the risk events as to how likely it is that they may occur and the potential impact such occurrences may have. The list of risk events is then entered into a risk register and each risk event is assigned a probability and impact, resulting in a risk degree factor, which is scored by the risk modeling software. At this point, a copy of the EUM is made, to which PRA then applies the uncertainty and maps the risk events to the appropriate tasks to build a risk model, called an Impacted Risk Model (IRM).

Analyze and Review

A Latin hypercube sampling analysis is run on the IRM. The risk analysis output can be viewed and evaluated in a wide variety of reports. The review options allow the risk management team to focus on areas of the schedule that pose the greatest risk to the overall program. This helps with the creation of an efficient and cost-effective risk mitigation plan.

Mitigate and Report

Based on the preliminary analysis, the risk management team reviews and evaluates alternative scenarios with varying reductions to duration, resource and cost uncertainty. Ultimately, the most cost-effective risk mitigation strategy is chosen and formalized into a risk mitigation plan.

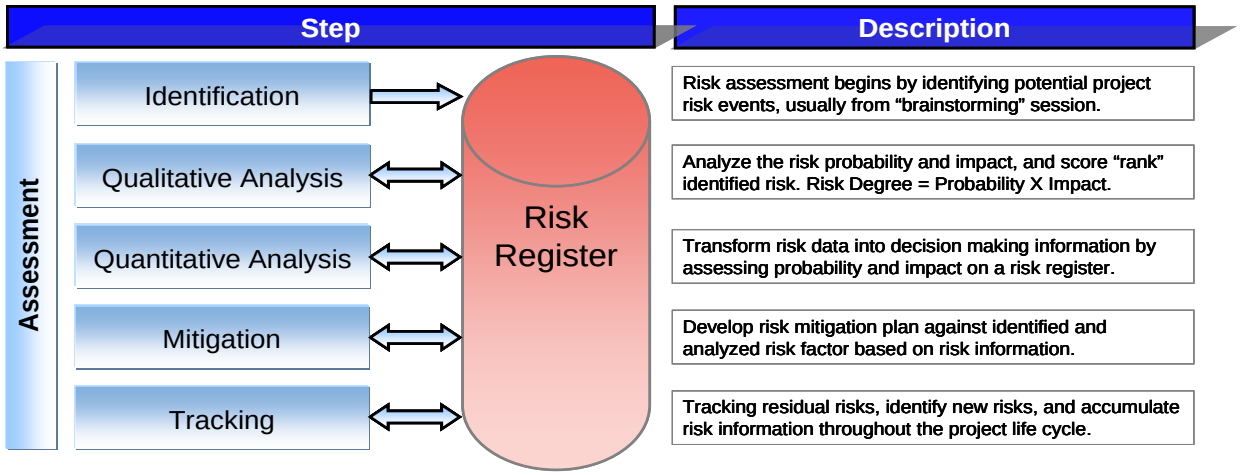

Figure 3. Schedule Risk Assessment Process

The figure below describes the various schedules that are created once the PMOC commences the OP 34 review of HART's project schedule, called the CPS. The final product is the IRM, which the PMOC uses for the risk analysis in PRA.

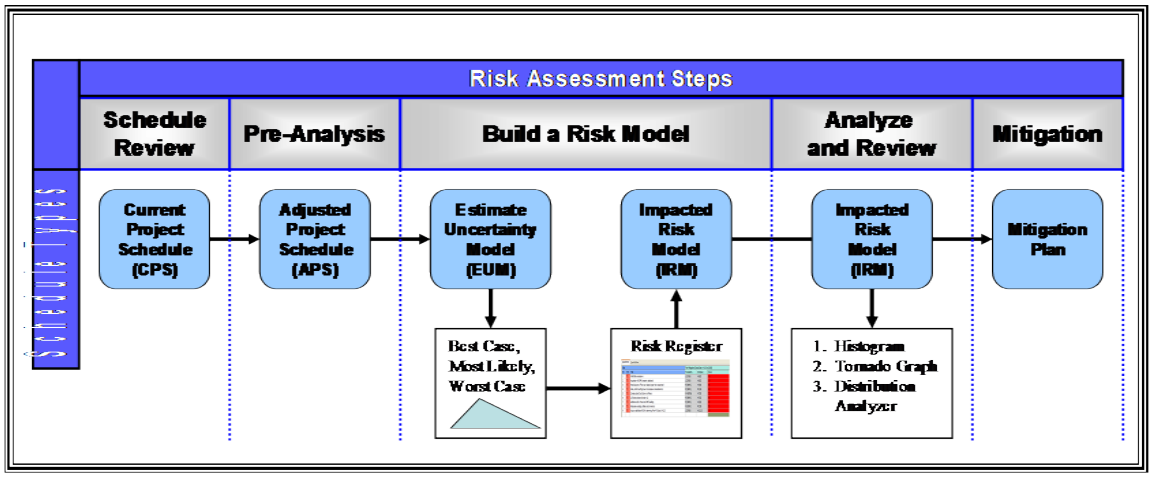

Figure 4. Schedule Risk Assessment Steps and Schedule Types

6.2 Schedule Risk Analysis

<u>Project Schedule Review</u>

The PMOC used HART's project schedule file *"MPS 1601 DC.xer"* (CPS) to conduct the Schedule Review. The PMOC concentrated its efforts on ensuring that a detailed, mechanical and fundamentally sound schedule was used for both the risk assessment and the contingency analysis. The PMOC made a backup copy of the CPS electronic file and made a significant number of adjustments to account for poor or missing logic ties and increased some activity detail to better represent the network logic in order to produce a more realistic risk analysis model. The PMOC used the "adjusted" project schedule, herein referred to as the "Adjusted Project Schedule" (APS), to provide more realistic risk assessment and contingency analysis output. The APS is considered most optimistic, as it is stripped of all latent and patent time contingency.

A summary of the PMOC adjustments are listed below:

- Corrected integrity check issues.
- Removed "buffer" float activities (no contingency existed that required removal).
- Removed three constraint dates.
- Incorporated some logic and relationship/lag adjustments to reduce excessive float.
- Cleaned up Open-Ended Activities (90 predecessor and 70 successor).
- Cleaned up "New Activities" & Zero Duration Activities.
- Estimate Uncertainty Modeling accounted for 5-day/week and 7 day/week calendar assignments.
- Added milestone for 50% construction completion for AGS and CCGS.
- The PMOC did not adjust the calendar library since the estimate uncertainty modeling accounts for activity duration adjustments and inconsistencies with multiple calendar assignments.

Pre-Analysis Check

The PMOC performed a pre-analysis check by applying a quick risk distribution range across all schedule activities and reviewing the confidence level range, duration sensitivity, and criticality index. Preliminary notes and observations were made for specific schedule drivers. Note that the pre-analysis check is performed as a pre-impacted risk analysis, meaning that the schedule does not have risk events incorporated at this point of the risk analysis process.

Build a Risk Model "Impacted Risk Plan"

(1) Estimate Uncertainty Model (EUM)

Before running the risk analysis, the PMOC assigned three durations to each activity in the schedule. The three durations for each activity represent best case "minimum", most likely, and worst case "maximum". The PMOC reviewed the activity Original Durations (OD) in the CPS and made an objective determination of the adequacy of each OD. Because the PMOC determined HART applied overly optimistic original durations in the MPS, the PMOC calculated the EUM most likely (Ml) durations for each activity by applying a 10% factor to all of the remaining durations for those activities currently underway and a 10% factor to all activities that have not yet started. In previous schedule risk analyses, the PMOC did not apply the 10% factor for determining the most likely EUM.

The PMOC calculated the EUM worse case (Wc) durations by applying a 30% factor to all of the remaining durations for those activities currently underway with an assigned 7-day calendar and a 30% factor to all activities that have not yet started with an assigned 7-day calendar.

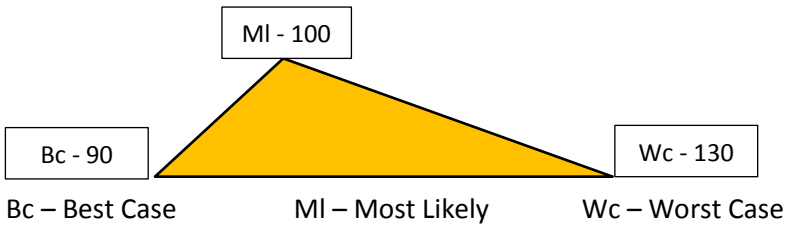

Figure 5. Duration Distribution Type for 7-Day Calendar Activities

Likewise, for those activities assigned to a 5-day per week calendar, the PMOC applied a 15% factor.

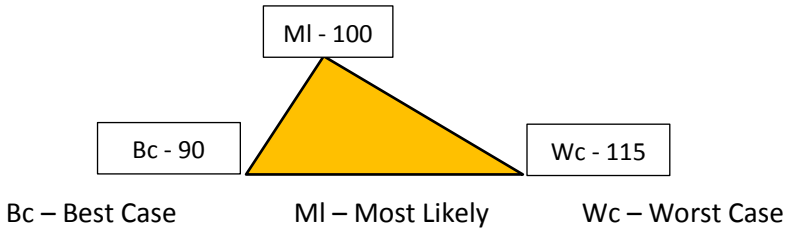

Figure 6. Duration Distribution Type for 5-Day Calendar Activities

The best-case (Bc) durations were calculated as 90% of the original duration or remaining durations. This value is low because the EUM is already based on a stripped and "best case" schedule. The value ranges (differences in activity durations) reflect levels of uncertainty.

Once the estimate uncertainty process step is complete, the EUM is used to develop the Impacted Risk Model (IRM).

(2) Impacted Risk Model (IRM)

The PMOC conducted a review and evaluation of all risks in the Project Risk Register in order to decide which risk events should be used for the schedule risk analysis (PRA). Once the risks were culled and prioritized, the PMOC assigned the risks events into the longest critical path and into the respective project alignment sections, WOFH/KHG, Airport and City Center, and the MSF.

Risk events (ID numbers) are used in the risk register to build the risk plan. Most of the risk events are tied to the Airport and City Center section alignment, since they are located near downtown and inherently contain more uncertainty than the more westerly, non-critical alignment sections that do not do adversely affect the risk analysis. The PMOC risk events used to perform the Risk Analysis are listed below:

Table 8. Risk Events for Schedule Risk Analysis

ID	Description
01	Relocation, Repair, Betterment, Encounter unforeseen u/g obstructions
02	Bid Protests, Other Delays Reviewing Bids
03	Traffic Mgmt. Issues, Congestion, Inefficiencies
04	Delays with Core Systems Automation, General Testing
05	Utility Co. Issues, Delays, Unwillingness to Cooperate, Delay w/ Utility Relo Install

Each risk event was scored based on a risk degree factor. The risk degree factor is calculated by the risk event probability and impact factors. The probability and impact factors for each risk event are objectively determined by the PMOC risk management team. The risk register scoring system prioritizes each risk event by the risk degree factor, see figure below.

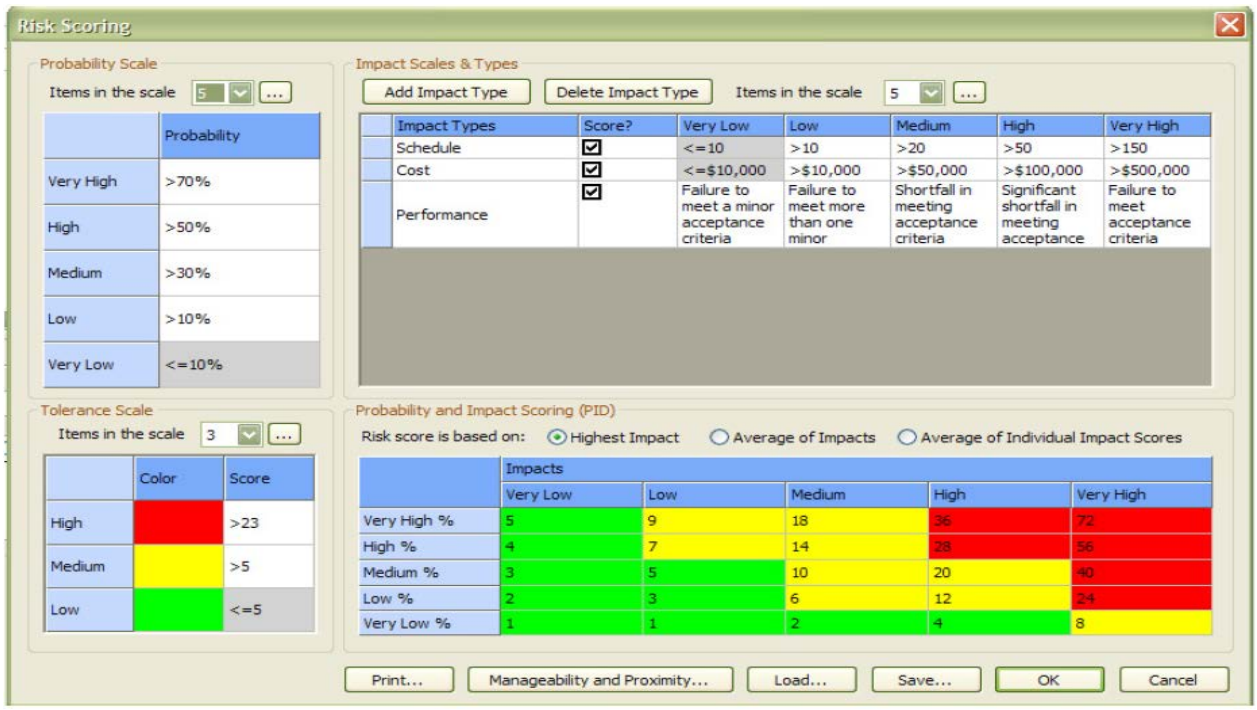

Figure 7. Schedule Risk Scoring Chart

Once the risk events and their risk degree factors are determined, they are incorporated into a copy of the PMOC EUM, resulting in a plan file called the IRM. The IRM is used to produce all of the schedule analysis "output" reports.

<u>Analyze and Review</u>

(1) Summary Results

The PMOC generated a confidence level histogram. The IRM schedule model calculated 1,000 simulations, selecting random durations for each task, to estimate the project completion date within a confidence range. This analysis yields the results shown in the figure below.

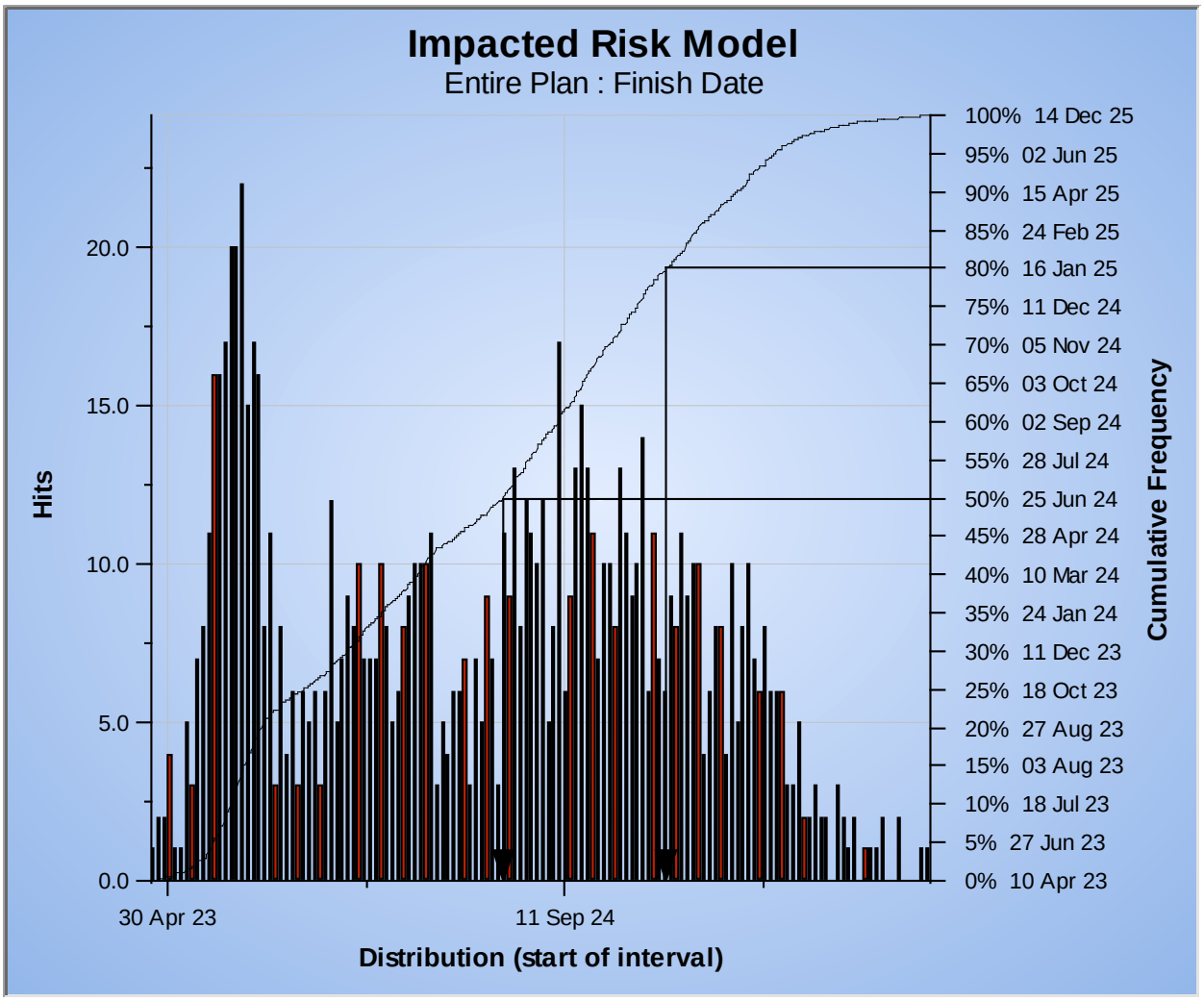

Figure 8. Project Completion Date Confidence Level

The IRM distribution range for project completion ranges from the 0% to 100% confidence levels, spanning a 973 calendar day period. The probability percentage points for the IRM are:

- 20% Confidence level completion date: 27-Aug-23
- 50% Confidence level completion date: 25-Jun-24
- 65% Confidence level completion date: 03-Oct-24
- 75% Confidence level completion date: 09-Dec-24
- 90% Confidence level completion date: 14-Apr-25
- 100% Confidence level completion date: 08-Dec-25

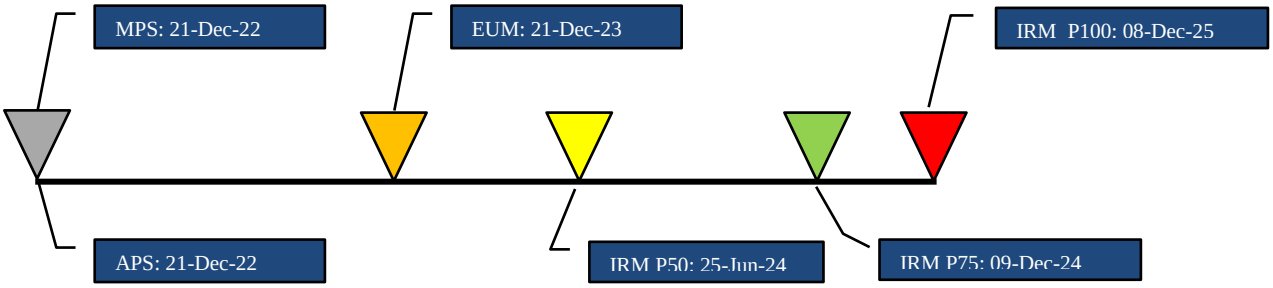

Figure 9. IRM Distribution

Table 9. 2014 vs 2016 IRM Distribution

PMOC Risk Assessment	Activity Description	CPS - Finish Dates	APS - Finish Dates	EUM - Finish Dates	IRM - Finish (P 50%)	IRM - Finish (P 75%)	IRM - Finish (P 100%)
2014	RSD FFGA	29-Mar-19	07-Feb-19	NA	17-Dec-19	20-Feb-20	31-Jul-20
2016	RSD	21-Dec-22	21-Dec-22	23-Dec-23	25-Jun-24	09-Dec-24	08-Dec-25

The risk event results are produced by running a schedule analysis using the IRM that contains qualitative risk events within the software risk register. The true indication of how sensitive each risk event ultimately becomes is not realized until the analysis is performed. For example, a risk event with a very high score does not necessarily mean that it will be highly sensitive to the schedule, as it may only affect non-critical activities containing total float. The schedule drivers that contain the most impact potential contain a high-risk degree and are on the longest critical path or near critical path.

OP 40 states that a confidence level of at least 65% of reaching the proposed RSD should be considered. Accordingly, the PMOC recommends that a 75% confidence level be used when determining the proposed RSD. When evaluating the likelihood of the proposed RSD, the PMOC considered factors including source data validation, duration sensitivity, criticality index, risk events, management capacity and capability, political environment, and governance. Some of the specific concerns that affected the recommended confidence level include:

- Consideration that schedule risks identified in 2014 are essentially the same now with little mitigation having occurred.
- Lack of certainty with regard to progression of HECO-related activities in CCGS.
- Schedule compression that will occur will lead to inefficiencies that have not been fully identified.
- Concerns with effective management of DB contracts
- Remaining AGS and CGS DB contracts will be constructed in the project's most congested and complicated areas, and there is uncertainty associated with the base schedule assumptions incorporated into the MPS for these contracts.
- There are a number of large construction projects occurring in Honolulu that will compete for labor and material resources with HART's project.
- Any uncertainty with timely receipt of funding could have significant impact on the

schedule.

- There is concern that the MPS has not adequately accounted for the number of right-of-way acquisitions needed for AGS and CCGS, including some that may be very complicated and will take more time that initially thought.

6.3 Schedule Contingency

Adjusted Project Schedule (APS)

The APS was used for both the schedule risk assessment and the Contingency Analysis Review. The APS is a backup copy of HART's Master Project Schedule (MPS) with adjustments made to logic, calendars and incorporation of additional activities to better reflect a logical critical path and alleviate excessive float in certain other logic paths. The APS is also stripped of all patent and latent contingency. Because the APS is pre-analysis, not containing estimate uncertainty or risk events, it is considered most optimistic, as it is stripped of all latent and patent time contingency.

Contingency Analysis

The objective of the contingency analysis, pursuant to OP40, is to estimate the minimum amount of schedule contingency required to complete the project on schedule. The FTA guidance states that the contingency recommendations shall be developed using the following assumptions:

- At the Revenue Service Date, schedule contingency requirements have been reduced to a minimum requirement or possibly eliminated.
- At the point of 100% complete with bid, the project should have sufficient schedule contingency available to absorb a schedule delay equivalent to 20% of the duration from Entry into Final Design through Revenue Operations.

The MPS data date is 29-Jan-16 and the RSD is 21-Dec-22, a difference of 1,787 days. According to the OP40, the project should contain the equivalent of 20% of this duration as contingency. The result is a contingency buffer total of 358 calendar days or 11.7 months.

The result of adding 358 calendar days, or 11.7 months, to HART's current MPS RSD of 21-Dec-22 equals an RSD of 14-Dec-23, as shown in the table below.

Table 10. Schedule Contingency Calculated by 20% Buffer Float

Data Date	APS RSD	Duration			20% Buffer Float Duration			MPS RSD 20% Float Added to RSD
		Days	Month	Years	Day	Month	Years	
29-Jan-16	21-Dec-22	1,787	58.7	4.9	358	11.7	.98	14-Dec-23

The figure below illustrates the same information relative to the PMOC Schedule Risk Analysis IRM dates plotted for the 10, 50 and 90th percentiles represented by letters F, G and H, respectively. The OP40 calculation for buffer float indicates a December 14, 2023 RSD, 34.5 months beyond the FFGA RSD date of 31-Jan-2020, and 11.7 months beyond the MPS RSD of 21-Dec-2022.

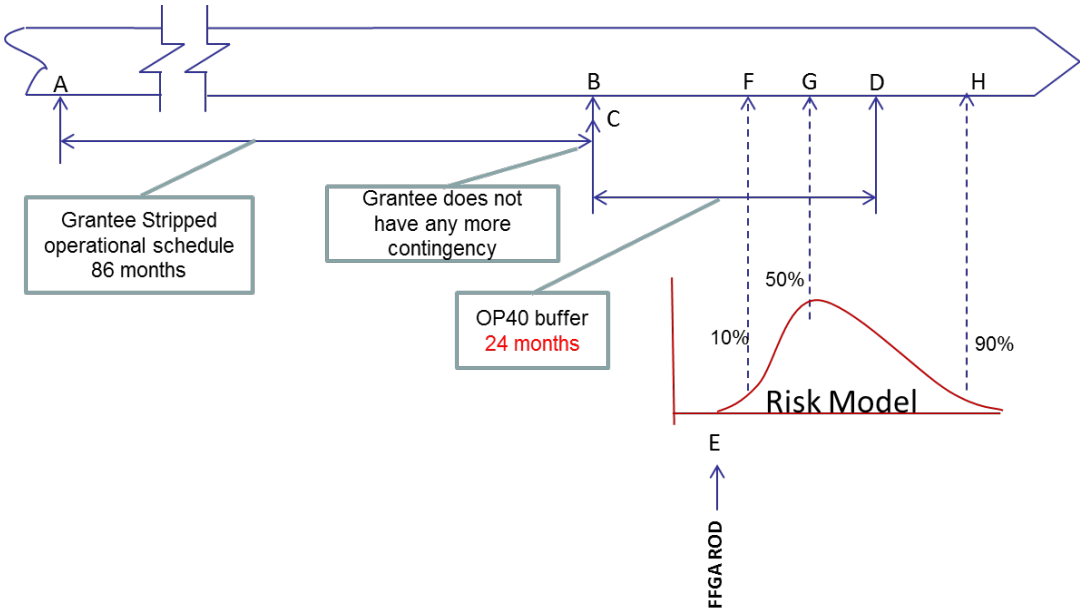

Figure 10. Buffer Float and RSD Analysis

6.4 Conclusion/Recommendations

The Revenue Service Date (RSD) identified in the FFGA is January 31, 2020. HART's current target date for the start of full revenue operations is December 2022 (per MPS with Data Date of January 29, 2016). However, the MPS contains no contingency.

(1) The revised Revenue Service Date (RSD) should be no earlier than December 2024, which represents the 75% confidence level in the OP 40 Schedule Risk Model.

(2) HART noted that the latest MPS submitted to the PMOC did not include any time contingency. HART must better document patent and latent time contingencies included in construction contract schedules and do the same within the MPS.

(3) HART should closely monitor the MPS longest critical path and near critical paths not only for each construction project but also for the overall program.

(4) HART should revise its staffing plan to ensure that schedule compression has not caused excessive staff requirements during peak demand of construction.

(5) The PMOC and HART should engage in focused "schedule containment workshops" on a monthly basis to monitor the efforts taken to achieve the revised RSD.

(6) HART should institute more aggressive and more consistent risk and contingency management efforts by its project controls department and risk manager. This includes, but is not limited to, alignment of current risk register updates and monitoring and mitigation with the MPS schedule updates and recorded risk and contingency mitigation actions.

7.0 PROJECT COST ESTIMATE REVIEW

The PMOC reviewed the Project in accordance with *FTA OP 33: Capital Cost Estimate Review*, dated September 2013, to assess and evaluate HART's current Estimate at Completion (EAC).

7.1 PMOC Assessment

The FFGA Project Budget was $5.122 billion, including $644 million in allocated and unallocated contingency and $173 million in financing costs. HART's current Estimate at Completion (EAC) of $6.827 billion identifies $396.5 million in allocated and unallocated contingency and $393 million in financing cost.

The PMOC had some difficulty in the verification of the EAC due to the number of various formats through which the cost information was provided. The major documents provided to the PMOC to support the EAC included:

- February 2016 SCC Spreadsheet
- March 2016 Contract Packaging Plan (CPP)
- February 2016 Forecast

The PMOC coordinated with agency staff and utilized information that was subsequently provided via emails and meetings. The PMOC evaluated the cost estimates for each Standard Cost Category (SCC) for mechanical soundness and consistency. These mechanical checks are used to determine if there are any material inaccuracies within the estimate. Components of the estimate were found to be essentially mechanically correct in the tabulation of the unit cost, application of factors, and translation to an SCC spreadsheet for most of the direct cost and soft cost contracts. However, specific estimate amounts could not be fully validated by the PMOC. The March 2016 CPP, which included allowances of various types for change orders or issues, is the only HART document that summarized all costs for the project with a budget value of $6.827 billion. HART did not update its FTA SCC Workbook with clear traceability for all values included in the CPP. Additionally, HART provided several budget sources for some of the costs, and variances were found between these documents.

<u>EAC Review</u>
HART has increased its budget since the 2014 Risk Refresh. The most significant increase occurred due to changing market conditions and the increased soft cost as a result of the RSD delay. A separate major cost issue arose in the form of Utility Relocations added to the budget to meet requirements imposed by HECO.

At present, approximately half of the construction work is awarded and the remaining work is "estimated" from various sources. The potential change orders for the awarded construction are typically estimated at a high-level and do not yet have detailed cost estimates developed. The costs for the remaining construction contracts (AGS, CCGS, and PHPG) are based on Independent Cost Estimates (ICE).

HART has not provided an ICE for the "added" HECO work included mostly in the UTIL contract and other separate contracts. The scope for this work is not well defined. HART should validate the scope and prepare an ICE as soon as possible to manage this work.

From discussions with HART and analyses of the documentation provided, the PMOC believes the HART EAC is not fully reflective of the sequencing identified in the current MPS. It is not clear if the escalation included in the HART EAC is supported by the current MPS. One reason for this caveat is that the MPS was recently revised, and the ICE for the AGS, CCGS, and PHPG were prepared before the schedule update. The PMOC has made some adjustment to account for this potential shortfall.

A significant setback occurred with the federal/state lawsuits for most of 2013. The cost associated with these delays has been mostly captured by HART change orders or adjustments included in the Budget or added in the PMOC's analysis. In general, this delay eroded most of the available project contingency. The delay also pushed back the remaining construction bids when the market is peaking. The AGS and CCGS are still in procurement, so there is significant uncertainty with regard to bidding market for the most complicated and difficult construction contracts associated with the program.

Escalation is not separately addressed in some various cost documents provided by HART. It was included in the ICE for the AGS, CCGS, and PHPG, but it was not consistently applied. The PMOC adjusted the budget to include appropriate escalation for these major contracts. HART did not provide the FTA SCC workbook as required at time of FFGA. The FTA SCC workbook would have clearly shown the escalation being used to develop the EAC. Once the remaining contracts are awarded, this risk should decline significantly. However, the PMOC recommends that HART verify its budgets and any ongoing estimate refresh efforts include adequate funds for escalation.

<u>Summary of PMOC Findings</u>

The following specific observations were made with regard to the cost estimate review:

- An individual Basis of Estimate (BOE) was updated for the Independent Cost Estimate (ICE) for the AGS and Pearl Highlands Parking Garage DB Contract (PHPG). The CCGS ICE is still being developed. However, there was no uniformity across individual BOEs:
    - The application of markups was inconsistent.
    - The application of the General Excise Tax (GET) varied.
    - Escalation rates varied between contracts.
- Variances were noted between some Contract Amounts as shown in the HART February 2016 SCC Spreadsheet as compared to the March 2016 CPP, the February 2016 EAC, and the various ICE documents. Stated another way, there is no overall document incorporating the cost from lower level details to the current HART CPP summary budget. This creates traceability concerns and the potential for errors or omissions in the budget. The PMOC sent HART an MS Excel spreadsheet comparison of this potential issue in April 2016, and the PMOC is awaiting a response in the form of comments or adjustments to the budget.
- The PMOC reviewed the EAC to expose all contingency:
    - ICE for PHPG – The resulting analysis showed that the ICE included a $35 million contingency in the estimate. However, HART's CPP did not appear to

separate out this contingency value. The PMOC reduced the budget for this contract in order to remove the perceived "latent" contingency.
    - The PMOC identified contingency issues for other CPP Contracts similar to PHPG, but the values were smaller. These include the CE&I East Contract, the Project-Wide Arts Contract, and the Owner-Controlled Insurance Program (OCIP) Contract. The contracts in question were identified in the PMOC April 2016 comparison spreadsheet.
    - The total amount of contingency identified in HART's EAC was $528.92 million.
- Some components of the cost estimate must still be revised or updated (e.g. soft costs, right-of-way, CCGS ICE, OCIP, and utilities, including HECO).
- Due to extension of the RSD, there may be some potential costs associated with maintenance of already constructed work. This scope is not specifically included in the current EAC.
- The PMOC performed an in-depth review of the three remaining DB contracts for the project. In general, the PMOC agreed with the unit cost and detailed build-up of the direct cost for all three contracts. However, the PMOC did not agree with the percentages used in each ICE for markups for items such as Engineering costs, GET (tax) application, Escalation, and General Conditions/Overhead. The change in the markups resulted in a significant adjustment for the AGS and CCGS but not for the PHPG.
- There are a number of potential change orders that have not been specifically included in HART's EAC, which were identified as having approximately $168.1 million in added cost.
- The PMOC identified another approximately $492.8 million in additive adjustments to the EAC.

The PMOC utilized the February 2016 SCC Spreadsheet provided by HART to distribute the project budget into FTA SCC Categories. Contingency was stripped from the estimate, as it was identified in the SCC distribution. Then, by utilizing the February 2016 EAC Forecast, the PMOC added HART's "Not Yet Executed" outstanding Change Orders into the various contracts. The potential changes are separated and updated monthly by contract into three categories: Pending, Probable, and Issues. The summary value of these three change types from the February 2016 EAC Forecast is $168.1 million.

<u>PMOC Adjustments</u>
Once all contingency was stripped and the potential change orders were added, the PMOC incorporated various adjustments into the base cost of the project prior to completing the cost risk analysis. Many of the adjustments identified in this report were discussed with HART staff in the months leading up to the Risk Refresh Workshop.

The PMOC adjustments totaling $492.8 million are summarized below:
- PMOC Analysis of AGS (Contract DB-450) ICE and markup – $109 million
    - Delta between ICE and HART EAC – $33 million
    - Mobilization/Demobilization – <$23 million>
    - General Conditions – $27 million
    - Overhead & Profit – <$7 million>
    - Added Escalation – $41 million

    - Excise Tax – $6 million
    - Engineering and Design – $32 million
- PMOC Analysis of CCGS (Contract DB-550) ICE and markup – $167 million
    - Delta between ICE and EAC - $27 million
    - General Conditions – $21 million
    - Bond/Insurance – $11 million
    - Overhead & Profit – $30 million
    - Added Escalation – $75 million
    - Excise Tax – $6 million
    - Engineering and Design – <$3 million>
- AGS and CCGS Stipends to Bidders – $2 million
- SCC 80 Soft Cost increase due to extension of RSD, various contracts – $90 million
    - CE&I West – $6 million
    - CE&I East – $18 million
    - PMSC – $14 million
    - GEC 3 – $14 million
    - CSC Support – $16 million
    - HART Labor & ODC – $15 million
    - Miscellaneous Support Contracts/Consultants – $7 million
- OCIP (Insurance) Cost increase (Contract MM-951) due to extension of RSD – $30 million
- Delay cost to the Core Systems Contract (DBOM-920) – $40 million
- Escalation cost to the Core Systems Contract (DBOM-920) – $10 million
- Revaluation of ROW and Temporary Construction Easements for HECO – $15 million
- Utility Relocation Costs (UTIL Contract) – $25 million
- Escalation cost to the Elevator/Escalator Contract (MI-930) – $4 million

As noted above, the Adjusted Stripped Base Cost Estimate (Table 11) includes $168.1 million in forecast or potential Change Orders that had been identified in HART's February 2016 Forecast. These changes are included in HART's March 2016 CPP ($6.827 billion budget), but they are not included in the February 2016 SCC Spreadsheet. The PMOC was required to add the forecasted change order cost to the HART February SCC to capture the true EAC in SCC format.

Table 11. Adjusted Stripped BCE

HART Estimate	$5,820.62
Allocated Contingency (PMOC Calculation)	$528.92
Unallocated Contingency	$84.56
Financing	$393.06
TOTAL	**$6,827.16**
Stripped Cost	$5,820.62
HART Forecast Change Orders	$168.11
PMOC Adjustments	$492.77
Adjusted Stripped BCE	**$6,481.50**
Incurred Costs (as of March 2016)	$1,912.75

All values in $M.

7.2 PMOC Recommendations

(1) Prepare cost estimates for all identified potential and possible changes (CCOs).
(2) Focus on updates for the AGS and CCGS estimates to allow time for mitigation.
(3) Refresh right-of-way (ROW) estimate to reflect current property costs and include costs for Temporary Construction Easements and impacts from the HECO work.
(4) Prepare an ICE for the remaining (un-awarded) HECO work.
(5) Refresh personnel manpower charts to account for new positions and a refined MPS to verify the cost included in SCC 80 soft costs.
(6) Verify that budgets and any ongoing estimate refreshes include adequate funds for escalation.
(7) Review the March 2016 CPP to confirm that latent contingency is not included in contract values.
(8) Review the March 2016 CPP to confirm that concurrent non-FFGA costs or "Betterments" are not included in the EAC.
(9) Revise any budgets or contracts impacted by the revised RSD as shown in the update to the MPS.
(10) Re-baseline budget following completion of the Risk Refresh activities.

8.0 COST RISK ANALYSIS

8.1 Purpose

Per FTA Oversight Procedure (OP) 40, PMOC has performed "an evaluation of the reliability of the grantee's project scope, cost estimate, and schedule, with special focus on the elements of uncertainty associated with the effectiveness and efficiency of the grantee's project implementation and within the context of the surrounding project conditions." Through the process of risk and contingency review, the PMOC attempts to aid the grantee in its efforts to better define the project's risks and to provide avenues for recovery should those risks become reality.

The purpose of this report is to provide a refresh of recommendations for adjustments to scope, cost, schedule, and project delivery options and to consider risk identification and risk mitigation options and alternatives, particularly in regard to contingencies, in order to respond to established project risks. This report is produced to establish the Project's ability to complete on time and within the identified budget. This report is based on information provided by HART as of April 2014.

8.2 Methodology

The purpose of this section is to describe the review and evaluation methodology utilized by the PMOC with regards to HART's identification of project risk and its plans for mitigating and managing these risks, including the use of schedule and cost contingencies.

The PMOC is required to synthesize available project information, explore and analyze uncertainties and risks, and provide a qualitative and quantitative assessment of ranges of forecasted cost and schedule. The PMOC reviewed risk mitigation options and alternatives, including use of cost and schedule contingencies.

The risk refresh requires an evaluation of the reliability of HART's project scope, cost estimate, and schedule, with specific focus on the elements of uncertainty normally associated with the implementation of the project. PMOC reviewed scope, cost, and schedule documents and presented these reviews in separate sections within this report. The objective of this refresh is to assess changes in the project risks and uncertainties associated with project conditions and the effectiveness and efficiency of project implementation in identifying and mitigating risks in regard to scope, cost and schedule. This report provides a qualitative and quantitative assessment of the ranges of forecasted cost and schedule and project management planning in order to respond to project risk. The PMOC's refresh is understood to be a critical input to FTA's decision regarding project advancement and funding.

The PMOC has performed regular monitoring visits to HART's project and has refreshed the PMOC's earlier risk assessment based upon an updated understanding of project risks and the latest schedule and cost information provided by HART. In March 2016, the PMOC participated in a risk refresh workshop with HART, the purpose of which was to discuss HART's progress in its risk management efforts and PMOC's observations and reflections from its initial review of HART's updated scope, cost, schedule, and risk information.

For the purposes of its risk refresh, the PMOC considered the project in four separate elements, which are termed here as "risk profiles":

- ***Risk Profile 1*** is associated with contracted direct cost work under construction;
- ***Risk Profile 2*** is associated with recently contracted direct cost work;
- ***Risk Profile 3*** is associated with yet-to-be-contracted direct cost work; and
- ***Risk Profile 4*** is associated with "soft costs."

8.3 Risk Identification

The PMOC has reviewed HART's updated risk register and has found that HART has represented risk directly related to the work. The risk register, however, represents risk magnitudes as single-point values, making it unclear as to the real breadth of risk. Review of the risk register finds that the risk register is a basic tool that has lost the sophistication of risk registers presented during prior PMOC risk reviews. Furthermore, there is no indication that the previously-presented Risk and Contingency Management Plan (RCMP) has been updated. This is an indication that the prior emphasis on risk management has waned.

Significant project risks include:

- Management capacity and capability:
    - Administrative influence in the project management process due to funding concerns
    - Staff instability and lack of availability of replacement staff with technical experience
    - Concerns regarding effective management, contract administration, empowerment, and training
    - Lack of active, independent risk management
- Deteriorating construction bidding market conditions, especially as the project moves toward the highly urbanized environment of downtown Honolulu
- Interferences by the alignment and stations contractors with the Systems Contractor
- Uncertainties surrounding negotiations with HECO about scope and timing for utility relocations
- Contractors seeking additional compensation for change orders and claims
- Impacts on construction resulting from business and traffic interferences
- Losing project momentum as a result of design changes

8.4 Cost Risk Assessment

This section includes the PMOC refresh of the cost risk of the project, based on the PMOC's review of HART's EAC. This section also describes the Beta Range Factor (BRF) assignments for the SCC Risk Assessment utilized in the FTA Risk and Contingency Review Workbook. Finally, the cost risk evaluation is described and the results are reported.

8.4.1 Methodology

Cost risk evaluation is a combination of the PMOC's professional judgment and objective cost data to summarize and make adjustments to HART's cost estimate. This is in addition to a rational and empirical application of a risk model analysis used to simulate the magnitude of project risk and establish the potential responses to manage the risk. In the context of the project risk evaluation, quantitative risk assessment is utilized in the analysis of risk exposure and the corresponding management of uncertainty. The PMOC utilized the following steps for the cost risk analysis of the project:

(1) HART's estimate falls short of the p65 predicted FTA model outcome by $1.189 billion ($661 million in recommended adjustments plus $528 million in additional recommended contingency). HART should review its project estimate and determine how to reduce costs to close this gap.

(2) The recommended amount of budget increase reflects the condition of no viable Secondary Mitigation being presented.

(3) Independent Risk Management must be instituted on the project. The RCMP must be resurrected and updated to ensure continual risk contingency tracking, custody, and reporting. The RCMP should include an updated contingency draw-down curve that reflects the current contingency balance and more accurate drawdown milestones. Diligence and vigilance must be applied to this effort to avoid another rapid contingency usage that could ultimately leave the project unprotected.

(4) Strong controls must be put in place immediately to avoid future rapid contingency reduction. The frequency and the levels of project management to which these statistics are reported should be improved and monitored monthly.

(5) Project cost and contingency levels should be independently reported at a management level that is not subject to politically-driven bias.

(6) The PMOC and HART should engage in a focused "cost containment workshop" on a monthly basis to monitor the efforts taken to avoid rapid contingency usage. HART needs to also perform a similar "cost containment workshop" with CE&I and CSC Oversight Consultant to contain costs.

8.4.2 SCC Adjustments

The PMOC used its professional judgment as well as an evaluation of objective data to develop its assessment of the Project costs and to develop the indicated adjustments. Adjustments noted below include changes proposed by the PMOC as well as changes proposed by HART, largely as a result of investigation of the project during this risk review cycle and including information provided in the March 2016 Risk Refresh Workshop. See Table 12 for a summary of PMOC/HART adjusted project costs by major SCC.

The Adjusted Estimate represents the stripped project cost in Year of Expenditure dollars ($YOE). The first $YOE column represents the HART EAC with contingency removed and adjusted by the PMOC for known, unexecuted changes; the second column represents further PMOC adjustments; the final column represents the PMOC-adjusted project EAC, stripped of contingencies. The PMOC recommends an adjustment to the base cost estimate in the amount of

$492.9 million. Details of the adjustments are discussed in Section 7.1 of this report. The final column forms the Lower Bound basis for the risk assessment. Note that Finance Costs are not included in this risk assessment.

Table 12. PMOC Adjustments to HART Estimate $YOE

Standard SCC codes		YOE Dollars		
SCC	Category	HART/PMOC stripped estimate	YOE HART/PMOC Adjustments	Adjusted Stripped Estimate
SCC 10	Guideway	1,571,515	152,596	1,724,110
10.02	Guideway: At-grade semi-exclusive (allows cross-traffic)	17	0	17
10.04	Guideway: Aerial structure	1,404,758	140,004	1,544,762
10.08	Guideway: Retained cut or fill	6,947	0	6,947
10.09	Track: Direct fixation	155,182	12,591	167,774
10.11	Track: Ballasted	2,912	0	2,912
10.12	Track: Special (switches, turnouts)	1,698	0	1,698
SCC 20	Stations, Stops, Terminals, Intermodals	634,273	55,605	689,878
20.02	Aerial station, stop, shelter, mall, terminal, platform	522,884	51,605	574,490
20.06	Automobile parking multi-story structure	60,406	0	60,406
20.07	Elevators, escalators	50,983	4,000	54,983
SCC 30	Support Facilities: Yards, Shops and Admin Bldgs	116,466	0	116,466
30.02	Light Maintenance Facility	7,859	0	7,859
30.03	Heavy Maintenance Facility	43,578	0	43,578
30.04	Storage or Maintenance of Way Building	8,691	0	8,691
30.05	Yard and Yard Track	56,339	0	56,339
SCC 40	Sitework and Special Conditions	1,325,117	68,444	1,393,561
40.01	Demolition, Clearing, Earthwork	119,017	17,882	136,899
40.02	Site Utilities, Utility Relocation	483,834	41,835	525,668
40.03	Haz. mat'l, contam'd soil removal/mitigation, ground water treatments	164	0	164
40.04	Environmental mitigation, e.g. wetlands, historic/archeologic, parks	18,235	0	18,235
40.05	Site structures including retaining walls, sound walls	15,487	0	15,487
40.06	Pedestrian / bike access and accommodation, landscaping	25,802	0	25,802
40.07	Automobile, bus, van accessways including roads, parking lots	178,279	0	178,279
40.08	Temporary Facilities and other indirect costs during construction	484,301	8,727	493,028
SCC 50	Systems	376,521	35,667	412,188
50.01	Train control and signals	115,412	8,885	124,297
50.02	Traffic signals and crossing protection	100,272	17,578	117,850
50.03	Traction power supply: substations	33,560	2,408	35,968
50.04	Traction power distribution: catenary and third rail	34,158	924	35,082
50.05	Communications	63,177	4,484	67,661
50.06	Fare collection system and equipment	26,194	1,100	27,294
50.07	Central Control	3,748	289	4,036
SCC 60	ROW, Land and existing improvements	217,495	15,000	232,495
60.01	Purchase or lease of real estate	183,903	13,851	197,754
60.02	Relocation of existing households and businesses	33,592	1,149	34,741
SCC 70	Vehicles	207,763	15,994	223,758
70.01	Light Rail	187,249	14,415	201,664
70.06	Non-revenue vehicles	14,135	1,088	15,223
70.07	Spare parts	6,380	491	6,871
SCC 80	Professional services and Agency costs	1,539,586	149,597	1,689,183
80.01	Project Development	135,281	0	135,281
80.02	Engineering	344,908	25,461	370,369
80.03	Project Management for Design and Construction	492,966	38,291	531,257
80.04	Construction Administration & Management	300,002	38,517	338,519
80.05	Professional Liability and other Non-Construction Insurance	75,261	32,274	107,535
80.06	Legal; Permits; Review Fees by other agencies, cities, etc.	63,458	7,394	70,851
80.07	Surveys, Testing, Investigation, Inspection	47,675	1,483	49,158
80.08	Start up	80,036	6,177	86,213
	SCC 10-80 total	5,988,736	492,903	6,481,639

8.4.3 Baseline Beta Values

For each risk profile, the starting point for the Beta values in this risk assessment was based on the Beta values imported from the prior (2014) risk refresh and is shown by major SCC category in the tables below. These values are developed from FTA standards, adjusted in consideration of slight advancements in the stage of project, and in consideration of the current level of estimate. Table 13 through Table 16 indicates the starting Beta values. Note that each Total Beta includes the standard 0.05 increment for post-construction risk.

Table 13. Imported Beta Values for Risk Profile 1

SCC	R	D	M	C	Total Beta
SCC 10 - 50	0.00	0.00	0.10	0.45	1.60
SCC 60	0.00	0.25	0.50	0.25	2.05
SCC 70	0.00	0.00	0.10	0.25	1.40
SCC 80.01-08	Not applicable				
R = Requirements Risk	D = Design Risk		M = Market Risk		
C = Construction Risk	Total Beta = 1 + (R + D + M + C+.05)				

Table 14. Imported Beta Values for Risk Profile 2

SCC	R	D	M	C	Total Beta
SCC 10 - 50	0.00	0.00	0.10	0.45	1.60
SCC 60	0.00	0.25	0.50	0.25	2.05
SCC 70	Not applicable				
SCC 80.01-08	Not applicable				
R = Requirements Risk	D = Design Risk		M = Market Risk		
C = Construction Risk	Total Beta = 1 + (R + D + M + C+.05)				

Table 15. Imported Beta Values for Risk Profile 3

SCC	R	D	M	C	Total Beta
SCC 10 - 50	0.00	0.25	0.25	0.45	2.00
SCC 60	0.00	0.90	0.80	0.25	3.00
SCC 70	Not applicable				
SCC 80.01-08	Not applicable				
R = Requirements Risk	D = Design Risk		M = Market Risk		
C = Construction Risk	Total Beta = 1 + (R + D + M + C+.05)				

Table 16. Imported Beta Values for Risk Profile 4

SCC	R	D	M	C	Total Beta
SCC 10-50	Not applicable				
SCC 70	Not applicable				
SCC 80.01	0.00	0.00	0.00	0.00	1.05
SCC 80.02	0.00	0.00	0.00	0.00	1.05
SCC 80.03	0.00	0.10	0.05	0.20	1.40
SCC 80.04	0.00	0.10	0.15	0.30	1.60
SCC 80.05	0.00	0.00	0.00	0.10	1.15
SCC 80.06	0.00	0.05	0.00	0.15	1.25
SCC 80.07	0.00	0.10	0.10	0.25	1.50
SCC 80.08	0.00	0.20	0.25	0.60	2.10
R = Requirements Risk D = Design Risk M = Market Risk					
C = Construction Risk Total Beta = 1 + (R + D + M + C+.05)					

Beta values for the current project were developed based on a refreshed view of the Scope, Cost, and Schedule risks identified in the project, informed by regular PMOC site visits and project reviews. The Beta values were adjusted by the PMOC team as indicated below. Note that the Beta value adjustments occurred independently for each Risk Profile as applicable. These Beta values were assigned as outlined in FTA guidance OP 40, and generally fall within ranges expected for this character of project. Beta values were applied at the second level SCC structure. Table 17 indicates the final Beta values included in this assessment. Detail for the SCC adjustments follows Table 17.

Table 17. Beta Values Risk Refresh

SCC	Description	Risk Profile 1	Risk Profile 2	Risk Profile 3	Risk Profile 4
10	**Guideway& Track Elements (Route Miles)**				
10.02	Guideway: Semi-exclusive	-	1.05	-	-
10.04	Guideway: Aerial structure	1.42	1.05	2.10	-
10.08	Guideway: Retained cut or fill	1.75	-	-	-
10.09	Track: Direct fixation	1.27	-	2.10	-
10.11	Track: Ballasted	1.75	-	-	-
10.12	Track: Special (switches, turnouts)	1.74	-	-	-
20	**Stations, Stops, Terminals, Intermodals**				
20.01	At-grade station, stop, shelter, mall, terminal, platform	-	-	-	-
20.02	Aerial station, stop, shelter, mall, terminal, platform	-	1.80	2.10	-
20.06	Automobile parking multi-story structure	-	-	2.10	-
20.07	Elevators, escalators	-	1.73	-	-
30	**Support Facilities: Yards, Shops, Admin. Bldgs.**				
30.02	Light Maintenance Facility	1.31	-	-	-
30.03	Heavy Maintenance Facility	1.26	-	-	-
30.04	Storage or Maintenance of Way Building	1.19	-	-	-
30.05	Yard and Yard Track	1.13	-	-	-
40	**Sitework& Special Conditions**				
40.01	Demolition, Clearing, Earthwork	1.55	1.80	2.10	-
40.02	Site Utilities, Utility Relocation	1.23	1.67	2.10	-
40.03	Haz. mat'l, contam'd soil removal/mitigation, ground water treatments	1.11	-	-	-
40.04	Environmental mitigation, e.g. wetlands, historic/archeological, parks	1.31	-	-	-
40.05	Site structures including retaining walls, sound walls	1.40	1.80	-	-
40.06	Pedestrian / bike access and accommodation, landscaping	1.75	1.79	-	-
40.07	Automobile, bus, van accessways including roads, parking lots	1.65	1.80	2.10	-
40.08	Temporary Facilities and other indirect costs during construction	1.15	-	-	-
50	**Systems**				
50.01	Train control and signals	1.98	-		-
50.02	Traffic signals and crossing protection	-	-		-
50.03	Traction power supply: substations	1.87	-		-
50.04	Traction power distribution: catenary and third rail	1.54	-		-
50.05	Communications	1.77	-		-
50.06	Fare collection system and equipment	-	1.80		-
50.07	Central Control	1.75	-		-
60	**ROW, Land, Existing Improvements**				
60.01	Purchase or lease of real estate	2.05	2.05		-
60.02	Relocation of existing households and businesses	2.05	2.05	3.00	-
70	**Vehicles**				
70.01	Light Rail	1.35	-		-
70.06	Non-revenue vehicles	1.35	-		-
70.07	Spare parts	1.35	-		-
80	**Professional Services**				
80.01	Preliminary Engineering	-	-	-	1.05
80.02	Final Design	-	-	-	1.05
80.03	Project Management for Design and Construction	-	-	-	1.40
80.04	Construction Administration & Management	-	-	-	1.60
80.05	Professional Liability and other Non-Construction Insurance	-	-	-	1.15
80.06	Legal; Permits; Review Fees by other agencies, cities, etc.	-	-	-	1.25
80.07	Surveys, Testing, Investigation, Inspection	-	-	-	1.50
80.08	Start up	-	-	-	2.10

8.4.4 Beta Value Adjustments

Significant issues noted in the scope, cost, and schedule reviews are reflected in the risk assessment model by means of adjustments to the risk Beta factors (β) applied to each SCC sub-category. These adjustments result in forecasts of ranges of cost for the project. Standard FTA Beta values incorporate an expectation of common risks that occur across transit projects; Beta adjustments below reflect those increases or decreases in risk that differ from risks occurring within standard Beta values.

The following sections present detail regarding the basis for adjustments, reflected previously in Table 12, beyond standard OP 40 Beta value suggestions. The purpose of this listing is to provide information regarding Beta values of note.

<u>SCC Wide Beta Value Changes</u>
System-wide Beta adjustments were made to several Risk Profiles:

- Risk Profile 1 (contracts well underway):
  - All partial Beta values were reduced to reflect the completion status of each SCC sub-line item;
  - Requirements risk increased by 0.20 to reflect risk related to management capacity and capability;
  - Market risk reduced by 0.05 to reflect contracted status; some market risk remains regarding pricing of change orders not finalized;
- Risk Profile 2 (contracts recently bid and/or contracted):
  - All partial Beta values were reduced to reflect the completion status of the SCC sub-line item;
  - Requirements risk increased by 0.20 to reflect risk related to management capacity and capability;
- Risk Profile 3 (uncontracted work):
  - Requirements risk increased by 0.20 to reflect risk related to management capacity and capability;
  - Design risk reduced by 0.10 to reflect 80% design status;
  - Market risk increased by 0.10 to reflect increased sense of bidder risk due to oncoming work in highly urbanized environment;
- Risk Profile 4 (professional services):
  - No global Beta adjustments applied.

<u>SCC-Specific Beta Value Changes</u>
The following issues determined the final resulting Beta values for the SCC sub-categories, which are the Beta values that reflect risk across all four categories of *Requirements*, *Design*, *Market*, and *Construction* risk, including the general Beta value increases previously noted in the section above. Noted below are only those conditions where exceptional changes to the standard Betas were noted. "Normal" risks associated with similar construction are accounted for in the base risk model.

Risk Profile 1:
SCC-50 – Systems

- Construction Risk, SCC 50.01 through 50.05 increase by 0.25 to reflect strong risk of future changes resulting from interference of other contracts;

SCC-70 – Vehicles (Risk Profile 1)

- Market Risk, SCC 70.01 & 70.07 decrease by 0.05 to reflect status that vehicles have recently started delivery, but yet remain untested;

Risk Profile 2:
SCC-10 – 60

- No Specific Beta Value Changes.

Risk Profile 3:
SCC-10 – 60

- No Specific Beta Value Changes.

Risk Profile 4:
SCC-80 – Soft costs

- No Specific Beta Value Changes.

Several concerning risks were noted, but not used as a basis for Beta value adjustments. It is expected that—in addition to the risks noted for which cost-risk Beta adjustments were made—these risks will receive significant risk management and mitigation focus. These risks include the following:

- Uncertainties surrounding negotiations with HECO about scope and timing for utility relocations
- Contractors seeking additional compensation for change orders and claims
- Impacts on construction resulting from business and traffic interferences
- Losing project momentum as a result of design changes

Failure to significantly reduce these risks may cause project cost increases above those modeled in this report.

8.4.5 Cost Risk Analysis

This section presents the PMOC's analysis of the model-based Project Cost Risk Assessment based on the FTA Risk and Contingency Review Workbook (version 4.0), utilizing the project-adjusted BRFs. This workbook is based on the summary organizational structure of the FTA SCC 10 through 80 for the capital cost elements of a project. SCC 90 (contingency) is specifically excluded as a duplicate measure of risk. Risk for SCC 100 (finance charges) is not covered in the standard FTA risk range factors. Project-level risk is an aggregated amount of the risk associated with all of the SCC Ranges.

Using the Beta values in Table 17, a simulation project risk model was developed; Table 18 presents the corresponding numeric data results from the risk model.

Table 18. Risk Model Data

YOE Sponsor values	Overall	Part 1 Bid, deep in construction	Part 2 Bid, barely started construction	Part 3 Not bid	Part 4 Soft costs
	6,434,102	1,770,373	943,577	2,057,615	1,662,537
Sponsor exposed contingency	613,478	75,259	119,332	274,151	144,736
Sponsor stripped estimate (SCC 10-80)	5,820,624	1,695,114	824,246	1,783,464	1,517,800
Change orders TBE	168,112	133,293	13,034	0	21,785
EAC stripped estimate	5,988,736	1,828,407	837,279	1,783,464	1,539,586
Secondary mitigation	0				
YOE PMOC values					
Inflation Adjustment	0	0	0	0	0
Adjustments	492,903	41,711	45,100	256,495	149,597
Adjusted estimate	6,481,639	1,870,118	882,379	2,039,959	1,689,183
Model recommendations					
Forecasted completion at (50%ile)	7,338,486	2,013,689	1,023,777	2,528,474	1,807,332
Base Funded Contingency amount	856,847	143,572	141,398	488,515	118,150
Contingency %	13%	8%	16%	24%	7%
Secondary mitigation target (65%ile)	7,623,104	2,061,379	1,070,745	2,690,744	1,846,578
Secondary mitigation recommended amount	284,618	47,690	46,968	162,269	39,246
Secondary mitigation %	4%	3%	5%	8%	2%
Secondary mitigation provided	0				
Additional Funded Contingency Requirement	284,618				
Recommended total funded budget	7,623,104				
Risk analysis					
Lower bound	6,481,639	1,870,118	882,379	2,039,959	1,689,183
Lower range reporting amount (40%ile)	**7,173,860**	1,986,105	996,611	2,434,616	1,784,632
Base forecast (50%ile)	7,338,486	2,013,689	1,023,777	2,528,474	1,807,332
Secondary mitigation level (65%ile)	7,623,104	2,061,379	1,070,745	2,690,744	1,846,578
Upper range reporting amount (80%ile)	**8,002,441**	2,124,940	1,133,344	2,907,015	1,898,884
Upper bound	10,790,557	2,592,112	1,593,442	4,496,607	2,283,335

Note: All values in $1,000; excludes finance costs.

This analysis indicates a recommended budget of $7.623 billion to maintain a project protect level at p65. Further analysis of these amounts is provided in sections below.

8.4.6 Cost Contingency

In its latest EAC, HART identified YOE $613 million in allocated and unallocated contingency; the PMOC found no additional latent contingency. This amount is reflected in Table 18. Furthermore, with known estimate adjustments, the PMOC has found that the contingency is likely to be additionally reduced to a deficit of $47.5 million against HART's current estimate to complete. When compared to the FFGA budget, the contingency is at a deficit of $1.533 billion.

The PMOC prepared a risk assessment by Risk Profile as previously described. At this refresh, the PMOC recommends a funded contingency of approximately 11% for the Risk Profile 1 (contracted and in construction direct cost), 21% for the Risk Profile 2 (recently contracted direct cost), 32% for the Risk Profile 3 (in design and uncontracted direct cost), and 9% contingency for the Risk Profile 4 (soft costs), equating to an overall contingency recommendation of $1.1414 billion (or ~17% of project costs) at the secondary mitigation level of p65.

Project contingency has faced significant challenges. HART, as of the 2014 PMOC review, had developed a contingency tracking process as shown in Figure 11. This drawdown was based on the contingency-stripped FFGA budget amount of $4,948.6 billion. HART continued tracking contingency beyond that time. However, this tracking was not in full accordance with the RCMP nor did it take into consideration all anticipated costs.

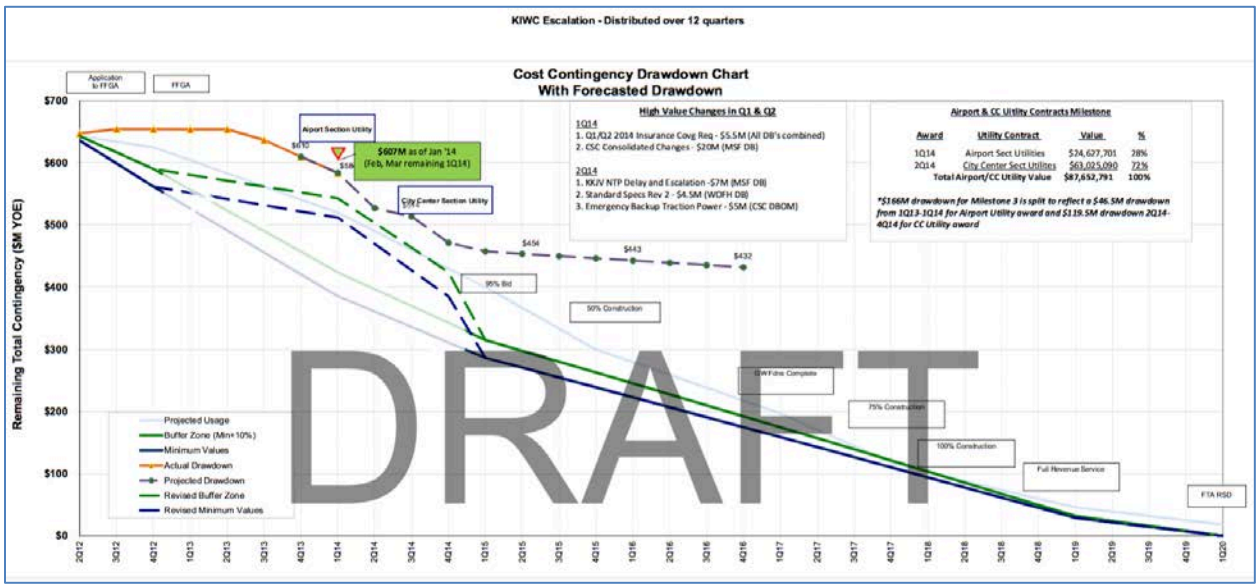

Figure 11. HART 2014 Contingency drawdown

In its 2014 Risk and Contingency Management Plan (RCMP), HART indicated:

> *"The GEC RM [risk manager] will assist the Project's managers in effectively managing risks. The most obvious indication of effective risk management is to demonstrate that the Project is not consuming cost or schedule contingency more rapidly than depicted by the mutually agreed-upon planned cost and schedule contingency values established at each Project milestone…"*
>
> *"… Where cost or time reserves are depleted to below the minimum contingency capacities, agreed-upon sources of additional contingency must be developed to replenish at least to the minimum required capacity. Failure to do so is likely to result in a project that either fails to meet its planned opening date or is unable to be completed within the available budget. To preserve contingencies, the GEC RM will assist the Project's managers in actively conducting primary risk mitigation procedures to reduce the overall level of risk. This will improve the chances of remaining above the minimum cost and schedule values. In addition, the Project will develop secondary mitigation plans to provide the means to replace contingency expended beyond planned amounts if that becomes necessary. As a minimum, at the specified Project Hold Points (or at other control points specified by HART), the GEC RM will update the schedule and cost drawdown curves and provide them to the HART PCM [Project Controls Manager] for concurrence."*

Figure 12 represents the reduction in contingency to date against the FFGA budget, based on PMOC analysis. The contingency drawdown indicates that, as of 2014 (the prior PMOC review), the project was analyzed to be approximately $180 million below the minimum contingency drawdown. By 2016, the project is analyzed to be approximately $1.772 billion below the minimum contingency drawdown curve.

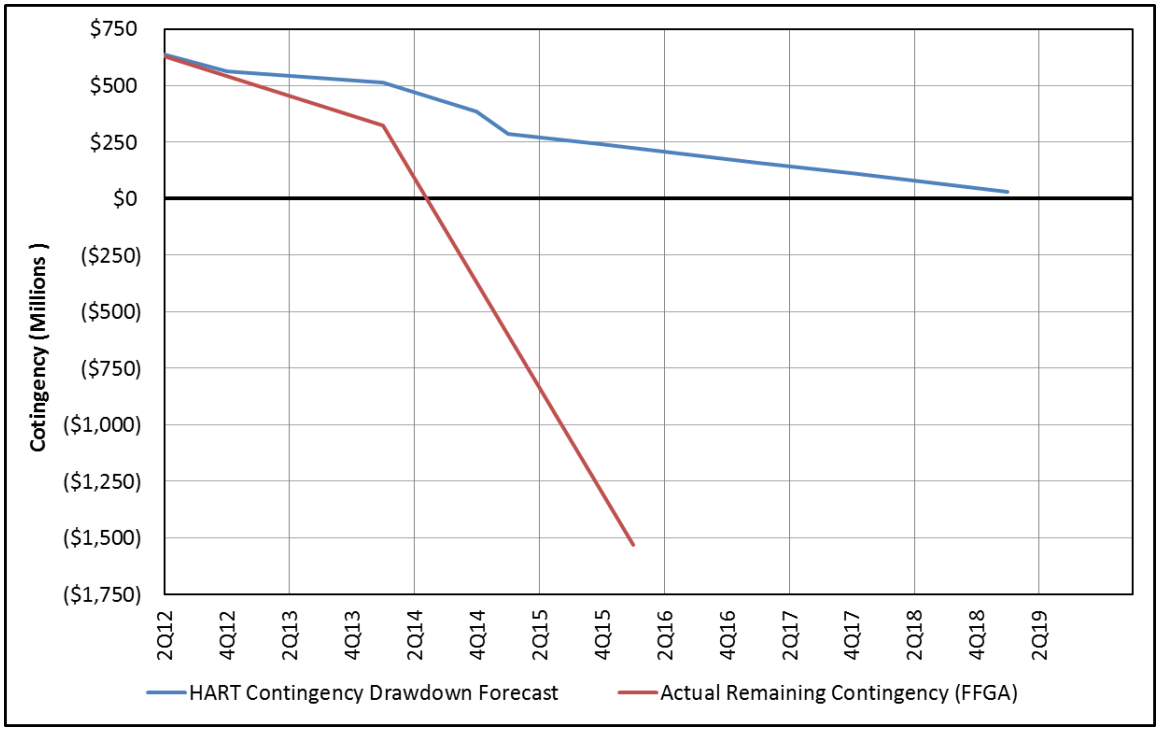

Figure 12. HART Forecast Contingency Drawdown vs. Actual Drawdown

8.5 Risk Mitigation

8.5.1 Primary Mitigation

HART developed a risk register with its identification of project risks. Development of a formal RCMP as an integral part of HART's PMP is expected, including establishment within HART's organization of authority to ensure that the RCMP is well-managed. While a revised, acceptable version was received in November 2013, no further updates have been received.

8.5.2 Secondary Mitigation

Secondary mitigation consists of pre-planned potential scope or process changes that may be triggered when risk events occur that cause overruns that cannot be resolved by available project contingency. It is noted that Secondary Mitigation is not to be confused with a value engineering exercise. Value engineering is a formal, systematic, multi-disciplined process designed to optimize the value of each dollar spent. Secondary mitigation is difficult to cost-effectively

obtain at this stage where major portions of the project are already contracted for construction and design is largely complete. However, station design continues and may be a source for secondary mitigation, as may other areas of the project.

Although lists of Secondary Mitigation items were presented by HART, these lists did not include analyses at the current level of estimating, scheduling, and scoping of the expected cost reductions in consideration. Evidence was not presented that HART fully evaluated the costs of design changes, the schedule implications, the effects on existing construction contracts, and the political will to entertain any such changes. In the April 2016 risk workshop, HART noted that most of the secondary measures would be difficult to implement. Therefore, the PMOC questioned the viability of any of the deductive options presented. Funded contingency would be required to provide project protection at the Secondary Mitigation level of p65, setting a funded budget recommendation at $7.623 billion. This level is indicated in Table 19.

Table 19. PMOC Recommended Secondary Mitigation

YOE Sponsor values	Overall	Part 1	Part 2	Part 3	Part 4
		Bid, deep in construction	Bid, barely started construction	Not bid	Soft costs
	6,434,102	1,770,373	943,577	2,057,615	1,662,537
Sponsor exposed contingency	613,478	75,259	119,332	274,151	144,736
Sponsor stripped estimate (SCC 10-80)	5,820,624	1,695,114	824,246	1,783,464	1,517,800
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EAC stripped estimate	5,988,736	1,828,407	837,279	1,783,464	1,539,586
Secondary mitigation	0				
YOE PMOC values					
Inflation Adjustment	0	0	0	0	0
Adjustments	492,903	41,711	45,100	256,495	149,597
Adjusted estimate	6,481,639	1,870,118	882,379	2,039,959	1,689,183
Model recommendations					
Forecasted completion at (50%ile)	7,338,486	2,013,689	1,023,777	2,528,474	1,807,332
Base Funded Contingency amount	856,847	143,572	141,398	488,515	118,150
Contingency %	13%	8%	16%	24%	7%
Secondary mitigation target (65%ile)	7,623,104	2,061,379	1,070,745	2,690,744	1,846,578
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Secondary mitigation %	4%	3%	5%	8%	2%
Secondary mitigation provided	0				
Additional Funded Contingency Requirement	284,618				
Recommended total funded budget	7,623,104				
Risk analysis					
Lower bound	6,481,639	1,870,118	882,379	2,039,959	1,689,183
Lower range reporting amount (40%ile)	**7,173,860**	1,986,105	996,611	2,434,616	1,784,632
Base forecast (50%ile)	7,338,486	2,013,689	1,023,777	2,528,474	1,807,332
Secondary mitigation level (65%ile)	7,623,104	2,061,379	1,070,745	2,690,744	1,846,578
Upper range reporting amount (80%ile)	**8,002,441**	2,124,940	1,133,344	2,907,015	1,898,884
Upper bound	10,790,557	2,592,112	1,593,442	4,496,607	2,283,335

Note: All values in $1,000; excludes financing costs.

8.6 Conclusion/Recommendations

During the March 2016 risk workshop, information was provided indicating that HART was aware of additional costs that should be included, which the PMOC added along with its own

independent estimate adjustments. The PMOC has prepared this risk refresh based upon additional information provided by HART after the workshop.

The PMOC found that HART's risk management effort has decreased substantially since the 2014 Risk Refresh. HART previously implemented a sophisticated method of tracking risk identification and mitigation activities that provided for consolidated reporting of the efforts, which showed the rate of progression of risk management. HART's failure to continue this consolidated reporting hampers the ability for risk managers and executive management to determine whether risk is being removed from the project at an adequate rate. In addition, no evidence was provided that the prior Risk and Contingency Management Plan (RCMP) was updated and the provided risk register did not conform to the level of sophistication of risk registers expected for a project of this complexity.

The PMOC separated the project into four distinct risk profiles to better model the effect of risk upon the project. The cost risk assessment recognized general reductions in risk due to advancement of construction and design. Furthermore, concerns that relate to currently experienced issues of management capability and capacity, market conditions, and construction complexities—especially as the project proceeds toward downtown Honolulu—are factored into the risk analysis.

It is recognized that efforts have been made to recover contingency levels through cost reduction measures, value engineering, and revised project delivery strategies. However, these types of changes are becoming increasingly less likely and less effective.

The PMOC basis of the stripped, adjusted estimate for cost risk modeling is as follows:

Table 20. Adjusted Stripped BCE for Model

Project FFGA Budget	**$5,122**
HART internal budget adjustment	$1,705
Less Financing	$393
HART EAC	**$6,434**
HART Reported Available Contingency	$613
Net Stripped Estimate	**$5,821**
HART Forecast Change Orders	$168
PMOC Adjustments	$493
Net Stripped, Adjusted Estimate	**$6,482**

All values in $M.

With the adjustments identified in this report, the current contingency is reduced to a deficit of $48 million when compared against HART's current EAC. This essentially indicates the project must be increased significantly above its current estimate to provide for contingency requirements for the future project completion.

The predicted FTA model outcome at the p50 level is $7.338 billion (excluding $393 million in finance costs). The predicted FTA model outcome at the p65 level is $7.623 billion (excluding $393 million in finance costs). This includes $1.141 billion in recommended funded contingency (17% of the adjusted, stripped estimate). This amount is higher than other projects

at this level of completion due to significant remaining project risks and as evidenced by project experience so far. HART's current EAC falls short of the p65 predicted FTA model outcome by $1.189 billion ($661 million in recommended adjustments plus $528 million in additional recommended contingency). There is an 18.5% difference between HART's project estimate of $6.434 billion and the p65 predicted FTA model outcome of $7.623 billion at p65.

The recommended estimate represents the p65 value from the FTA risk assessment model, when adjusted for the specifics of this project. The historic-trended model indicates 40%-likely to 80%-likely range of $7.174 billion to $8.002 billion.

Secondary mitigation is difficult to cost-effectively obtain at this stage where major portions of the project are already contracted for construction and design is largely complete. However, station design continues and may be a source for secondary mitigation, as may other areas of the project. In the April 2016 risk workshop, discussion indicated that it was extremely unlikely that any Secondary Mitigation scope reductions would be available. Therefore, funded contingency would be required to provide project protection at the Secondary Mitigation level of p65, setting a funded budget recommendation at $7.623 billion.

The table below presents the comparison of costs by SCC for the FFGA budget, current HART EAC, and PMOC p50 and p65 Targets.

Table 21. Cost Comparison by SCC

SCC	SCC Description	2012 FFGA Budget	2012 FFGA Contingency	2012 FFGA Stripped Budget	2016 HART EAC	2016 PMOC p50 Target	2016 PMOC p65 Target
10	Guideway & Track Elements	$1,275,328,962	$161,023,818	$1,114,305,144	$1,525,966,630	$1,724,110,459	$1,724,110,459
20	Stations, Stops, Terminals, Intermodal	$506,165,689	$84,360,947	$421,804,742	$631,093,687	$689,877,924	$689,877,924
30	Support Facilities: Yards, Shops, Admin. Bldgs	$99,425,456	$6,890,443	$92,535,013	$115,477,626	$116,466,248	$116,466,248
40	Sitework & Special Conditions	$1,103,867,264	$123,297,838	$980,569,426	$1,272,832,497	$1,393,561,182	$1,393,561,182
50	Systems	$247,460,781	$26,176,298	$221,284,483	$357,180,319	$412,050,882	$412,050,882
60	Row, Land, Existing Improvements	$222,188,386	$24,790,439	$197,397,947	$208,798,069	$232,494,652	$232,494,652
70	Vehicles	$208,501,186	$21,672,166	$186,829,020	$191,474,521	$223,757,870	$223,757,870
80	Professional Services	$1,183,826,026	$93,387,212	$1,090,438,814	$1,517,800,455	$1,689,182,536	$1,689,182,536
	Allocated Contingency	(Incl.in above SCCs)	$541,599,161	$541,599,161	-	-	-
	Unallocated Contingency	$101,871,170	$101,871,170	$101,871,170	$613,478,238	$856,847,261	$1,141,465,062
	Sub-Total	$4,948,634,920	$643,470,331	$4,948,634,920	$6,434,102,042	$7,338,349,014	$7,622,966,815
	Financing Cost	$173,058,242	-	$173,058,242	$393,058,242	$393,058,242	$393,058,242
	Total Project Cost	$5,121,693,162	$643,470,331	$5,121,693,162	$6,827,160,284	$7,731,407,256	$8,016,025,057

Notes:

The Financing Cost for the 2016 PMOC EAC is based on the 2016 HART EAC. This value would increase as the overall project cost increases.

The SCC 10-80 values for the 2016 PMOC Targets are the Adjusted, Stripped Base Cost Estimates.

Recommendations

(1) HART's estimate falls short of the p65 predicted FTA model outcome by $1.189 billion ($661 million in recommended adjustments plus $528 million in additional recommended contingency when compared against HART's current estimate at completion). HART should review its project estimate and determine how to reduce costs or increase revenues to close this gap.

(2) The recommended amount of budget increase reflects the condition of no viable Secondary Mitigation being presented.

(3) Independent Risk Management must be instituted on the project. The RCMP must be resurrected and updated to ensure continual risk contingency tracking, custody, and reporting. The RCMP should include a re-baselined budget and contingency draw-down curve that reflects the current contingency balance and more accurate drawdown milestones. Diligence and vigilance must be applied to this effort to avoid another rapid contingency usage that could ultimately leave the project unprotected.

(4) Strong controls must be put in place immediately to avoid future rapid contingency reduction. The frequency and the levels of project management to which these statistics are reported should be improved and monitored monthly.

(5) Independent reporting of project cost and contingency levels should be at a management level and should not be subject to politically-driven bias.

(6) The PMOC and HART should engage in a realistic, focused "cost containment workshop" on a monthly basis to monitor the efforts taken to avoid rapid contingency usage. HART must also perform a similar "cost containment workshop" with CE&I and CSC Oversight Consultant to contain costs.

9.0 APPENDICES

Appendix A: List of Acronyms

AGS	Airport Guideway and Stations
AHJV	Ansaldo Honolulu Joint Venture
AIS	Archaeological Inventory Survey
APS	Adjusted Project Schedule
BCE	Base Cost Estimate
BOE	Basis of Estimate
BOS	Basis of Schedule
BRF	Beta Range Factor
CCGS	City Center Guideway and Stations
CCO	Contract Change Orders
CE&I	Construction Engineering & Inspection
CFO	Chief Financial Officer
CPM	Critical Path Method
CPP	Contract Packaging Plan
CPS	Current Project Schedule
CSC	Core Systems Contract
DB	Design-Build
DBB	Design-Bid-Build
DBOM	Design-Build-Operate-Maintain
DTS	Department of Transportation Services
EAC	Estimate at Completion
EUM	Estimate Uncertainty Model
FFGA	Full Funding Grant Agreement
FHSG	Farrington Highway Station Group
FTA	Federal Transit Administration
GEC	General Engineering Consultant
GET	General Excise Tax
HART	Honolulu Authority for Rapid Transportation
HECO	Hawaiian Electric Company
HDOT	Hawaii Department of Transportation
ICE	Independent Cost Estimate
IFB	Invitation to Bid
IRM	Impacted Risk Model
KHG	Kamehameha Highway Guideway
KHSG	Kamehameha Highway Station Group
MCC	Management Capacity and Capability
MPS	Master Project Schedule
MSF	Maintenance & Storage Facility
NTI	National Transit Institute
OCIP	Owner Controlled Insurance Program
OD	Original Duration
OP	Oversight Procedure
PHPG	Pearl Highlands Parking Garage
PMOC	Project Management Oversight Contractor
PMP	Project Management Plan
PMSC	Program Management Support Consultant
PPP	Public Private Partnership
PRA	Primavera Risk Analysis
RCMP	Risk and Contingency Management Plan
RFP	Request for Proposals
ROD	Record of Decision

ROW	▪	Right-of-Way
RSD	▪	Revenue Service Date
SCC	▪	Standard Cost Category
SOA	▪	State Oversight Agency (SOA)
WOFH	▪	West Oahu/Farrington Highway
WOSG	▪	West Oahu Stations Group
WSSG	▪	Westside Stations Group
YOE	▪	Year of Expenditure