Klohn Crippen Berger

BC Hydro

Site C

Worker Accommodation Options Assessment

Final September 2012
Revised July 2013
P05032A04.16

ISO 9001:2008
Certificate No. FS 62747

Klohn Crippen Berger

July 12, 2013

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Siobhan Jackson
Socio-Economic and Heritage Manager
Site C Clean Energy Project

Dear Siobhan:

Site C Clean Energy Project
Worker Accommodation Options Assessment
Final September 2012
Revised July 2013

We are pleased to submit this revised Worker Accommodation Options Assessment for the Site C Project which incorporates the comments received from BC Hydro. This assessment was revised in July 2013 to incorporate changes to the distribution of off-site workers between north and south camps and expand the sensitivity analyses to include a potential 40% in-community scenario. These changes reflect assumptions in the Site C Environmental Impact Statement (January 25, 2013).

We enjoyed working with you on this very interesting assignment and look forward to continuing to work with you as the Project advances.

Please contact me at 604-251-8448 or via e-mail if you have any questions or comments.

Yours truly,
KLOHN CRIPPEN BERGER LTD.

Debra Lamash
Manager, Socio-Environmental Group

SRA/SB:cd

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BC Hydro

Site C

Worker Accommodation Options Assessment

TABLE OF CONTENTS

1 INTRODUCTION 4
1.1 Project Overview 4
1.2 Study Objective and Overview 4
1.3 Study Design 5
1.4 Key Study Considerations and Assumptions 6
1.4.1 Considerations 6
1.4.2 Key Assumptions 6
2 SCOPE 8
2.1 Accommodation Types 8
2.1.1 Camp Accommodation 8
2.1.2 Off-Site Accommodation 8
2.2 Construction Works 9
2.2.1 Workforces Included in this Study 9
2.2.2 Workforces Not Included in this Study 9
3 TASK 1: REVIEW OF EXISTING INFORMATION AND BASE CASE CONFIRMATION 10
3.1 Review of Existing Information 10
3.1.1 Document Review 10
3.1.2 Consultation Input 10
3.1.3 Interviews 11
3.2 Base Case 11
3.2.1 Camp Facilities Included in the Base Case 14
4 TASK 2: CONFIRMATION OF WORKFORCE AND ROOM REQUIREMENTS BY SITE AND SCHEDULE 15
4.1 Construction Camp Requirements Based on End of Shift Rotation Assumptions 15
4.1.1 Construction Camp Requirements if Workers Vacate Their Rooms 15
4.1.2 Construction Camp Requirements if Workers Keep Their Rooms 18
4.2 Total Room Requirements for Camp 21
5 TASK 3: OPTIONS ANALYSIS 24
5.1 Option Identification for Initial Analysis 24
5.1.1 Options Used for Initial Analysis 24
5.1.2 Assumptions for Initial Analysis 26
5.1.3 Variables and Costs Used for Initial Options Analysis 27
5.1.4 Key Findings from Initial Analysis 27
5.1.5 Conclusions: 29
5.2 Preferred Option 29

TABLE OF CONTENTS
(continued)

5.2.1 Sensitivity Analysis Results 30

6 FINAL RECOMMENDATIONS 32

7 CLOSING 33

List of Tables

Table 3.1 Base Case Worker Housing Requirements 12

Table 4.1 Maximum Number of Rooms Required by Camp Location 15

Table 5.1 List of Options Used for Initial Analysis 25

Table 5.2 Assumptions used in initial Options analysis 26

Table 5.3 Camp Operational Periods (shown in green) 26

Table 5.4 Rating Systems for Variables 27

Table 5.5 Initial Options Analysis Key Findings Summary 28

Table 5.6 Operational Period Sensitivity Analysis 30

List of Figures

Figure 3.1 Proposed Camp Locations 13

Figure 4.1 Maximum Number of Rooms Required in the North Camp if Workers Vacate Rooms 16

Figure 4.2 Maximum Number of Rooms Required in the South Camp if Workers Vacate Rooms 17

Figure 4.3 Maximum Number of Rooms in North Camp if Workers Keep Rooms 19

Figure 4.4 Maximum Number of Rooms in South Camp if Workers Keep Rooms 20

Figure 4.5 Maximum Number of Rooms Required (Both Camps Combined) 22

Figure 4.6 Maximum Number of Rooms Required (North and South Camp Maximums) 23

List of Appendices

Appendix I Key Findings from Options Analysis

Abbreviations and Acronyms

%	Percent
BC	British Columbia
BC Hydro	BC Hydro and Power Authority
DBO	Design-Build-Operate
DBM	Design Basis Memorandum
KCB	Klohn Crippen Berger Ltd.
kV	Kilovolt
PY's	Person Years
RV	Recreational Vehicle
Site C	Site C Clean Energy Project
SNC	SNC-Lavalin Inc.

1 INTRODUCTION

1.1 Project Overview

The Site C Clean Energy Project (Site C), a proposed third dam and hydroelectric generating station on the Peace River, would be located approximately seven kilometres (km) southwest of Fort St. John, just downstream of the Moberly River. Site C is currently in the environmental and regulatory review phase (Stage 3), which includes an independent environmental assessment process.

Construction of Site C is estimated to require approximately 7,000 person-years (PYs) of employment during construction (not including early works and decommissioning of temporary construction facilities). The workforce would vary seasonally and annually to match the construction schedule, with lower numbers in the earlier and final years. About 90% of the construction workforce would be required to construct the dam and generating station (i.e., the core facilities). The remainder of the workforce, the "non-core facility workers" would be required for works away from the dam site including the Highway 29 realignments, Hudson's Hope berm construction, general road works, reservoir clearing, construction material transport, transmission line construction, quarries, and other project-related activities.

Due to the size of the construction workforce required, and existing high employment levels in northeast BC, it is anticipated that the regional labour force will not be able to fulfill the Site C construction requirements. As such, the Site C labour force is anticipated to include local and regional workers leaving current jobs (and creating an inflow of new workers), currently unemployed local and regional residents, new residents, and workers travelling from outside the region on a rotation basis. The Housing Assessment baseline and forecast for the Peace River Regional District (Golder/Lions Gate Consulting, 2011a) found that demand for housing in relation to regional supply would create adverse effects if not mitigated. Planning for temporary worker accommodation (i.e., construction camps) to provide housing for potentially all Site C workers, as a conservative approach, is one of the strategies being proposed to mitigate potential adverse effects on accommodation in the region.

1.2 Study Objective and Overview

The objective of this study was to provide a high level analysis of various worker accommodation options for Site C core facility construction workers. The final accommodation plan will be based on more detailed analysis completed as project planning proceeds and on contractor proposals as BC Hydro plans to procure an experienced camp operator to design, construct, operate, and manage the core facility construction camps.

This study documents a "Base Case" and explores potential benefits and costs associated with changing dependent variables such as where workers are housed (e.g. on the north bank or south bank), the proportion of workers housed at each camp, camp operational periods, and camp design (e.g. one camp or two). As specific costing information and analysis is commercially sensitive based on the anticipated procurement for camp services, it is not presented in this report.

This study consisted of the following tasks:

- **Task 1** – Review of Existing Information and Base Case Confirmation
- **Task 2** – Confirmation of Workforce and Room Requirements by Site and Schedule
- **Task 3** – Core Facility Workforce Accommodation Options Analysis

The costs and workforce estimates used in this study are based on preliminary construction plans and assumptions. If the project proceeds, final contractor accommodation plans will be influenced by factors such as project schedule, contract packaging, design, scope, availability of local accommodation, construction methods, and construction sequencing. Annual monitoring of the workforce size, housing requirements and availability, and related needs during construction will also inform required adjustments to the worker accommodation plan.

1.3 Study Design

As stated above, the study is comprised of three key tasks. The sub-tasks associated with each key task are identified below:

- Task 1: Review of Existing Information and Base Case Confirmation
  - Complete a desktop review of existing information pertaining to worker accommodation.
  - Participate in discussions with key project personnel.
  - Summarize results and findings comprising the Base Case.
  - Develop an information presentation format and key parameters to be used as the basis for comparing the Base Case to alternate scenarios.
  - Review public, First Nations, and agency input.
- Task 2: Confirmation of Workforce and Room Requirements by Site and Schedule
  - Develop a workforce versus construction schedule time graph to identify worker requirements by site (i.e., north side of the Peace River or south side of the Peace River).
- Task 3: Core Facility Workforce Accommodation Options Analysis
  - Complete an options analysis for worker accommodation specifically defining the size and location of core facility worker accommodation based on the anticipated construction schedule and taking into consideration existing information related to:
    - infrastructure (e.g., water, sewer, waste management, power) required for the camps in addition to those required for construction;
    - construction activities and layout (e.g., contractor areas, parking); and
    - policies that may affect worker accommodation, including physical camp set up, off-shift rotation support (e.g., travel, storage, room retention).

Although not all of the information required to complete Task 3 in a comprehensive manner was available, sufficient information was available to identify options and relative costs and, thereby, achieve the objective of the study.

1.4 Key Study Considerations and Assumptions

1.4.1 Considerations

Planning for construction workforce accommodation requires consideration of several factors including:

- Reducing worker and public safety hazards.
- Planning for flexibility in accommodation capacity (i.e., being able to expand and contract the number of units to match the actual number of workers on-site) to mitigate against accommodation related impacts to construction productivity and cost.
- Identifying means through which to accurately forecast worker numbers to enable camp operators to provide the accommodation required and, thereby, avoid schedule delays.
- Identifying means through which services such as first aid, emergency services, medical support, water, sewer, power, fire protection and security services can be provided on-site.
- Enhancing benefits to the local community while reducing potential adverse effects.
- Attracting and retaining workers by providing a high quality of life and well being through the delivery of health, recreation and leisure facilities.
- Incorporating input gathered to date from interested parties.

1.4.2 Key Assumptions

Key study assumptions are as follows:

- Base infrastructure would be built to accommodate the peak construction workforce.
- Beds would be added on an “as-needed” basis to match actual demand.
- Workers will vacate their room when they leave site for their off-shift time.
- Shift rotation will consist of five weeks on and one week off (each week will consist of six 10-hour days of work during a seven day period).
- Workers will not be paid a live out allowance.
- A daily travel allowance will be paid to workers travelling to site daily with the amount to be determined by the camp contractors. An average allowance was used in this study.

The approach proposed by BC Hydro, and reflected in the assumptions, is not intended to limit opportunities for local residents to work on the project, or preclude the possibility that some workers may choose to move to, and live in, Fort St. John or other regional communities. However, given the

risk of construction delays if sufficient accommodation is not available and, in turn, the risk to the overall project schedule, a conservative approach for accommodation infrastructure was taken. Despite the conservative approach proposed, one Option which involved reduced on-site infrastructure was assessed to provide an indication of the financial considerations associated with this assumption.

2 SCOPE

As stated in Section 1, this study is concerned solely with housing for Site C's core facility workers. Worker accommodation options for non-core facility workers, as well as potential community housing enhancement initiatives being considered by BC Hydro, will be documented elsewhere.

Investigating off-site options (e.g., accommodation in Fort St. John, RV camps, etc) was used as a tool to explore, at a high level, some of the major economic and social costs if a portion of the core workforce was housed off-site. However, this study does not include an assessment of housing market effects or other impacts on workers or the local community.

2.1 Accommodation Types

The accommodation types included in this study were:

- dam and generating station (i.e., core facility) worksite accommodation (camp accommodation); and,
- off-site accommodation (e.g., in-community, existing RV parks, etc).

The following housing types were not included in this study:

- temporary accommodations for early construction works;
- non-core facility housing;
- regional worksite accommodation; and
- new, BC Hydro procured, RV parks.

2.1.1 Camp Accommodation

It is proposed that core facility workers would be housed in worker camps at the dam and generating station site. Camp accommodation would mainly consist of pre-fabricated units including kitchens, dining halls, recreation facilities, sleeping dormitories, and other facilities (e.g. bathrooms, showers etc.). In addition to the camp facilities, parking, offices, and transportation stops for shuttles to transport workers to and from site would be located on-site.

2.1.2 Off-Site Accommodation

Due to the uncertainty associated with off-site accommodation, only two variants of one Option involving off-site accommodation are considered in the analysis. Off-site accommodation includes in-town housing, RV parks or other accommodation that workers may find. This alternative is included as a high level means to investigate potential social and economic costs associated with housing a portion of the workforce off-site.

2.2 Construction Works

2.2.1 Workforces Included in this Study

Workforces associated with the following works will require accommodation at the core facility construction site:

- site access
- diversion works
- earthfill dam and earthworks
- RCC buttress and right bank structures
- hydromechanical equipment
- turbine generator and associated high voltage and equipment
- balance of plant
- miscellaneous project buildings
- switchyard works
- switchyard electrical equipment
- reception centre
- worker accommodation
- catering personnel in camp
- site services and site restoration
- BC Hydro and owner engineer personnel

2.2.2 Workforces Not Included in this Study

The workforces associated with the following activities are not included in the core facility workforcenumbers:

- Works prior to camps being operational including:
  - access road works
  - dam and related works
  - worker accommodation
  - construction power related works
  - miscellaneous project buildings and structure works
  - site services works
  - BC Hydro and owner engineering personnel
  - diversion works
- Decommissioning of temporary construction facilities and site restoration
- Highway 29 relocation
- Reservoir clearing
- Peace Canyon 500 kV GIS extension
- 500 kV transmission line

3 TASK 1: REVIEW OF EXISTING INFORMATION AND BASE CASE CONFIRMATION

3.1 Review of Existing Information

In completing this study, available project-related documents and public consultation results were reviewed and key project-related personnel interviewed as described below.

3.1.1 Document Review

A variety of available information related to Site C was reviewed including:

- reports and planning documents related to worker accommodation and associated infrastructure; and
- drafts of studies being undertaken specifically for the environmental assessment.

As stated earlier, given that some of the information and analysis in the existing reports and draft studies is commercially sensitive based on the anticipated camp procurement process, the studies are not identified and the commercially sensitive information is not explicitly presented in this report.

3.1.2 Consultation Input

The following input received from public and stakeholder consultation and materials (i.e., BC Hydro Public Consultation Material from April 2012), regional and local government liaison, and discussions with First Nations was considered in the options analysis.

3.1.2.1 Public and Stakeholder Consultation

During public and stakeholder consultation in 2008, participants were asked about the importance of five factors regarding housing out-of-town workers. Of those factors, participants considered the following to be of high importance:

- minimizing impact on local housing costs;
- minimizing the need for additional services (e.g., health care, schools, recreation facilities and policing); and
- creating opportunities for out-of-town workers to bring their families to the region.

3.1.2.2 Regional and Local Government Liaison

Discussions with local and regional governments (e.g., District of Hudson's Hope, City of Fort St. John, Chetwynd, Taylor, and Peace River Regional District) from 2010 to 2012 identified a number of considerations regarding workforce accommodation including:

- minimizing distortion and disruption of the local housing market;
- hiring local businesses and employees;
- encouraging local residency for workers not from the area;

- supporting and showcasing sustainable housing styles and design, and leaving a positive housing legacy;
- learning from other communities that have experienced “boom and bust” cycles;
- considering transportation and commuting aspects of the workforce; and
- considering occupying previously used sites for short-term regional camp locations.

3.1.2.3 First Nations

Preliminary worker accommodation plans have been presented to First Nations in the region as information updates and requests for feedback. The following key comments have been received:

- interest in BC Hydro’s procurement process and joint venture requirements for camps;
- interest in business opportunities and employment opportunities for members within worker accommodation facilities; and
- questions on the regional (non-core) temporary work accommodation sites in relation to lands and exercise of treaty rights.

3.1.3 Interviews

The study team met with BC Hydro representatives involved in worker accommodation planning to discuss the means through which the Base Case was developed and to understand the considerations informing the decisions regarding worker accommodation.

3.2 Base Case

The Base Case was the starting point for analysis in this study. Although the actual camp configuration will be designed by the eventual camp contractor, the current concept for the Base Case is that two temporary camps would be constructed within the core facility construction site with one being located on the north side of the Peace River (north camp) and the other on the south side of the river (south camp) (Figure 3.1) (Appendix I). The north camp would be situated on BC Hydro-owned land, while the south camp would be situated on Crown land.

The key considerations in defining the Base Case were:

- to situate workers as close as possible to their work site to:
  - enhance worker safety and productivity; and
  - minimize the costs and logistical issues of transporting workers through an active construction site.
- to be able to house all workers requiring accommodation at the core facility site to avoid potential impacts to productivity should off-site housing not be available.

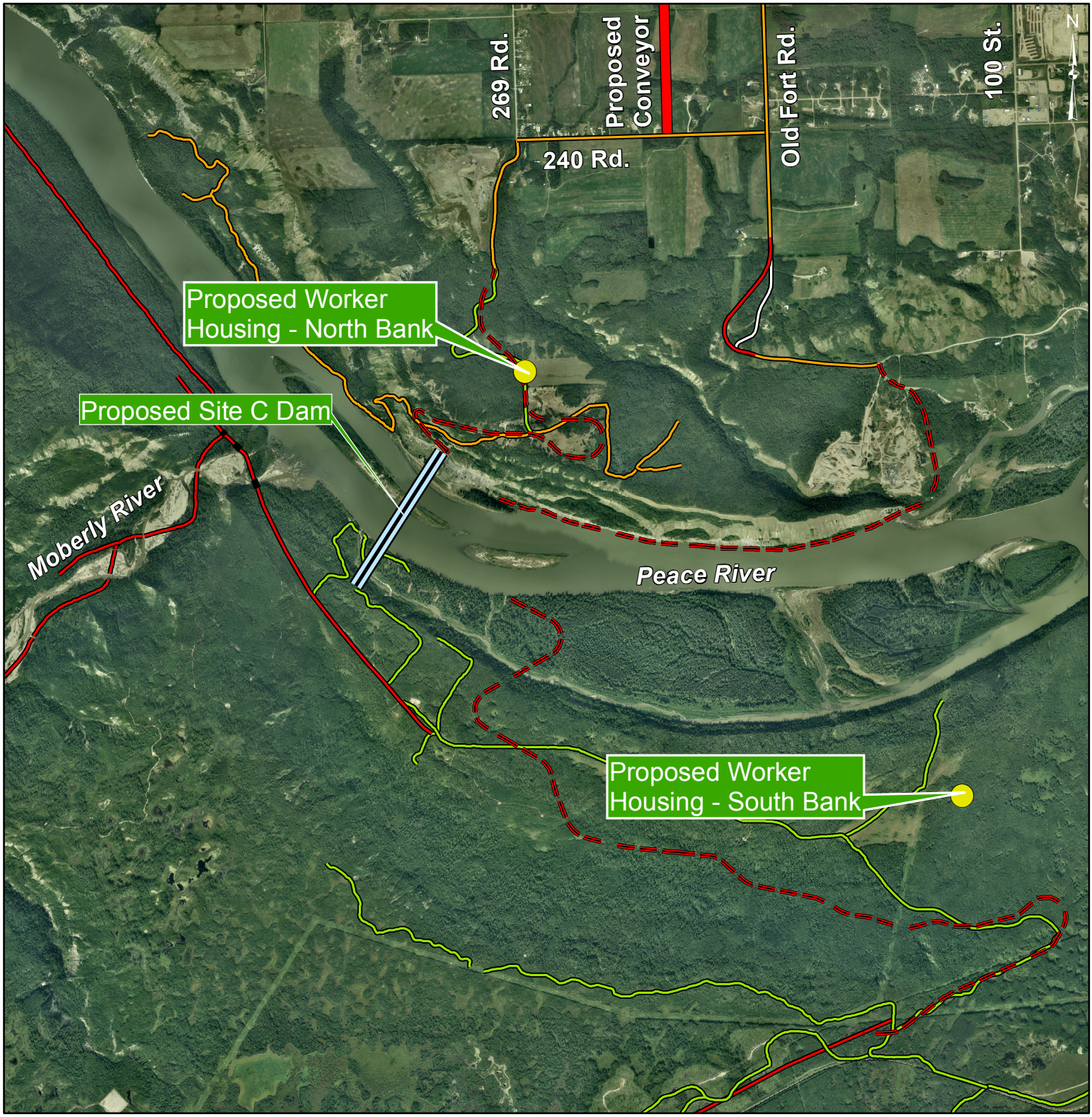
The Base Case, as summarized in Table 3.1, assumes that the north camp and the south camp would be operational in June 2015 and August 2015 respectively with the north camp operating through to the end of construction and the south camp closing approximately six months earlier. Accommodation units would be added to both camps based on demand forecast by the construction contractors. It is important to note that the worker numbers identified above (i.e., 1700 total) do not reflect the total workforce requirements, only the requirements for camp rooms at peak construction.

Table 3.1 Base Case Worker Housing Requirements

Location	Staff Group	Base Infrastructure Capacity	Operational Period[1]
North Camp	BC Hydro staff and construction workers[2]	500	June 2015 to Spring 2022
South Camp	Construction workers[3]	1200	August 2015 to December 2021

It is possible that the base infrastructure could accommodate approximately 10% more workers and that even more could be accommodated, if needed, by staggering meal times, etc., provided that the accommodation units could be placed on site.

[2] The north camp would house the north bank construction workforce including north bank construction access roads, the north bank excavation, the diversion works, initial dam construction works and the commissioning of the turbines and generators, as well as BC Hydro and engineering staff.
[3] The south camp would house the south bank construction workforce including south bank construction access roads, the south bank excavation, dam and cofferdam construction works, RCC buttress, concrete structures, approach and tailrace channels, mechanical and electrical works.

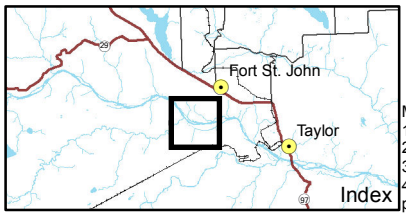


Legend

- Proposed Worker Housing

Project Transportation Routes
- Existing Access
- Existing Access — To Be Upgraded
- Proposed New Access
- Dam Site Roads
- Road To Be Decommissioned
- Temporary Clearing Bridge

Transportation
- Road
- Highway
- Railway



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Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Orthophotos created from 1:15,000 photos taken Aug.25th 2011.

SITE C CLEAN ENERGY PROJECT

BC hydro

Proposed Worker Housing Locations

DATE	March 11, 2013	DWG	1016-C14-A6346	R 0

Path: X:\ArcGISProjects\Environment\Socio_Econ\WorkerA\com\DamSite\Housing_1016_C14_A6346.mxd

© BC Hydro 2013 - all rights reserved. This map is for information purposes only and accuracy is not guaranteed.

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification

3.2.1 Camp Facilities Included in the Base Case

Definition of the Base Case for this analysis included consideration of the following:

- camp power supply and distribution (excluding power lines)
- infrastructure and civil
- engineering, fabrication, transportation, installation of camp buildings including:
  - dormitory
  - washing and laundry
  - kitchen and dining
  - recreation and leisure
  - commissary
  - other service buildings
- water supply and treatment
- sewage treatment
- security
- catering services
- camp maintenance

As with any plan completed early in project development, information for items such as sewage, water, infrastructure, etc. were based on similar projects and third party contractor estimates and, as such, will be updated by the selected contractor as planning proceeds and the specific service requirements are defined.

4 TASK 2: CONFIRMATION OF WORKFORCE AND ROOM REQUIREMENTS BY SITE AND SCHEDULE

The purpose of Task 2 was to estimate where workers would be required to work (i.e. on the north bank or on the south bank). This task also involved a time component as it was necessary to estimate which month each worker would be required at their respective worksite. Data from the preliminary cost estimates and manpower schedules were used by the Site C integrated engineering team to determine requirements by site and schedule and the findings were provided to the worker accommodation study team. Labour curves were developed to illustrate the monthly distribution of the workforce by worksite over the construction and decommissioning period.

All figures in this section were created based on the earlier stated assumption that all workers will work a five week on, one week off rotation and that during the work week, workers will work six 10-hours days and have one day off.

Another key consideration in determining camp size was whether workers would keep their rooms while on leave and the findings of this analysis are presented in Section 4.1.

4.1 Construction Camp Requirements Based on End of Shift Rotation Assumptions

Two scenarios were investigated to compare the number of rooms that would be required:

1. Workers vacating their rooms at the end of their shift rotation; and
2. Workers keeping their rooms while away from site.

Table 4.1 summarizes the findings of this analysis, which is illustrated and discussed in more detail in Section 4.1.1 and Section 4.1.2

Table 4.1 Maximum Number of Rooms Required by Camp Location

Description	North Camp	South Camp	Total
Workers vacate room	492	1220	1712
Workers keep room	591	1464	2055

4.1.1 Construction Camp Requirements if Workers Vacate Their Rooms

Figure 4.1 and Figure 4.2 show the maximum number of rooms required during any given month in the north camp and south camp if workers vacate their rooms when they are on leave (i.e., peak month requirement of 492 rooms in the north camp and 1220 rooms in the south camp). Under this scenario rooms are only provided for workers who are currently working on site and not the entire workforce and, as the rooms vacated would be taken up by incoming workers, the number of rooms vacant at any given time would be minimized.

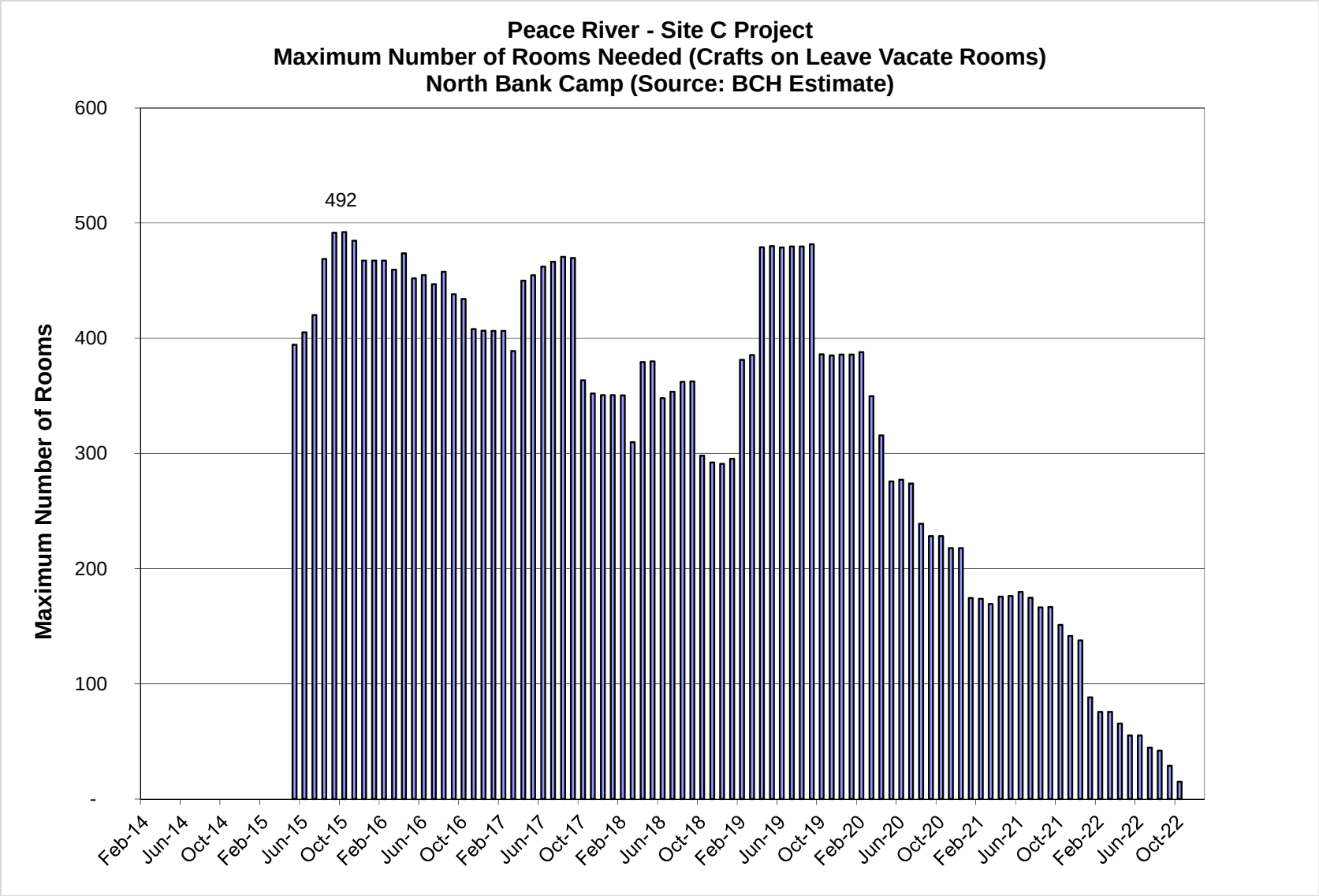

Figure 4.1 Maximum Number of Rooms Required in the North Camp if Workers Vacate Rooms

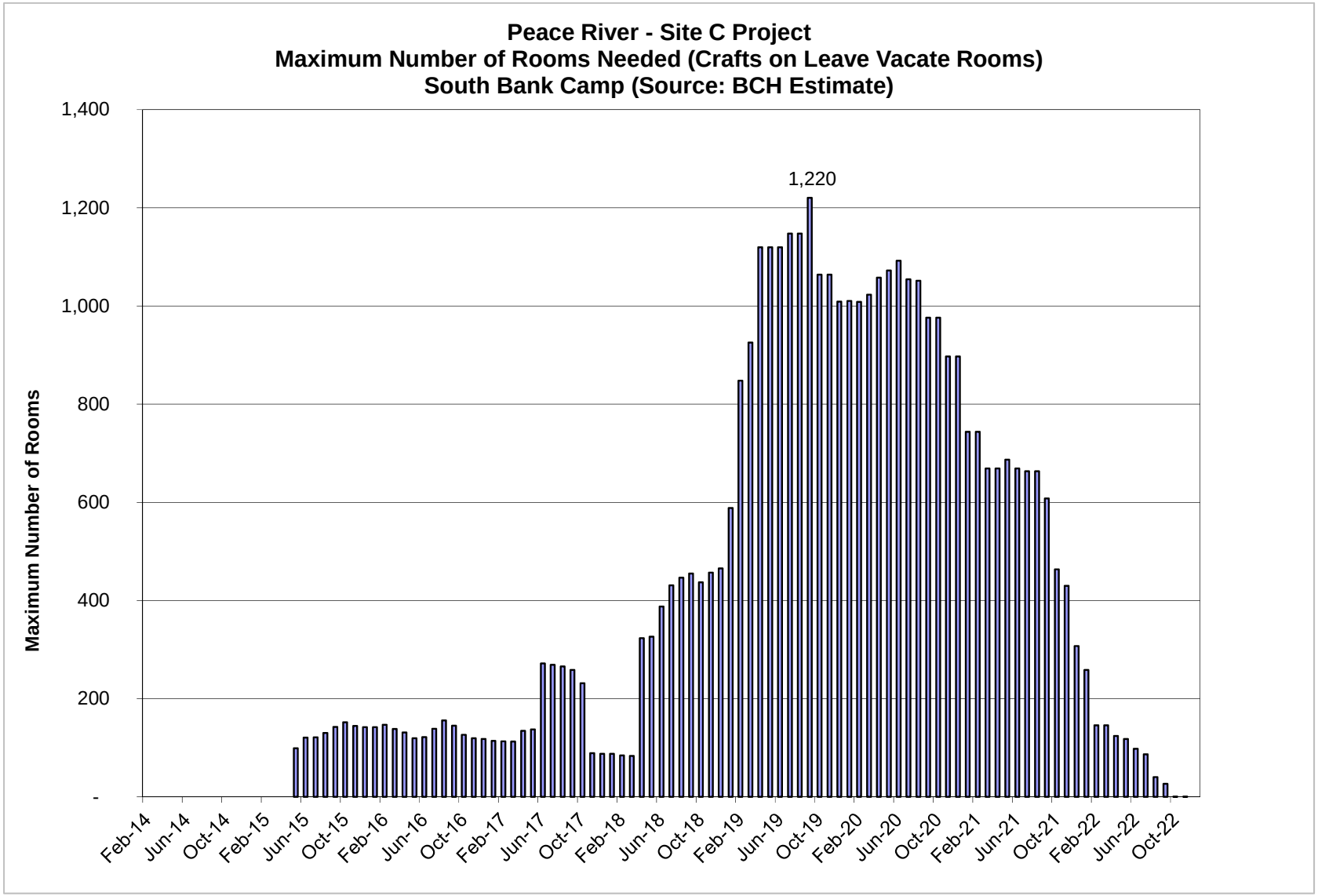

Figure 4.2 Maximum Number of Rooms Required in the South Camp if Workers Vacate Rooms

4.1.2 Construction Camp Requirements if Workers Keep Their Rooms

Figure 4.3 and Figure 4.4 show the maximum number of rooms that would be required in any given month in each of the north camp and south camp if workers were to keep their room when on leave. As is evident, approximately 17% more rooms would be required (i.e., peak month requirement of 590 rooms in the north camp and 1464 rooms in the south camp) and these rooms would be vacant at all times. In view of this, it does not make logistical or financial sense for workers to keep their rooms when they are on leave.

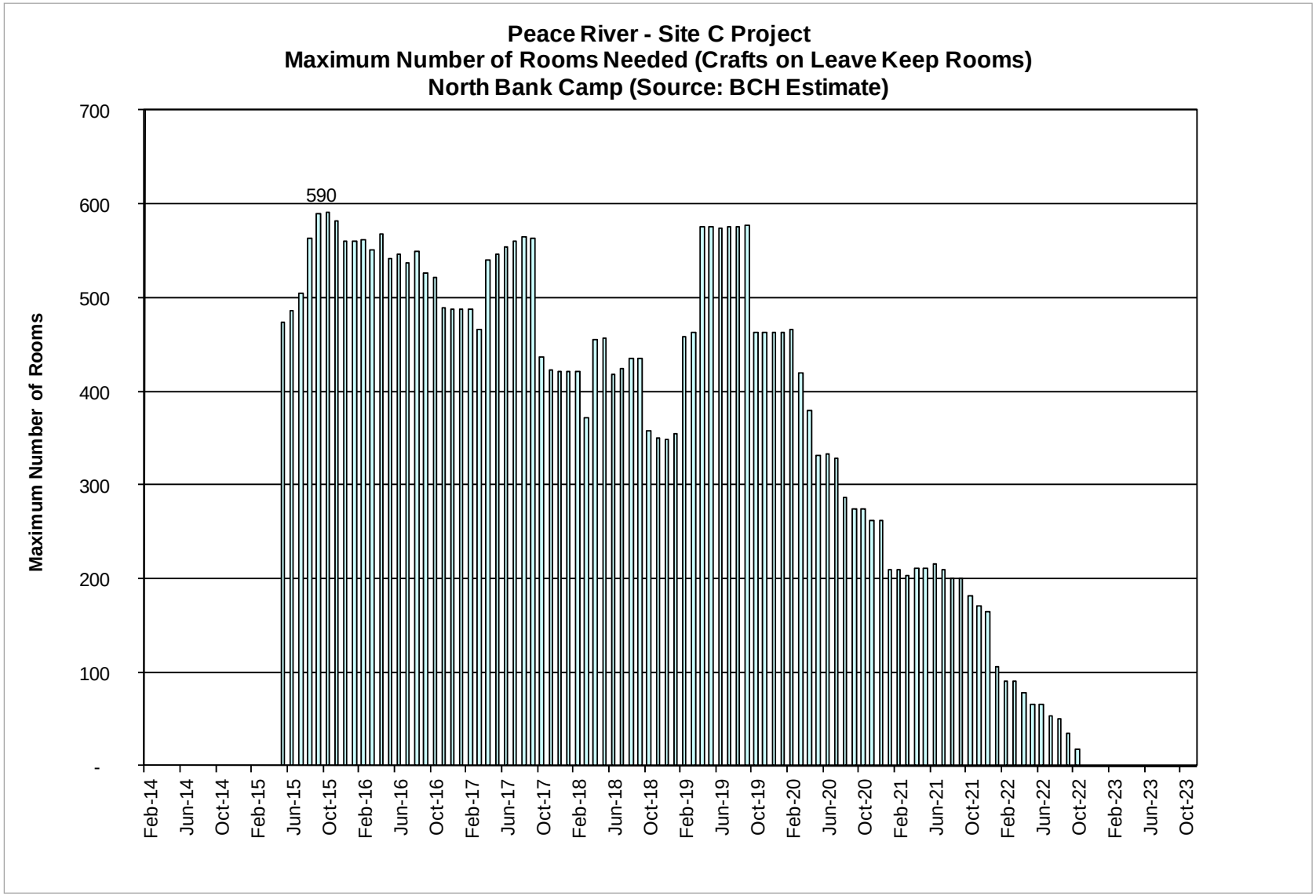

Figure 4.3 Maximum Number of Rooms in North Camp if Workers Keep Rooms

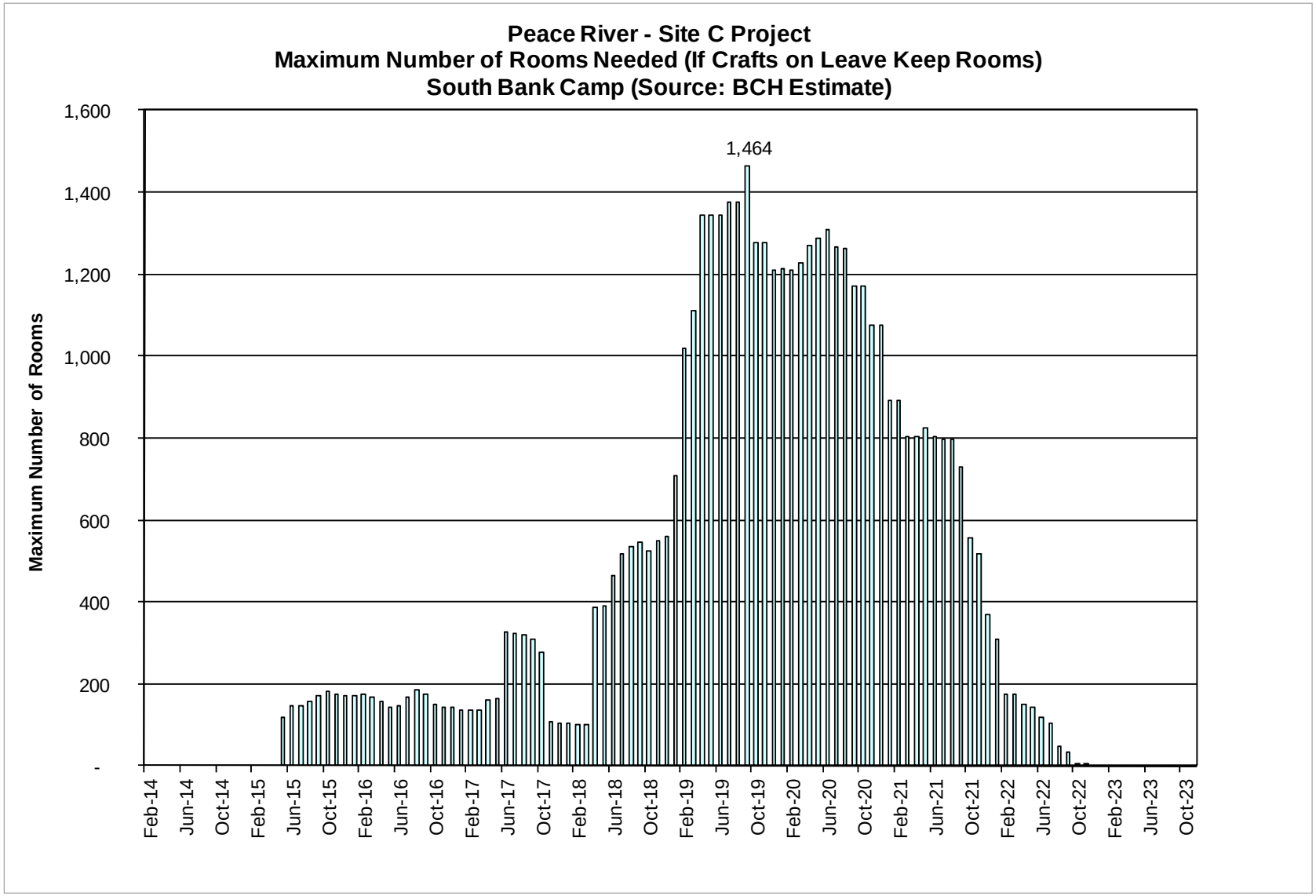

Figure 4.4 Maximum Number of Rooms in South Camp if Workers Keep Rooms

4.2 Total Room Requirements for Camp

Based on the analysis described in Section 4.1, it was determined that it was preferable to have workers vacate their rooms at the end of their shift rotation as this would minimize the number of vacant rooms at any given time. Manpower curves were developed for both camps together to better illustrate the estimated camp room requirements for each of the north camp and south camp under this scenario. Figure 4.5 shows the total number for both camps combined while Figure 4.6 shows each camp separately so that total maximum numbers for each camp can be differentiated.

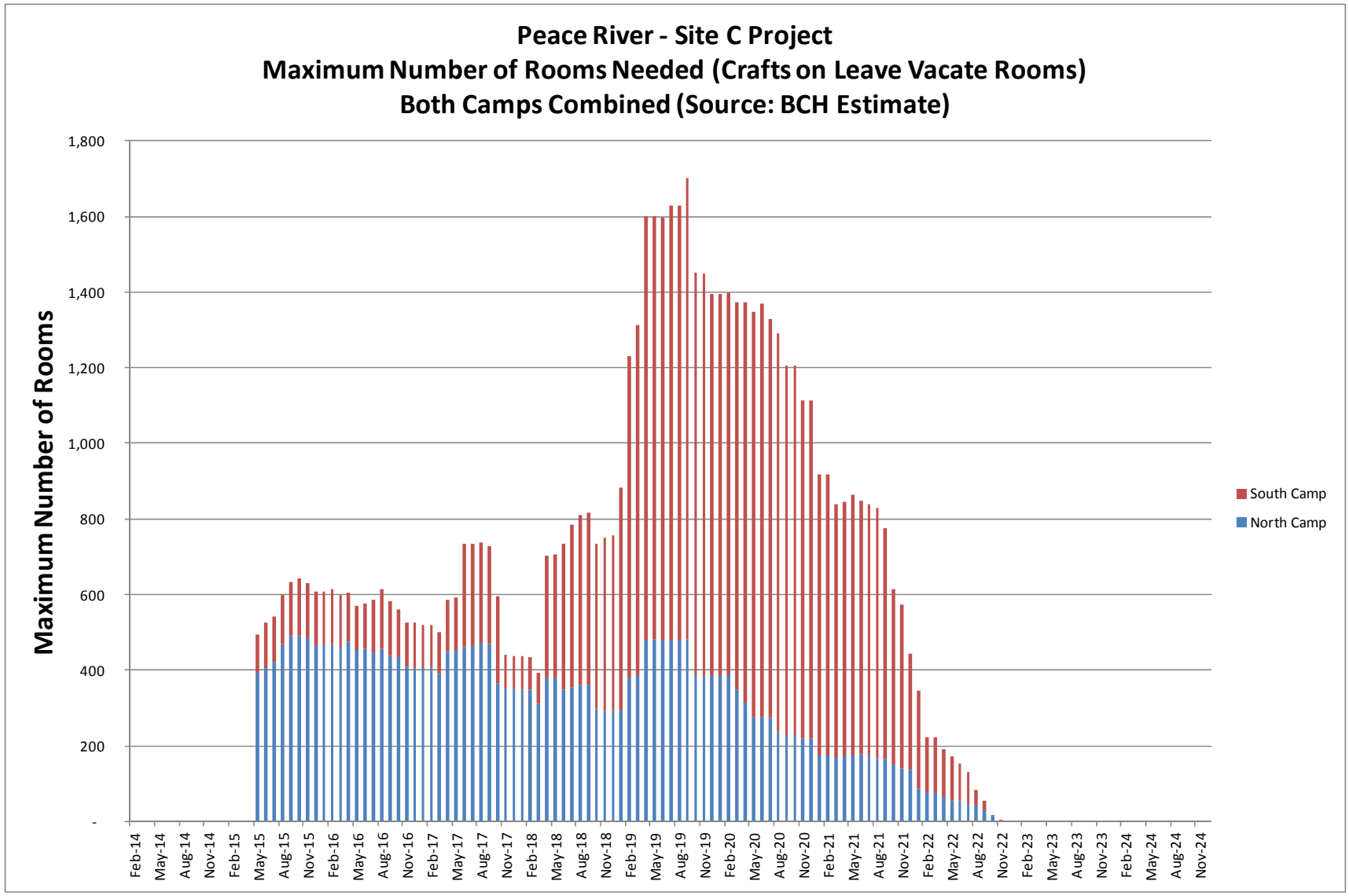

Figure 4.5 Maximum Number of Rooms Required (Both Camps Combined)

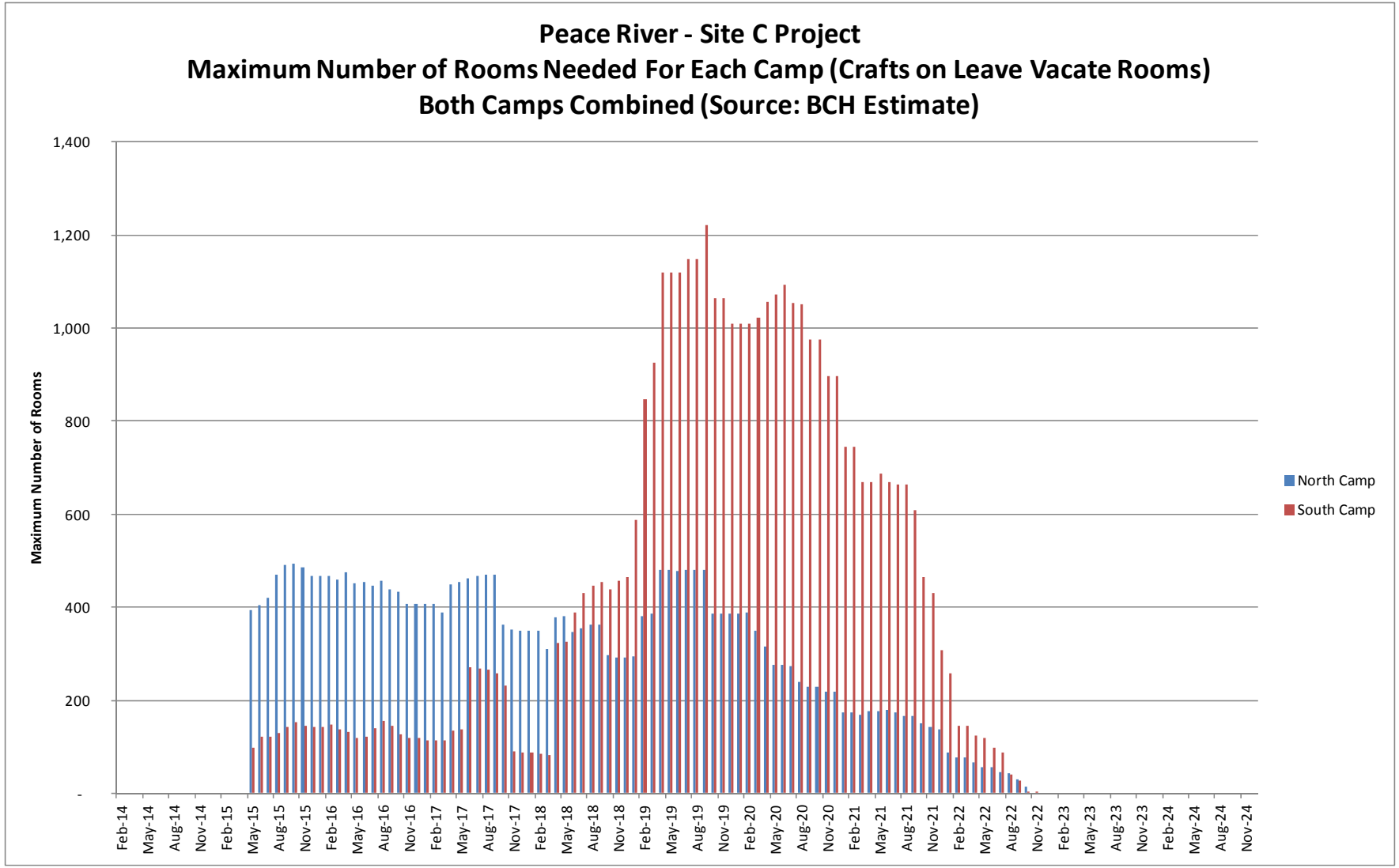

Figure 4.6 Maximum Number of Rooms Required (North and South Camp Maximums)

5 TASK 3: OPTIONS ANALYSIS

The options analysis for worker accommodation was based on information available from reports and documents, consultation, and interview as described in Section 3.1. The analysis involved the following key steps:

1. Option Identification
2. Option Analysis
3. Option Refinement
4. Analysis of Final Options

5.1 Option Identification for Initial Analysis

This section identifies the Options selected for initial analysis (Section 5.1.1), discusses the assumptions and variables considered in assessing the Options (Section 5.1.3 and Section 5.1.3), and presents the findings (Section 5.1.4) and conclusions (Section 5.1.5) of the analysis.

5.1.1 Options Used for Initial Analysis

Nine Options were selected for initial analysis. Table 5.1 provides an overview of each Option, its key features, and the reason it was selected.

It is important to note that, in this analysis, the peak workforce for each month was used to calculate the potential maximum number of beds required and the analysis is based on potential effects at peak requirements during construction to assess the worst-case scenario. This does not mean that the maximum numbers of beds will be required for all months or years; however, base infrastructure will be built to accommodate the maximum number of workers in the peak year. In actuality, BC Hydro plans to use an adaptive approach wherein contractors will provide an update on the anticipated number of workers required to BC Hydro on an agreed to schedule to enable camps to be sized according to actual needs.

It was recognized at the outset that some of the Options identified were not necessarily viable but they were investigated to ensure that all potential Options were examined and to confirm whether certain elements of the Option may be viable even if the entire Option itself was not viable. In the following sections, all Options are compared to the Base Case.

Table 5.1 List of Options Used for Initial Analysis

Type	Option		Key Features	Reason for Inclusion
Base Case	A	Two Camp Base Design	• North Camp: 500 beds[4] • South Camp: 1200 beds	Study Base Case and the basis against which the other Options are compared.
Single Camp	B	One South Bank Camp	• South Camp: 1700 beds	To assess a one-camp Option with the camp being located on the south side of the river.
	C	One North Bank Camp	• North Camp: 1700 beds	To assess a one-camp Option with the camp being located on the north side of the river. This Option was considered at the request of the City of Fort St. John
Varying Operational Periods Based on Construction Schedule	D	Two Camp Design with Early North Bank Camp Closure	• North Camp: 500 beds, operates until 2020 • South Camp: 1200 beds	To determine the effect of shutting down the north camp earlier and bussing north bank workers from the south side to the north side.
	E	Two Camp Design Optimized for Schedule	• North Camp: 750 beds, operates from 2015 to 2020 • South Camp: 1200 beds, operates 2018 to 2022	To mirror the worker locations based on the schedule (peaks and troughs) as shown in Figure 4.3 and Figure 4.4 and to house workers in the closest possible camp to their worksite.
	F	Two Equivalent-Sized Camps, with South Bank Camp During Three Peak Years	• North Camp: 850 beds, operates 2015 to 2022 • South Camp: 850 beds, operates during 3 peak years (2019 to 2021)	To determine if it would be feasible to increase the size of the north camp (as per the request of Fort St. John) so that, for the majority of the Project life, workers are situated as close as possible to Fort St John. During peak years (2017 to 2019) the south camp would be operated to reduce logistical issues, productivity losses, and safety concerns associated with bussing a large number of workers across an active construction site.
	G	Two Camp Design with South Bank Camp During Four Peak Years	• North Camp: 750 beds, operates 2015 to 2022 • South Camp: 1200 beds, operates during 4 peak years (2018 to 2021)	To determine what would happen if more workers are housed closer to Fort St John. During peak years all workers would be housed on their respective side. This is similar to Option F except, far fewer workers would be required to be bussed across the active construction site.
Investigation of Off-site Accommodation[5]	H	Two Camp Design with 15% of Workers Living Off-Site	• South Camp: 1200 beds • North Camp: 250 beds • 15% of workers live off-site	To determine if it would be feasible to have a portion of workers living off site (e.g. Fort St John, RV parks etc.) to enhance local economic effects, encourage relocation to Fort St. John, and to provide opportunities for workers to bring their families to the region. Because the assumption for all Options was that all workers would vacate their rooms during the off-shift, a larger number of rooms would have to be rented off site to house the workers (Section 4.1.1). Workers housed off-site would not be able to vacate their rooms on the off-shift.
	I	Two Camp Design with 15% of Workers Living Off-Site with Reduced Infrastructure	• South Camp: 1037 beds • North Camp: 418 beds • 15% of workers live off-site	To determine the magnitude of the economic benefits associated with reducing the infrastructure in Option H based on the actual projected capacity.

[4] The term "beds" refers to the number of accommodation units required at the anticipated maximum capacity. It is important to note that in actuality dormitories will be added and removed according to worker schedules.
[5] Based on a review the number of supervisory versus craft positions and local industry experience, BC Hydro estimated that 15% of total workers would prefer to live off-site.

5.1.2 Assumptions for Initial Analysis

Table 5.2 presents the assumptions for each Option and Table 5.3 presents the operational period for each camp by Option.

Table 5.2 Assumptions used in initial Options analysis

Assumption	Option								
	A	B	C	D	E	F	G	H	I
There are 313 work days per year based on current shift rotation.	X	X	X	X	X	X	X	X	X
Workers on leave will not keep their rooms.	X	X	X	X	X	X	X	X	X
Travel between north bank and south bank takes 15 minutes each way.		X	X	X	X	X	X		
Bussing cost is $150/hr for driving time and $50/hr for waiting time.	X	X	X	X	X	X	X	X	X
One bus seats 50 workers.	X	X	X	X	X	X	X	X	X
Workers will be paid overtime for travel beginning at the North Bank muster point.	X	X	X	X	X	X	X	X	X
15% of workers live off-site[6].								X	X
Travel Allowance of $20 per day[7] is only paid on work days.								X	X
Base camp infrastructure is required for the maximum number of workers to mitigate against potential off-site housing shortages.	X	X	X	X	X	X	X	X	

Table 5.3 Camp Operational Periods (shown in green)

Option	Camp	Year[8]							
		2015	2016	2017	2018	2019	2020	2021	2022
A	North								
	South								
B	North								
	South								
C	North								
	South								
D	North								
	South								
E	North								
	South								
F	North								
	South								
G	North								
	South								
H	North								
	South								
I	North								
	South								

[6] Based on a review the number of supervisory versus craft positions and local industry experience, BC Hydro estimated that 15% of total workers would prefer to live off-site.
[7] In actuality this figure may vary; however, the assumption used in this study is that the majority of commuters would come from Fort St. John and would be paid $20 to travel to site.
[8] Operational periods are shortened in 2015 and 2022 due to the projected camp operational dates (Table 3.1).

5.1.3 Variables and Costs Used for Initial Options Analysis

Available information related to the following variables was used to compare the Options:

- Preliminary cost:
  - catering and housekeeping
  - site preparation
  - building and installation
  - utilities
  - maintenance and operations
  - live out allowance costs
- Bussing cost
- Effect on productivity
- Safety
- Likelihood of spending time in Fort St. John

Worker preferences and the regional housing situation were also considered but not quantified. Each variable was compared to the Base Case based on the rating systems outlined in Table 5.4.

Table 5.4 Rating Systems for Variables

Costs	Bussing Cost	Safety	Likelihood of Spending Time in Town	Productivity Loss
Equal or less than the Base Case	Equal to the Base Case	No workers bussed through the active construction site	> 400 workers living and working at north camp or >15% of workers live off-site	No workers bussed through the active construction site
<10% more expensive than the Base Case	$1 to $15,000,000	1 to 300 workers bussed through the active construction site	> 400 workers living at north camp most years; no workers living at north camp some years	1 to 300 workers bussed through the active construction site
>10% more expensive than the Base Case	>$15,000,000	> 300 workers bussed through the active construction site	No workers living at north camp	> 300 workers bussed through the active construction site

5.1.4 Key Findings from Initial Analysis

Table 5.5 summarizes the key findings of the initial options analysis. Based on available information, there was approximately a $51 million difference between the least expensive and most expensive Option with catering and housekeeping; bussing; and equipment, installation and transportation having, by far, the highest associated costs.

The Options are ranked from 1 to 9 in Table 5.1 and coloured green (most preferable) to red (least preferable) based on each of the variables listed. It is important to note that potential effects on productivity and safety were not quantified but, if they were, they would make those Options ranked lowest for these variables (i.e., Option B, Option C and Option G) even less attractive relative to the other Options.

Table 5.5 Initial Options Analysis Key Findings Summary

Variables	A- Two Camp Base Design	B- One South Bank Camp	C- One North Bank Camp	D- Two Camp Design with Early North Bank Camp Closure	E- Two Camp Design Optimized for Schedule	F- Two Equivalent-Sized Camps, with South Bank Camp During 3 Peak Years	G- Two Camp Design with South Bank Camp During 4 Peak Years	H- Two Camp Design with 15% of Workers Living Off-Site	I- Two Camp Design with 15% of Workers Living Off-Site with Reduced Infrastructure
Bussing (labour only)	1	8	9	2	6	7	5	3	3
Bussing cost	1	8	9	2	6	7	5	3	3
Catering/ Housekeeping	9	1	1	8	5	6	7	3	3
Site Preparation	4	9	1	4	7	3	7	4	2
Equipment, Installation and Transportation	6	3	3	6	8	5	9	1	1
Utilities (water, sewage and power infrastructure)	4	1	3	4	8	7	8	4	2
Maintenance and Operations (building maintenance, power, waste management and fuel)	6	7	4	3	8	5	8	1	1
Travel Allowance	1	1	1	1	1	1	1	8	8
Productivity Loss	2	8	9	1	5	7	5	3	3
Safety	2	8	9	1	5	7	5	3	3
Likelihood of spending time in Fort St. John	1	9	1	7	8	1	1	1	1
TOTAL	**4**	**7**	**9**	**3**	**5**	**6**	**8**	**2**	**1**

5.1.5 Conclusions:

As stated earlier, many cost and qualitative factors were considered in the Options analysis including:

- Bussing requirements which affects cost, safety, and productivity;
- Infrastructure requirements and operation periods;
- Worker preferences;
- Regional housing situation; and
- Likelihood of workers spending time in Fort St. John.

After considering these factors, Option H was identified as the preferred Option because of its ability to respond to worker schedules, accommodate worker preferences, reduce productivity loss and safety hazards and allow workers to access the community. The main reasons for not selecting each of the remaining Options are as follows:

- Option A, although economical, does not optimize economies of scale throughout each year (e.g., when less than 100 workers are situated on the north side it may make sense to have those 100 workers on the south camp to save costs overall).
- Option B, Option C, and Option F involve substantial amounts of bussing and were not carried through to further analysis because bussing workers across an active construction site could result in increased risks to productivity and safety.
- Option D was discarded because BC Hydro is planning to build permanent office, parking and site access facilities on the north side, therefore this Option is not viable.
- Option G and Option E were discarded because additional infrastructure would be required at the north camp to accommodate the workers from the south worksite when the south camp is not operational. This means that the north camp would be overbuilt.
- Option I was discarded because the reduction in infrastructure costs would not outweigh the production schedule risks in case of a housing shortage in the region.

A more detailed description of each of Option is provided in Appendix I.

5.2 Preferred Option

Once Option H was selected as the preferred Option, sensitivity analysis was undertaken to assess the effects of:

- Varying the percentages of workers who live off-site (i.e., 15%, 20%, 25%, 30% and 40% of the workforce being housed off-site ; and
- Varying the operational periods of the camp as shown below:
  - North Camp:

- Year 1 to Year 8
- Year 1 to Year 7
- Year 1 to Year 6
  - The north camp must be operational in Year 1 because of the large numbers of workers on that side in the early years of the project.

- South Camp:
  - Year 1 to Year 8
  - Year 1to Year 7
  - Year 4 to Year 8
  - Year 4 to Year 7
  - Year 3 to Year 8
  - Year 3 to Year 7

5.2.1 Sensitivity Analysis Results

Overall, the results of the sensitivity analysis showed that cost-wise, there is very little difference between varying percentages and operational periods based on the information currently available. However, there are some minor differences that are discussed below.

5.2.1.1 Varying the Percentage of Workers off-site

The analysis demonstrated that the greater the percentage of the workforce housed off-site, the less expensive the overall cost of the Option was. This is due to the fact that payments to off-site workers (i.e., travel costs) are less than the daily cost of providing a camp space for each worker. The analysis found that varying the percentages of the workforce off site amounts to a difference of approximately 6%, with the total costs decreasing with percentage of workers off-site. However, it is important to consider that there would be greater on-site transportation requirements associated with greater numbers of workers living off-site and that this would have consequences in terms of bussing required, increased safety risk, and more complicated site management which would add to the overall construction cost.

5.2.1.2 Varying the Operational Periods

To determine how costs changed when the camp operational periods were varied, a number of operational periods for each camp were identified and assessed. Table 5.6 ranks the 18 Options considered by number and colour with green being the least costly and red being the Options with the highest cost.

Table 5.6 Operational Period Sensitivity Analysis

	Applicable Time Period	South					
		Year 1 – 8	Year 1-7	Year 3-8	Year 4-8	Year 3-7	Year 4-7
North	Year 1-8	18	17	14	13	10	11
	Year 1-7	16	15	12	9	6	7
	Year 1-6	8	5	4	2	3	1

Varying operational periods results in a cost difference of about 2% between the least and most expensive Options based on the available information. Therefore, although operating the north camp from Year 1 to Year 6 and the south camp from Year 4 to Year 7 appears to be the most economical, the cost differences between operational periods are negligible based on the level of information currently available.

6 FINAL RECOMMENDATIONS

Based on the assessment described in this report and our understanding of construction site operations, the final worker accommodation plan should ideally contain the following elements:

- A camp on each side of the river to enable workers to be housed closest to their worksite;
- Minimizing bussing and travel between sides to minimize conflicts between industrial and legal traffic and any associated productivity and safety issues;
- Optimizing operational periods for the camp based on actual contractor requirements;
- Providing base infrastructure to support the maximum number of anticipated workers to avoid productivity effects if housing is not available in the region; and
- Installing and removing dormitories to match real time requirements including ensuring that proper planning is in place to determine both contractor needs in terms of beds at site and actual available accommodation in the region.

In conclusion, the preferred Option consists of all the ideal elements of the analysis, combining safety, production, worker preferences, locating workers closest to their worksite, and minimizing costs to the extent possible given certain safety and socio-economic considerations. However, as the specifics of the preferred Option cannot be finalized until Project planning is further advanced, the success of this Option will depend on the adaptive management plan put in place to ensure that actual labour and socio-economic conditions are addressed.

7 CLOSING

This report was prepared by Klohn Crippen Berger Ltd. at the request of BC Hydro. The material in it reflects Klohn Crippen Berger's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Klohn Crippen Berger Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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REFERENCES

BC Hydro, 2012. Public consultation material April 2012.

Various Confidential Reports

APPENDIX I

Key Findings from Options Analysis

Option A: Two Camp Base Design																
Year	Camp	Number of workers sleeping at each camp	Number of workers working at each camp	Number of workers to be bussed between camps	Catering/ housekeeping cost per person per day	Catering/ housekeeping cost total per year	Transportation cost (labour only)	Bussing cost	Site prep	Equipment and installation	Transportation of equipment	Water supply and distribution	Sewage	Power generation and distribution infrastructure	Maintenance and operation	Totals
2014	North Camp								$1,222,591	$18,962,021	$1,542,030	$3,474,339	$3,374,774	$1,564,954	$868,094	**$31,008,803**
	South Camp								$3,802,259	$44,212,559		$5,241,295	$6,749,549	$3,129,909	$2,223,067	**$65,358,638**
2015	North Camp	492.3	492.3	0.0	$45.61	$4,097,461	$0	$0							$307,661	**$4,405,122**
	South Camp	152.0	152.0		$61.35	$1,702,295									$95,025	**$1,797,320**
2016	North Camp	473.8	473.8	0.0	$47.52	$8,217,192	$0	$0							$592,194	**$8,809,387**
	South Camp	155.9	155.9		$61.35	$3,490,321									$194,835	**$3,685,157**
2017	North Camp	470.6	470.6	0.0	$47.52	$8,162,706	$0	$0							$588,267	**$8,750,973**
	South Camp	271.8	271.8		$50.89	$5,048,033									$339,709	**$5,387,741**
2018	North Camp	380.0	380.0	0.0	$48.59	$6,739,045	$0	$0							$474,973	**$7,214,018**
	South Camp	465.4	465.4		$47.52	$8,072,383									$581,758	**$8,654,141**
2019	North Camp	481.6	481.6	0.0	$45.61	$8,016,754	$0	$0							$601,943	**$8,618,698**
	South Camp	1220.4	1220.4		$37.86	$16,864,172									$1,525,463	**$18,389,634**
2020	North Camp	388.0	388.0	0.0	$48.59	$6,880,774	$0	$0							$484,962	**$7,365,736**
	South Camp	1092.0	1092.0		$39.28	$15,655,990									$1,364,980	**$17,020,970**
2021	North Camp	179.9	179.9	0.0	$56.07	$3,681,494	$0	$0							$224,859	**$3,906,354**
	South Camp	743.9	743.9		$41.35	$11,227,172									$929,848	**$12,157,020**
2022	North Camp	347.0	88.2	258.8	$49.29	$3,121,791	$1,129,185	$526,521							$216,901	**$4,994,397**
	South Camp	0.0	258.8		$0.00	$0									$0	**$0**
2023	North Camp															
	South Camp															
Total						$111,577,584	$1,129,185	$526,521	$5,024,850	$63,174,580	$1,542,030	$8,715,634	$10,124,323	$4,694,863	$11,614,540	**$218,124,109**

NOTE: Mobilisation = $600,000

Option B: One South Bank Camp																
Year	Camp	Number of workers sleeping at each camp	Number of workers working at each camp	Number of workers to be bussed between camps	Catering/ housekeeping cost per person per day	Catering/ housekeeping cost total per year	Transportation cost (labour only)	Bussing cost	Site prep	Equipment and installation	Transportation of equipment	Water supply and distribution	Sewage	Power generation and distribution infrastructure	Maintenance and operation	Totals
2014	North Camp															
	South Camp								$5,703,389	$59,588,579	$1,532,394	$6,417,557	$10,124,324	$4,694,864	$3,334,601	**$91,395,706**
2015	North Camp	0	492													
	South Camp	644	152	492	$42.92	$5,046,713	$2,147,826	$1,001,497							$402,686	**$8,598,721**
2016	North Camp	0	474													
	South Camp	630	156	474	$43.53	$10,003,746	$4,134,198	$1,927,711							$787,030	**$16,852,684**
2017	North Camp	0	471													
	South Camp	742	272	471	$41.35	$11,204,572	$4,106,785	$1,914,928							$927,976	**$18,154,261**
2018	North Camp	0	380													
	South Camp	845	465	380	$40.45	$12,481,470	$3,315,856	$1,546,131							$1,056,731	**$18,400,189**
2019	North Camp	0	482													
	South Camp	1702	1220	482	$36.14	$22,450,260	$4,202,258	$1,959,446							$2,127,406	**$30,739,370**
2020	North Camp	0	388													
	South Camp	1480	1092	388	$36.40	$19,662,659	$3,385,592	$1,578,648							$1,849,942	**$26,476,840**
2021	North Camp	0	180													
	South Camp	924	744	180	$40.20	$13,554,417	$1,569,777	$731,962							$1,154,707	**$17,010,862**
2022	North Camp	0	88													
	South Camp	347	259	88	$49.29	$3,121,791	$385,036	$179,536							$216,901	**$3,903,265**
2023	North Camp															
	South Camp															
Total						$97,925,627	$23,247,328	$10,839,859	$5,703,389	$59,588,579	$1,532,394	$6,417,557	$10,124,324	$4,694,864	$11,857,979	**$231,931,898**

NOTE: Mobilisation = $400,000

Option C: One North Bank Camp																
Year	Camp	Number of workers sleeping at each camp	Number of workers working at each camp	Number of workers to be bussed between camps	Catering/ housekeeping cost per person per day	Catering/ housekeeping cost total per year	Transportation cost (labour only)	Bussing cost	Site prep	Equipment and installation	Transportation of equipment	Water supply and distribution	Sewage	Power generation and distribution infrastructure	Maintenance and operation	Totals
2014	North Camp								$4,156,809	$59,588,579	$1,532,394	$6,343,734	$11,474,232	$5,320,844	$2,951,520	**$91,368,111**
	South Camp															
2015	North Camp	644	492	152	$42.92	$5,046,713	$663,383	$380,708							$402,686	**$6,493,489**
	South Camp	0	152													
2016	North Camp	630	474	156	$43.53	$10,003,746	$1,360,176	$780,589							$787,030	**$12,931,540**
	South Camp	0	156													
2017	North Camp	742	471	272	$41.35	$11,204,572	$2,371,559	$1,361,010							$927,976	**$15,865,117**
	South Camp	0	272													
2018	North Camp	845	380	465	$40.45	$12,481,470	$4,061,342	$2,330,756							$1,056,731	**$19,930,299**
	South Camp	0	465													
2019	North Camp	1702	482	1220	$36.14	$22,450,260	$10,649,486	$6,111,613							$2,127,406	**$41,338,765**
	South Camp	0	1220													
2020	North Camp	1480	388	1092	$36.40	$19,662,659	$9,529,131	$5,468,655							$1,849,942	**$36,510,387**
	South Camp	0	1092													
2021	North Camp	924	180	744	$40.20	$13,554,417	$6,491,411	$1,513,421							$1,154,707	**$22,713,956**
	South Camp	0	744													
2022	North Camp	347	88	259	$49.29	$3,121,791	$1,129,185	$526,521							$216,901	**$4,994,397**
	South Camp	0	259													
2023	North Camp															
	South Camp															
Total						$97,925,627	$36,255,673	$18,473,272	$4,156,809	$59,588,579	$1,532,394	$6,343,734	$11,474,232	$5,320,844	$11,474,898	**$252,546,062**

NOTE: Mobilisation = $400,000

Option D: Two Camp Design with Early North Bank Camp Closure																
Year	Camp	Number of workers sleeping at each camp	Number of workers working at each camp	Number of workers to be bussed between camps	Catering/ housekeeping cost per person per day	Catering/ housekeeping cost total per year	Transportation cost (labour only)	Bussing cost	Site prep	Equipment and installation	Transportation of equipment	Water supply and distribution	Sewage	Power generation and distribution infrastructure	Maintenance and operation	Totals
2014	North Camp								$1,222,591	$18,962,021	$1,542,030	$3,474,339	$3,374,774	$1,564,954	$658,035	**$30,798,744**
	South Camp								$3,802,259	$44,212,559		$5,241,295	$6,749,549	$3,129,909	$2,223,067	**$65,358,638**
2015	North Camp	492	492	0	$45.61	$4,097,461	$0.00	$0							$307,661	**$4,405,122**
	South Camp	152	152		$61.35	$1,702,295									$95,025	**$1,797,320**
2016	North Camp	474	474	0	$47.52	$8,217,192	$0.00	$0							$592,194	**$8,809,387**
	South Camp	156	156		$61.35	$3,490,321									$194,835	**$3,685,157**
2017	North Camp	471	471	0	$47.52	$8,162,706	$0.00	$0							$588,267	**$8,750,973**
	South Camp	272	272		$50.89	$5,048,033									$339,709	**$5,387,741**
2018	North Camp	380	380	0	$48.59	$6,739,045	$0.00	$0							$474,973	**$7,214,018**
	South Camp	465	465		$47.52	$8,072,383									$581,758	**$8,654,141**
2019	North Camp	482	482	0	$45.61	$8,016,754	$0.00	$0							$601,943	**$8,618,698**
	South Camp	1220	1220		$37.86	$16,864,172									$1,525,463	**$18,389,634**
2020	North Camp	388	388	0	$48.59	$6,880,774	$0.00	$0							$484,962	**$7,365,736**
	South Camp	1092	1092		$39.28	$15,655,990									$1,364,980	**$17,020,970**
2021	North Camp	0	180	180			$1,569,777	$731,962								**$2,301,738**
	South Camp	924	744		$40.20	$13,554,417									$1,154,707	**$14,709,124**
2022	North Camp	0	88	88			$385,036	$179,536								**$564,573**
	South Camp	347	259		$49.29	$3,121,791									$216,901	**$3,338,692**
2023	North Camp															
	South Camp															
Total						$110,223,334	$1,954,813	$911,498	$5,024,850	$63,174,580	$1,542,030	$8,715,634	$10,124,323	$4,694,863	$11,404,481	**$217,770,406**

NOTE: Mobilisation = $600,000

Option E: Two Camp Design Optimized for Schedule																
Year	Camp	Number of workers sleeping at each camp	Number of workers working at each camp	Number of workers to be bussed between camps	Catering/ housekeeping cost per person per day	Catering/ housekeeping cost total per year	Transportation cost (labour only)	Bussing cost	Site prep	Equipment and installation	Transportation of equipment	Water supply and distribution	Sewage	Power generation and distribution infrastructure	Maintenance and operation	Totals
2014	North Camp								$1,833,887	$26,302,500	$1,767,239	$4,067,844	$5,062,161	$2,347,431	$1,235,697	**$42,616,759**
	South Camp								$3,802,259	$42,343,000		$5,241,295	$6,749,549	$3,129,909	$2,223,067	**$63,489,079**
2015	North Camp	644	492	152	$42.92	$5,046,713	$663,383.33	$309,325							$402,686	**$6,422,107**
	South Camp	0	152													
2016	North Camp	630	474	156	$43.53	$10,003,746	$1,360,175.96	$634,228							$787,030	**$12,785,180**
	South Camp	0	156													
2017	North Camp	742	471	272	$41.35	$11,204,572	$2,371,559.07	$1,105,820							$927,976	**$15,609,927**
	South Camp	0	272													
2018	North Camp	380	380	0	$48.59	$6,739,045	$0.00	$0							$474,973	**$7,214,018**
	South Camp	465	465		$47.52	$8,072,383									$581,758	**$8,654,141**
2019	North Camp	482	482	0	$36.14	$6,352,236	$0.00	$0							$601,943	**$6,954,180**
	South Camp	1220	1220		$37.86	$16,864,172									$1,525,463	**$18,389,634**
2020	North Camp	388	388	0	$36.40	$5,154,562	$0.00	$0							$484,962	**$5,639,524**
	South Camp	1092	1092	0	$39.28	$15,655,990									$1,364,980	**$17,020,970**
2021	North Camp	0	180	180			$1,569,776.50	$731,962								**$2,301,738**
	South Camp	924	744		$40.20	$13,554,417									$1,154,707	**$14,709,124**
2022	North Camp	0	88	88			$385,036.34	$179,536								**$564,573**
	South Camp	347	259		$49.29	$3,121,791									$216,901	**$3,338,692**
2023	North Camp															
	South Camp															
Total						$102,369,627	$6,349,931	$2,960,872	$5,636,146	$68,645,500	$1,767,239	$9,309,139	$11,811,710	$5,477,340	$11,982,143	**$226,309,646**

NOTE: Mobilisation = $600,000

Option F: Two Equivalent-Sized Camps with South Bank Camp During 3 Peak Years																	
Year	Camp	Number of workers sleeping at each camp	Number of workers working at each camp	Number of workers to be bussed between camps	Catering/ housekeeping cost per person per day	Catering/ housekeeping cost total per year	Transportation cost (labour only)	Bussing cost	Site prep	Equipment and installation	Transportation of equipment	Water supply and distribution	Sewage	Power generation and distribution infrastructure	Maintenance and operation	Totals
2014	North Camp								$2,078,405	$30,997,290	$1,532,394	$4,322,409	$5,737,116	$2,660,422	$1,382,738	**$48,710,774**
	South Camp								$2,699,604	$30,997,290		$4,356,936	$4,792,180	$2,222,235	$1,693,990	**$46,762,235**
2015	North Camp	644	492	152	$42.92	$5,046,713	$663,383	$309,325							$402,686	**$6,422,107**
	South Camp	0	152													**$0**
2016	North Camp	630	474	156	$43.53	$10,003,746	$1,360,176	$634,228							$787,030	**$12,785,180**
	South Camp	0	156													**$0**
2017	North Camp	742	471	272	$41.35	$11,204,572	$2,371,559	$1,105,820							$927,976	**$15,609,927**
	South Camp	0	272													**$0**
2018	North Camp	845	380	465	$40.45	$12,481,470	$4,061,342	$1,893,739							$1,056,731	**$19,493,282**
	South Camp	0	465													**$0**
2019	North Camp	850	482	368	$40.45	$12,549,613	$3,215,216	$1,499,204							$1,062,500	**$18,326,532**
	South Camp	852	1220		$40.45	$12,578,030									$1,064,906	**$13,642,936**
2020	North Camp	630	388	242	$42.92	$9,868,722	$2,111,657	$984,632							$787,442	**$13,752,453**
	South Camp	850	1092		$40.45	$12,549,613									$1,062,500	**$13,612,113**
2021	North Camp	180	180	0	$56.07	$3,681,494	$0	$0							$224,859	**$3,906,354**
	South Camp	744	744		$41.35	$11,227,172									$929,848	**$12,157,020**
2022	North Camp	347	88	259	$49.29	$3,121,791	$1,129,185	$526,521							$216,901	**$4,994,397**
	South Camp	0	259													**$0**
2023	North Camp															
	South Camp															
Total						$104,912,935	$14,912,518	$6,953,470	$4,778,009	$61,994,580	$1,532,394	$8,679,345	$10,529,296	$4,882,657	$11,600,107	**$230,775,309**

NOTE: Mobilisation = $600,000

Option G: Two Camp Design with South Bank Camp During 4 Peak Years																	
Year	Camp	Number of workers sleeping at each camp	Number of workers working at each camp	Number of workers to be bussed between camps	Catering/ housekeeping cost per person per day	Catering/ housekeeping cost total per year	Transportation cost (labour only)	Bussing cost	Site prep	Equipment and installation	Transportation of equipment	Water supply and distribution	Sewage	Power generation and distribution infrastructure	Maintenance and operation	Totals
2014	North Camp								$1,833,887	$27,471,563	$1,767,239	$4,067,844	$5,062,161	$2,347,431	$1,235,697	**$43,785,822**
	South Camp								$3,802,259	$44,212,559		$5,241,295	$6,749,549	$3,129,909	$2,223,067	**$65,358,638**
2015	North Camp	644	492	152	$42.92	$5,046,713	$663,383	$309,325							$402,686	**$6,422,107**
	South Camp	0	152													**$0**
2016	North Camp	630	474	156	$43.53	$10,003,746	$1,360,176	$634,228							$787,030	**$12,785,180**
	South Camp	0	156													**$0**
2017	North Camp	742	471	272	$41.35	$11,204,572	$2,371,559	$1,105,820							$927,976	**$15,609,927**
	South Camp	0	272													**$0**
2018	North Camp	380	380	0	$48.59	$6,739,045	$0	$0							$474,973	**$7,214,018**
	South Camp	465	465		$47.50	$8,068,985									$581,758	**$8,650,744**
2019	North Camp	482	482	0	$45.61	$8,016,754	$0	$0							$601,943	**$8,618,698**
	South Camp	1220	1220		$37.86	$16,864,172									$1,525,463	**$18,389,634**
2020	North Camp	388	388	0	$48.59	$6,880,774	$0	$0							$484,962	**$7,365,736**
	South Camp	1092	1092		$39.28	$15,655,990									$1,364,980	**$17,020,970**
2021	North Camp	180	180	0	$56.07	$3,681,494	$0	$0							$224,859	**$3,906,354**
	South Camp	744	744		$41.35	$11,227,172									$929,848	**$12,157,020**
2022	North Camp	347	88	259	$49.29	$3,121,791	$1,129,185	$526,521							$216,901	**$4,994,397**
	South Camp	0	259													**$0**
2023	North Camp															
	South Camp															
Total						$107,111,209	$5,524,303	$2,575,894	$5,636,146	$71,684,122	$1,767,239	$9,309,139	$11,811,710	$5,477,340	$11,982,143	**$232,879,244**

NOTE: Mobilisation = $600,000

Option H: Two Camp Design with 15% of Workers Living Off-Site																		
Year	Camp	Number of workers sleeping at each camp	Number of workers working at each camp	Number of workers to be bussed between camps	Catering/ housekeeping cost per person per day	Catering/ housekeeping cost total per year	Transportation cost (labour only)	Bussing cost	Site prep	Equipment and installation	Transportation of equipment	Water supply and distribution	Sewage	Power generation and distribution infrastructure	Maintenance and operation	Workers living off-site		Totals
																Workers in town	Travel Allowance	
2014	North Camp								$1,222,591	$16,700,000	$1,310,400	$3,474,339	$3,374,774	$1,564,954	$742,733			**$28,389,791**
	South Camp								$3,802,259	$38,563,000		$5,241,295	$6,749,549	$3,129,909	$2,103,316			**$59,589,328**
2015	North Camp	428	492	32	$48.51	$3,787,269	$140,420	$65,476							$267,372	116	$301,531	**$4,562,183**
	South Camp	120	152		$62.19	$1,360,281									$74,911			**$1,435,191**
2016	North Camp	411	474	31	$48.95	$7,338,428	$274,444	$127,969							$513,452	113	$589,328	**$8,843,734**
	South Camp	124	156		$61.79	$2,805,864									$155,523			**$2,961,387**
2017	North Camp	396	471	37	$49.33	$7,136,345	$323,593	$150,886							$495,423	134	$694,869	**$8,801,251**
	South Camp	235	272		$54.96	$4,708,209									$293,356			**$5,001,566**
2018	North Camp	295	380	42	$52.49	$5,659,533	$368,491	$171,822							$369,247	152	$791,280	**$7,360,525**
	South Camp	423	465		$48.63	$7,510,827									$528,974			**$8,039,801**
2019	North Camp	311	482	85	$51.93	$5,899,820	$741,845	$345,910							$389,096	306	$1,593,002	**$8,969,980**
	South Camp	1135	1220		$38.02	$15,754,444									$1,419,199			**$17,173,643**
2020	North Camp	240	388	74	$54.73	$4,792,143	$645,090	$300,795							$299,875	266	$1,385,236	**$7,423,407**
	South Camp	1018	1092		$39.19	$14,562,398									$1,272,575			**$15,834,973**
2021	North Camp	87	180	46	$65.57	$2,093,430	$402,656	$187,752							$109,331	166	$864,645	**$3,657,980**
	South Camp	698	744		$43.25	$11,014,821									$872,170			**$11,886,991**
2022	North Camp	54	88	17	$70.85	$692,111	$75,635	$35,268							$33,453	62	$162,416	**$998,945**
	South Camp	241	259		$54.66	$2,408,592									$150,913			**$2,559,506**
2023	North Camp																	
	South Camp																	
Total						$98,124,516	$2,972,175	$1,385,878	$5,024,850	$55,263,000	$1,310,400	$8,715,634	$10,124,323	$4,694,863	$10,090,920		$6,382,306	**$204,088,865**

NOTE: Mobilisation = $600,000

Option I: Two Camp Design with 15% of Workers Living Off-Site with Reduced Infrastructure																		
Year	Camp	Number of workers sleeping at each camp	Number of workers working at each camp	Number of workers to be bussed between camps	Catering/ housekeeping cost per person per day	Catering/ housekeeping cost total per year	Transportation cost (labour only)	Bussing cost	Site prep	Equipment and installation	Transportation of equipment	Water supply and distribution	Sewage	Power generation and distribution infrastructure	Maintenance and operation	Workers living off-site		Totals
																Workers in town	Travel Allowance	
2014	North Camp								$1,046,037	$16,340,292	$1,310,400	$3,320,561	$2,887,424	$669,480	$742,733			**$26,316,926**
	South Camp								$3,597,441	$39,510,933		$5,039,448	$6,385,967	$2,961,308	$2,103,316			**$59,598,413**
2015	North Camp	428	492	32	$48.51	$3,787,269	$140,420	$65,476							$267,372	116	$301,531	**$4,562,183**
	South Camp	120	152		$62.19	$1,360,281									$74,911			**$1,435,191**
2016	North Camp	411	474	31	$48.95	$7,338,428	$274,444	$127,969							$513,452	113	$589,328	**$8,843,734**
	South Camp	124	156		$61.79	$2,805,864									$155,523			**$2,961,387**
2017	North Camp	396	471	37	$49.33	$7,136,345	$323,593	$150,886							$495,423	134	$694,869	**$8,801,251**
	South Camp	235	272		$54.96	$4,708,209									$293,356			**$5,001,566**
2018	North Camp	295	380	42	$52.49	$5,659,533	$368,491	$171,822							$369,247	152	$791,280	**$7,360,525**
	South Camp	423	465		$48.63	$7,510,827									$528,974			**$8,039,801**
2019	North Camp	311	482	85	$51.93	$5,899,820	$741,845	$345,910							$389,096	306	$1,593,002	**$8,969,980**
	South Camp	1135	1220		$38.02	$15,754,444									$1,419,199			**$17,173,643**
2020	North Camp	240	388	74	$54.73	$4,792,143	$645,090	$300,795							$299,875	266	$1,385,236	**$7,423,407**
	South Camp	1018	1092		$39.19	$14,562,398									$1,272,575			**$15,834,973**
2021	North Camp	87	180	46	$65.57	$2,093,430	$402,656	$187,752							$109,331	166	$864,645	**$3,657,980**
	South Camp	698	744		$43.25	$11,014,821									$872,170			**$11,886,991**
2022	North Camp	54	88	17	$70.85	$692,111	$75,635	$35,268							$33,453	62	$162,416	**$998,945**
	South Camp	241	259		$54.66	$2,408,592									$150,913			**$2,559,506**
2023	North Camp																	
	South Camp																	
Total						$98,124,516	$2,972,175	$1,385,878	$4,643,477	$55,851,225	$1,310,400	$8,360,010	$9,273,391	$3,630,788	$10,090,920		$6,382,306	**$202,025,085**

NOTE: Mobilisation = $600,000