



## **Columbia River Project Water Use Plan**

**Kinbasket and Arrow Recreation Management Plan**

**Lower Columbia Indian Eddy Dredging: Definition Phase**

**Implementation Year: 1**

**Reference: CLBWORKS 20**

*Lower Columbia River Indian Eddy Dredging Definition Phase Task 1  
Summary Report*

**Study Period: October 2015**

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**February, 29, 2016**



## Executive Summary

The CLBWORKS-20A: Lower Columbia Dredging at Indian Eddy: Definition Phase (Definition Phase) program follows reports and recommendations from CLBWORKS-19: Lower Columbia Indian Eddy Dredging Environment and Engineering Assessment. CLBWORKS-19 addressed uncertainties identified by the Columbia Water Use Plan Consultative Committee about whether attenuated flushing flows on the Columbia River upstream of Trail resulted in the deposition of excess sediment within Indian Eddy. In addition, there were concerns that sand deposited at Gyro Park found approximately 0.5 km upstream of Indian Eddy was eroding and being deposited downstream in Indian Eddy. The CLBWORKS-20A Definition Phase was divided into two tasks. Task 1 included data collection (bathymetric surveys), data analysis (including comparison to bathymetric data collected in 2008), and reporting. Task 2 will include the production of meeting visuals, stakeholder engagement, and the recording stakeholder meeting minutes if required.

During the completion of Task 1, the comparison of bathymetric data between surveys indicated that the elevation of the access into the eddy through its downstream end remained relatively stable between 2008 and 2015, with changes of no greater than  $\pm 0.25$  m. The upstream portion of the entrance into the eddy shows sediment deposition of up to 0.5 m, with small sections showing areas with depositions of up to 1 m.

The comparison of the data between bathymetric surveys shows that the majority of the eddy had similar substrate elevations (range of no greater than  $\pm 0.25$  m). However, consistently higher elevations were documented in the northern portion of the eddy compared to the previous survey, with the majority of areas exhibiting between 0.25 and 0.50 m of deposition. This indicated that sediment from the northern banks are being mobilized and deposited immediately to the south in the deeper areas of the eddy. The shallow area in the southeast part of the eddy shows a movement eastward (i.e., closer to the left downstream bank) by approximately 20 m.

At the time of survey, the river banks above the water surface show lower elevations compared to the 2008 survey and indicate that the banks were subject to erosion between 2008 and 2015. An overall net erosion of 3197 m<sup>3</sup> of sediment within the study area was documented during the survey.

The amount of erosion and the substrate elevations documented in the study area during this program indicate that at this time, a risk to public safety in regards to accessing and egressing from Indian Eddy is not present. Therefore, there is no immediate need to conduct dredging operations in Indian Eddy. However, it is important to note that river morphology can change over time due to natural or regulated processes that occur within the active river channel. The hydrograph, the time of the year when the surveys are conducted, and other local conditions (i.e., precipitation and anthropomorphic activity) at site can also impact sediment deposition in the study area.



## Acknowledgements

Special thanks are extended to Jason Watson (BC Hydro, Burnaby) for support, advice, and assistance.

The following employees of **GOLDER ASSOCIATES LTD.** contributed to the collection of data and the preparation of this report.

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## Table of Contents

**1.0 INTRODUCTION..... 1**

    1.1 Objectives..... 1

**2.0 METHODS ..... 1**

    2.1 Study Area and Sample Timing ..... 1

    2.2 Bathymetry Surveys..... 3

    2.3 Bathymetry Survey Data Analysis and Comparison ..... 3

**3.0 RESULTS ..... 5**

**4.0 CONCLUSIONS..... 5**

**5.0 CLOSURE..... 7**

**6.0 REFERENCES..... 8**

### FIGURES

Figure 1: Project Study Area ..... 2

Figure 2: Bathymetry and Topographic Surveys 2008 and 2015. Note: Black dots within the study area represent onshore survey points and the tracks followed by the boat during the survey..... 4

Figure 3: Changes in River Bottom Thickness between 2008 and 2015..... 6



## **1.0 INTRODUCTION**

The CLBWORKS-20A: Lower Columbia Dredging at Indian Eddy: Definition Phase Program was conducted in response to the Conditional Columbia Works and Effective Monitoring Studies; Item 8(a) attached to the Order for Columbia River Projects dated January 26, 2007. The Lower Columbia Dredging at Indian Eddy Program is included within the Kinbasket and Arrow Reservoirs Recreational Management Plan. This management plan is focused on recreational concerns, including debris and sedimentation management and providing access to the reservoirs (boat launches) (BC Hydro 2015).

This Definition Phase follows reports and recommendations from CLBWORKS-19: Lower Columbia Indian Eddy Dredging Environment and Engineering Assessment. CLBWORKS-19 (A and B) addressed uncertainties identified by the Columbia Water Use Plan Consultative Committee (WUP CC) about whether attenuated flushing flows on the Columbia River upstream of Trail resulted in the deposition of excess sediment within Indian Eddy. In addition, there was some concern that sand deposited at Gyro Park (approximately 0.5 km upstream of Indian Eddy) has been eroding and depositing in Indian Eddy (BC Hydro 2015). Given the uncertainty associated with the need for dredging Indian Eddy, the Definition Phase allows for information to be collected to determine if physical works are required.

BC Hydro contracted Golder Associates Ltd. (Golder) to provide the field and office services to address the objectives of the Definition Phase. This document details the methods used and the results of the sampling during Task 1 of the Definition Phase, and provides conclusions regarding navigability between the boat launch in Indian Eddy and the mainstem Columbia River.

### **1.1 Objectives**

The Definition Phase was divided into two tasks. Task 1 included data collection (bathymetric surveys), data analysis (including comparison to bathymetric data collected in 2008), and reporting. Task 2 will include the production of meeting visuals, stakeholder engagement, and the recording stakeholder meeting minutes if required.

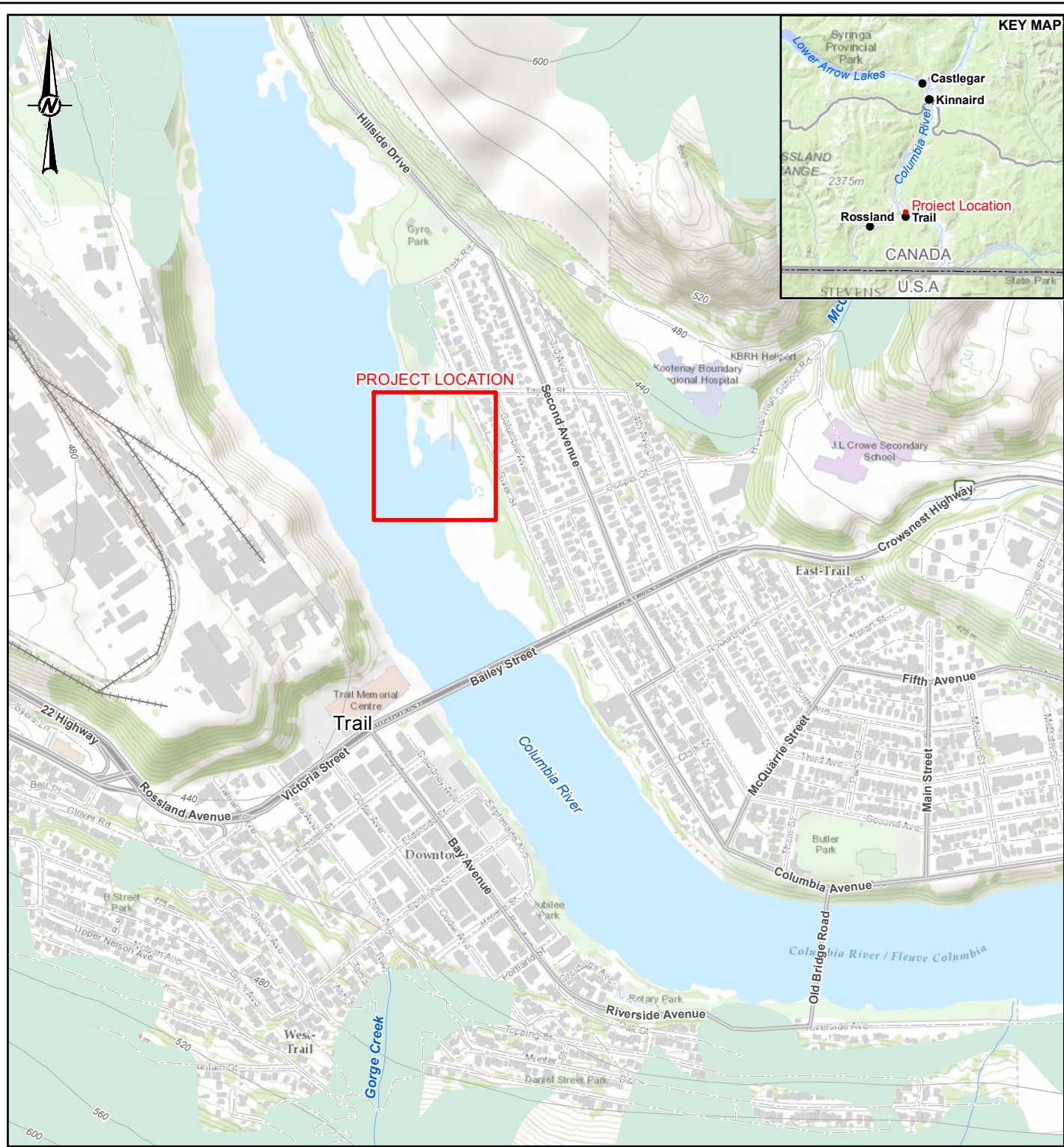
Task 1 had three distinct objectives:

- 1) Conduct bathymetric surveys in 2015 to obtain updated topographic profiles of the study area.
- 2) Compare current survey data to data collected during previous surveys in April and June 2008 (NHC 2009).
- 3) Assess changes in navigable water depth between surveys, and identify if there is a need to conduct dredging operations to address safety concerns to public use of the study area.

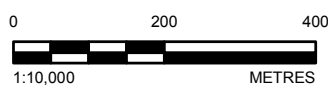
## **2.0 METHODS**

### **2.1 Study Area and Sample Timing**

The bathymetry survey was conducted on October 22<sup>nd</sup>, 2015 in the Indian Eddy boat launch area of the lower Columbia River near Trail, BC (Figure 1).



- LEGEND**
- PROJECT LOCATION
  - CONTOUR (20m)
  - MAJOR ROAD
  - LOCAL ROAD
  - RAILWAY
  - WATERCOURSE
  - WOODED AREA



**REFERENCES**

1. LANDUSE, LANDCOVER, WATERCOURSE, AND CONTOUR DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. TRANSPORTATION DATA OBTAINED FROM THE PROVINCE OF BRITISH COLUMBIA. COPYRIGHT © 2013. ALL RIGHTS RESERVED.
3. WATERBODY, RAILWAY DATA OBTAINED FROM IHS ENERGY INC.
4. BASEMAP SOURCE SOURCES: ESRI, HERE, DELORME, INTERMAP, INCREMENT P CORP, GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDINANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N

CLIENT  
**BC HYDRO**

PROJECT  
**INDIAN EDDY BATHYMETRY SURVEY**

TITLE  
**PROJECT STUDY AREA**

CONSULTANT	
YYYY-MM-DD	2016-02-29
DESIGNED	BH
PREPARED	CD
REVIEWED	BH
APPROVED	DS



PROJECT NO.	PHASE	REV.	FIGURE
1541157	1000	0	<b>1</b>

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## 2.2 Bathymetry Surveys

The bathymetry survey of the Indian Eddy on Columbia River involved a combination of hydrographic and terrestrial surveys. The two methods were used to collect coordinates of measured topography and water surface elevations were:

- a) **GPS Total Station Surveys.** A SOKKIA GSR2700 ISX with Real Time Kinematic (GPS RTK) capabilities and benchmark system were used to measure topography on land and in wadeable areas of the Columbia River and Indian Eddy, as well as water surface elevations. The topography was measured along the river banks following a shore-normal transect pattern (i.e., transects perpendicular on the shoreline) that extended from above the top of bank elevations to below the water surface at the time of survey (Figure 2). The GPS RTK system was tied into the Geodetic Control Monument (GCM) network maintained by the BC Provincial Government. The survey monument used for control was GCM no. 367631, with the following UTM Zone11 coordinates: Easting 448411.820m, Northing 5439146.555m, and Elevation 416.277m.
- b) **River Depth Surveys.** An RDI Workhorse RioGrande® Acoustic Doppler Current Profiler (ADCP) system (with a precision of + or – 1 cm) was used to perform the sonar depth measurements in the wetted portions of the study area. The transducer of the ADCP was mounted 0.15 m below the water surface with a minimum measurable depth of 0.14 m below the ADCP transducers. Thus, the minimum measurable water depth was 0.29 m during the surveys. Following the methodology utilized during the 2008 surveys, river near shore transects sampled during the present study were perpendicular to the shoreline (Figure 2). In the mainstem Columbia River upstream and downstream and the eddy, transects parallel to the shoreline were sampled (Figure 2). Extra effort was expended on areas that were identified in the field as having a high degree of variation in river bottom elevation. Additional water velocity data were collected but not processed or presented in this report, and are archived for future use if required.

During the sonar depth data collection, the GPS RTK was attached to the ADCP system and the local coordinates were transmitted and incorporated in the raw depth dataset by the ADCP data collection software. The two survey methods were referenced to the same datum and thus it was possible to splice them together to produce a single data set.

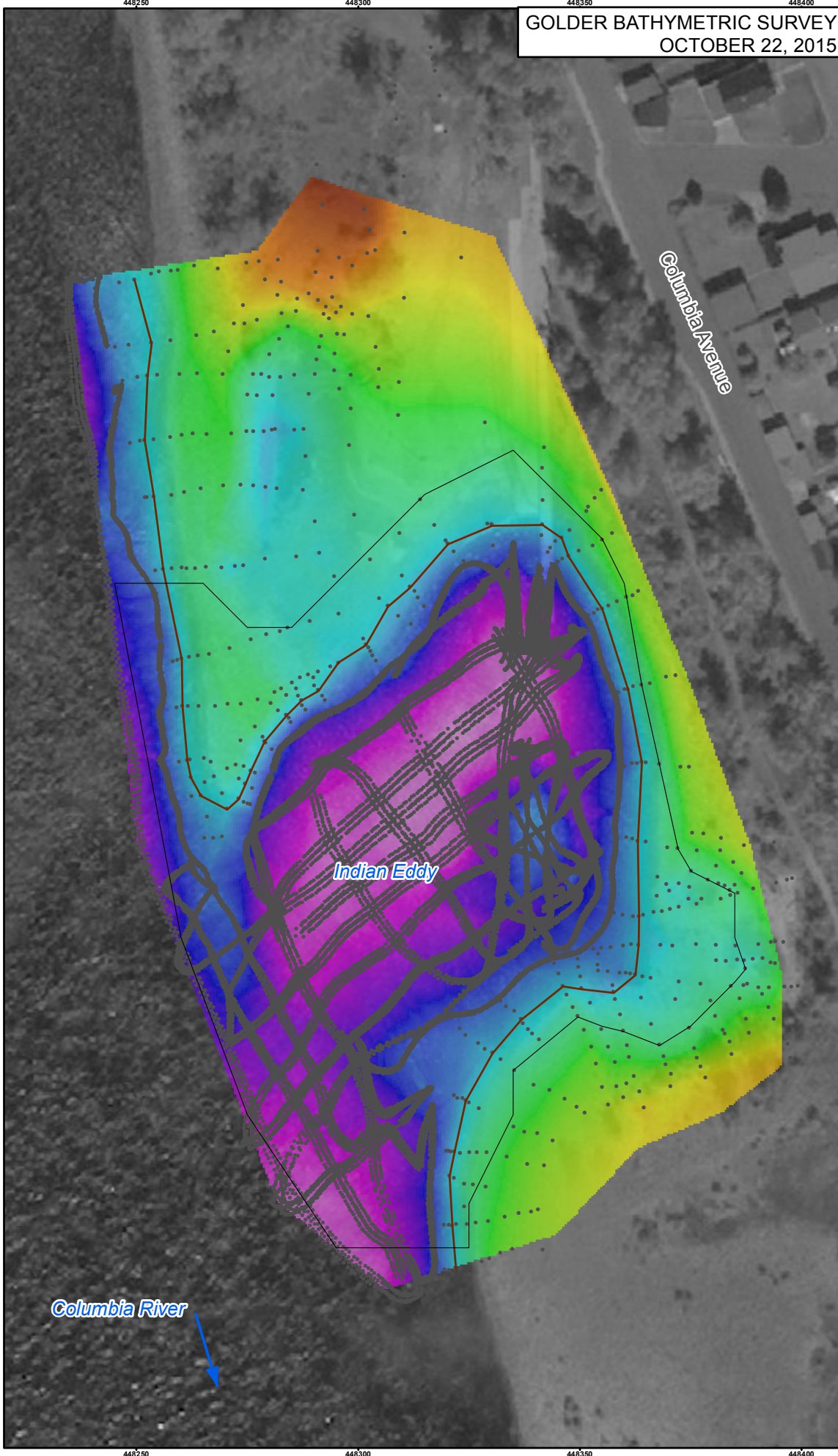
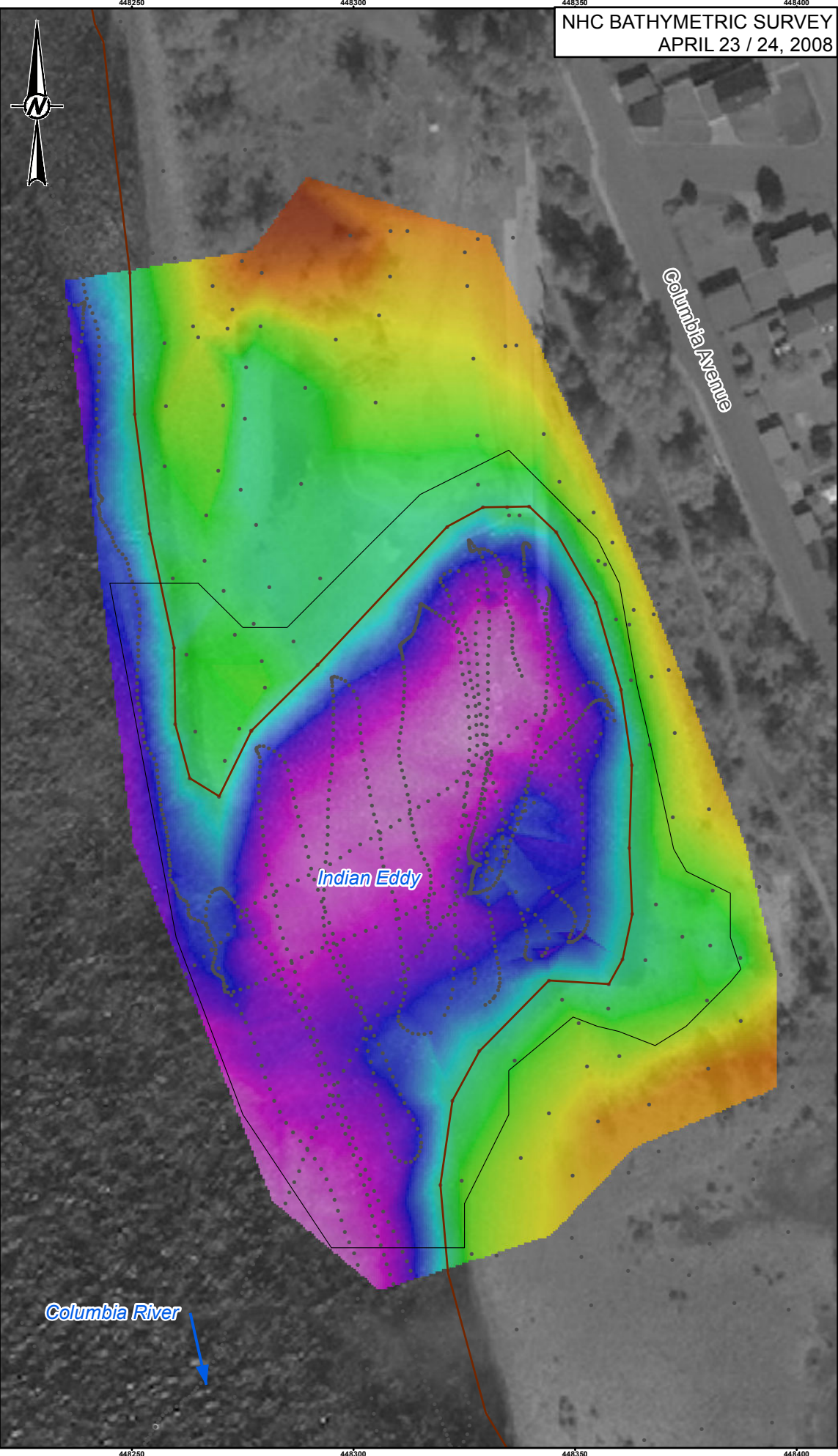
## 2.3 Bathymetry Survey Data Analysis and Comparison

The previous surveys were conducted by Northwest Hydraulics Consultants (NHC) in April and June 2008 (NHC 2009), and the point data files were provided to Golder in electronic format. Bathymetric surfaces for both the present and previous surveys were constructed by Golder by using linear interpolation to calculate the elevation between each data point. The bathymetric surfaces created from the two datasets cover the same spatial extent, and have the same spatial resolution (cell size of 0.5 m) (Figure 2).

All bathymetric surveys were analyzed using the same datum and spatial extension to allow for an easy comparison of the elevations documented during each sample period. The eddy limit was established at 1 m above the water elevation at the time of the 2015 survey. It was determined that if water levels reached elevations above this limit, water depths would be deep enough that concerns to the safety of the public using the eddy would not be present.

NHC BATHYMETRIC SURVEY  
APRIL 23 / 24, 2008

GOLDER BATHYMETRIC SURVEY  
OCTOBER 22, 2015

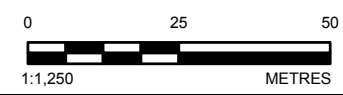


**LEGEND**

- BOAT TRANSECT AND GROUND SURVEY POINTS
- SHORELINE AT TIME OF SURVEY
- EDDY LIMIT

BATHYMETRY / TOPOGRAPHIC SURFACE (m)

High : 412  
Low : 400



- REFERENCE(S)**
1. NHC BATHYMETRY SURFACE PRODUCED BY GOLDER NOV 2015, FROM NHC SURVEY APRIL 23 / 24, 2008. SURVEY POINTS FROM CAD FILES INDIAN EDDY APR 2008.DWG AND INDIAN EDDY JUN 2008.DWG
  2. GOLDER BATHYMETRY SURFACE PRODUCED BY GOLDER NOV 2015, FROM SURVEY OCT 22, 2015
  3. IMAGERY SOURCE SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

CLIENT  
**BC HYDRO**

PROJECT  
**INDIAN EDDY BATHYMETRY SURVEY**

TITLE  
**BATHYMETRY AND TOPOGRAPHIC SURVEYS 2008 AND 2015**

CONSULTANT	YYYY-MM-DD	2015-12-07
DESIGNED	DC	
PREPARED	CD	
REVIEWED	BH	
APPROVED	DS	

PROJECT NO. 1541157      PHASE 1000      REV. 0      **FIGURE 2**

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### 3.0 RESULTS

The comparison of the data between bathymetric surveys shows that the majority of the eddy had similar substrate elevations (range of not greater than  $\pm 0.25$  m; Figure 3). However, consistently higher elevations were documented in the northern section of the eddy. Compared to the previous surveys, the majority of areas on the north shore exhibited between 0.25 and 0.50 m of deposition. Small amounts of area along the north shore exhibited up to 1 m of sediment deposition. This indicated that sediment from the northern banks are being mobilized and deposited immediately to the south in the deeper areas of the eddy. The island near the center of the eddy exhibited movement eastward (i.e., closer to the left downstream bank) by approximately 20 m.

The comparison of the two bathymetric surveys was also intended to identify potential entrance and egress issues associated with navigation of vessels using the Indian Eddy boat launch location. The comparison indicated that the elevation of the access into the eddy through its downstream end remained relatively stable between 2008 and 2015, with changes not greater than  $\pm 0.25$  m. Similar to the northern portions of the eddy, the upstream portion of the entrance into the eddy shows sediment deposition of up to 0.5 m, with small sections showing areas with depositions of up to 1 m.

At the time of survey, the river banks above the water surface show lower elevations compared to the 2008 survey, and indicate that the banks were subject to erosion between 2008 and 2015. Within the eddy limit, the total net volume of sediments that were deposited between the two surveys is  $1536 \text{ m}^3$ , while the total net volume of sediments eroded was  $4732 \text{ m}^3$ . This resulted in a net erosion of  $3197 \text{ m}^3$  of sediment (Figure 3).

### 4.0 CONCLUSIONS

The amount of erosion and the substrate elevations documented in the study area during this program indicate that at this time, a risk to public safety in regards to accessing and egressing from Indian Eddy is not present. Therefore, there is no immediate need to conduct dredging operations in Indian Eddy. However, river morphology can change over time due to natural and regulated processes that occur within the active river channel. The annual river hydrograph, the time of the year when the surveys are conducted, and other local conditions (i.e., precipitation and anthropomorphic activity) at the site can also impact sediment deposition in the study area.



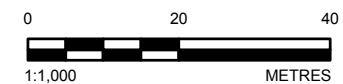
**LEGEND**

□ EDDY LIMIT

**CHANGE IN RIVER BOTTOM THICKNESS BETWEEN 2008 AND 2015**  
**EROSION (NEGATIVE) AND DEPOSITION (POSITIVE) (M)**

- -2.4 TO -1.25
- -1.25 TO -1
- -1 TO -0.5
- -0.5 TO -0.25
- -0.25 TO 0.25
- 0.25 TO 0.5
- 0.5 TO 1
- 1 TO 1.25

VOLUME DIFFERENCE BETWEEN 2008 AND 2015	m3
TOTAL EROSION	4,732.30
TOTAL DEPOSITION	1,535.55
NET VOLUME DIFFERENCE	-3,196.75



**NOTE (S)**  
 1. BATHYMETRY SURFACE DIFFERENCE CREATED BY GOLDER NOV, 2015. DERRIVED FROM SUBTRACTING ELEVATION FROM 2008 SURVEY FROM ELEVATION OF THE 2015 SURVEY AND REPRESENTS A CHANGE OF THE RIVER BOTTOM'S MATERIAL THICKNESS.

**REFERENCE(S)**  
 1. BATHYMETRY SURFACE DIFFERENCE CREATED BY GOLDER NOV, 2015  
 2. IMAGERY SOURCE SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

CLIENT  
 BC HYDRO

PROJECT  
 INDIAN EDDY BATHYMETRY SURVEY

TITLE  
**CHANGE IN RIVER BOTTOM THICKNESS BETWEEN 2008 AND 2015**

CONSULTANT	YYYY-MM-DD	2015-12-07
DESIGNED	DC	
PREPARED	CD	
REVIEWED	BH	
APPROVED	DS	

PROJECT NO. 1541157      PHASE 1000      REV. 0      TITLE CHANGE IN RIVER BOTTOM THICKNESS BETWEEN 2008 AND 2015      FIGURE 3

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## 5.0 CLOSURE

We trust that this report meets your current requirements. If you have any further questions, please do not hesitate to contact the undersigned.

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- BC Hydro. 2015. CLBWORKS 20A: Lower Columbia River Indian Eddy Dredging, 2015 – 2016 Definition Phase. Physical Works Terms of Reference, Columbia Water Use Plan.
- NHC. 2009. Lower Columbia River Program 19A – Dredging at Indian Eddy Engineering Assessment. North Report prepared for BC Hydro, Castlegar BC. 32 p.+ 2 appendices.

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