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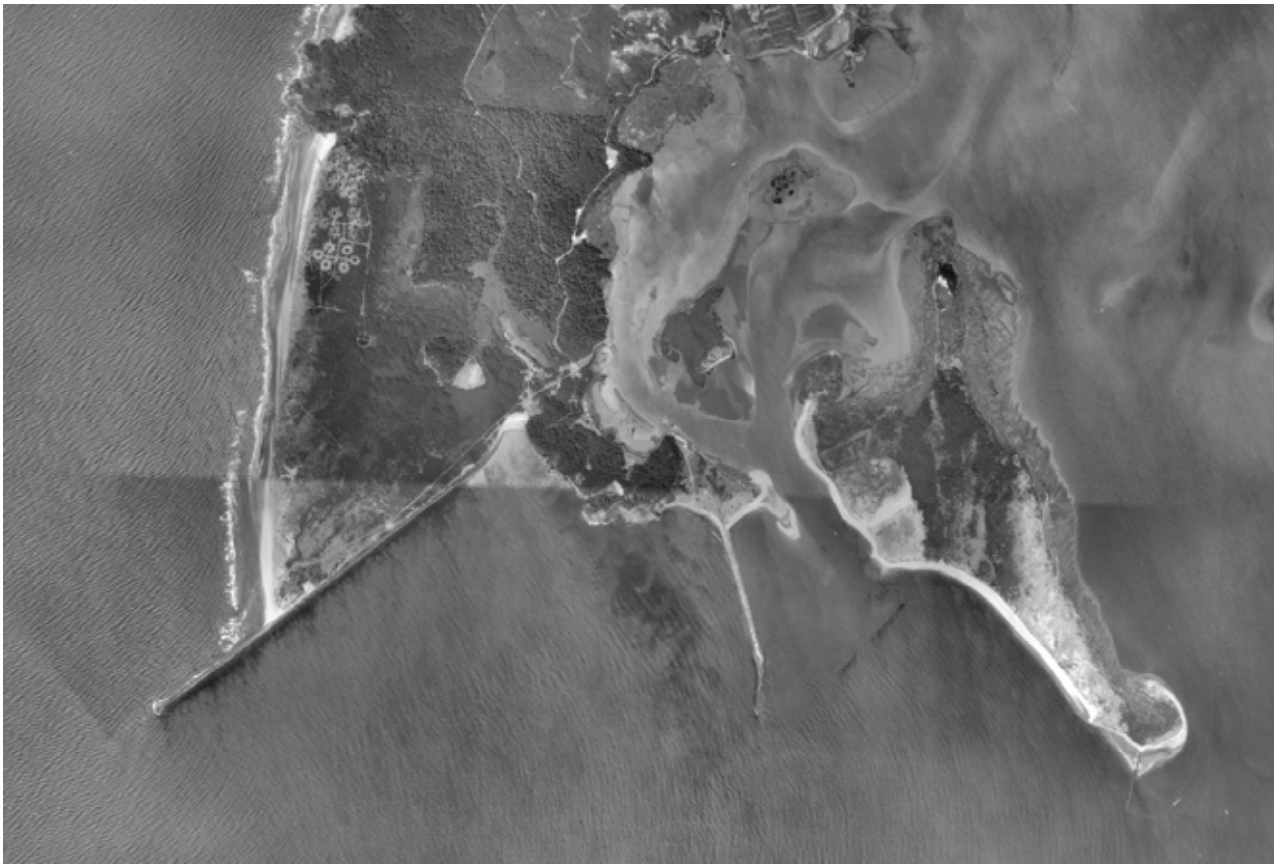
Benson Beach Phase III Study
Geophysical Investigation

August 2003



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Benson Beach Phase III Study
Geophysical Investigation

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF MAPS (ATTACHED)

Sheet 1: Interpreted Bedrock Contour Map

Sheet 2: Survey Tracklines

Acronyms and Abbreviations

USACE	US Army Corps of Engineers
ASCII	American Standard Code for Information Interchange
DEA	David Evans and Associates, Inc.
DGN	MicroStation drawing file
DGPS	Differential Global Positioning System
Hz	Hertz
kHz	kilo Hertz
NAD 27	North American Datum of 1927
SPCS	State Plane Coordinate System

1.0 INTRODUCTION

The Corps of Engineers is looking to identify subsurface materials adjacent to the North Jetty at the Columbia River mouth for possible use as a sump for dredged material for eventual distribution onto Benson Beach, located on the north side of the North Jetty. Identification of in-situ materials is important to determine if the area can be dredged to the size and depth required for the sump.

David Evans and Associates, Inc. (DEA) conducted a geophysical investigation of the area of interest near the North Jetty on the Columbia River. The primary goal of the investigation was to help identify subsurface materials that will impact planned dredging operations in the area. Survey operations were conducted on August 26, 27 and 28, 2003. This report describes the control used for the survey, data acquisition methodology, and an interpretation of the data obtained. In addition to this report, deliverables include a project CD-ROM, containing digital data, MicroStation DGN files, and a Microsoft Word file of this report.

2.0 DATUMS AND PROJECT CONTROL

Conducting a survey on an established coordinate system, referenced by monuments, enables the survey to be reproduced at a later date. For this survey, the horizontal datum was the North American Datum of 1927 (NAD27), State Plane Coordinate System (SPCS), Oregon North Zone with units in U.S survey feet. Vertical datum for this survey is Mean Lower Low Water (MLLW) based on observed tides from the NOAA gauge in Astoria and adjusted to the North Jetty.

Positioning for this survey was provided by a differential global positioning system (DGPS) with vertical observations based on an automated water level gauge adjusted to the Corps staff gauge. Differential correctors were obtained from the US Coast Guard differential beacon at Fort Stevens, Oregon.

The survey included a general horizontal position check using DGPS techniques on the light at the south end of Sand Island. Coordinates of the light were provided by the USACE and were given as:
X = 1113157, Y = 965081. The vessel maneuvered its bow under the light, as best as possible with the given swell and current, and the position acquired agreed within +/- 5 feet. This check was used to confirm general navigation parameters and settings and not as an exact check of the accuracy of the system.

3.0 GEOPHYSICAL INVESTIGATION METHODOLOGY

3.1 SURVEY COVERAGE

The survey area was a triangular shaped region between the North Jetty on the north side of the site and the main channel of the Columbia river to the south. A total of 36 seismic lines were run within this area. Twenty-five main lines were run in a southwest to northeast orientation at a 200-foot line spacing. Eleven cross lines were run at a 500-foot spacing. A survey trackline map (Sheet 2) is included in this report.

3.2 SURVEY VESSEL AND CREW

The vessel for this survey was the *Minotaur*, a 30-foot survey boat owned and operated by Zephyr Marine. The geophysical crew consisted of a senior geophysicist from DEA and vessel operator from Zephyr Marine and a representative from the USACE.

3.3 POSITIONING AND NAVIGATION

Horizontal positions were acquired with a Trimble 4000 DGPS positioning system. Position data was used in real-time to provide navigation information to the vessel operator and was time tagged and logged with geophysical and other ancillary data. The actual survey tracks were displayed in real-time on a monitor located at the helm to aid in a systematic survey of the area. Event marks were generated at a 100-foot interval and automatically marked on the seismic paper records. In addition to logging the navigation data in the Hypack navigation system, the navigation was set over a serial line to the ISIS image processing system to be recorded along with the digital seismic data. The streamer and source were positioned on opposite sides of the survey vessel with the center point of reflection generally located beneath the GPS antenna, thus removing the need to apply offset distances.

3.4 WATER SURFACE OBSERVATIONS

Water surface measurements were obtained from the NOAA gauge # 9439040 and corrected to the North Jetty. All geophysical data from this investigation was reduced to MLLW elevations in the interpretation.

3.5 GEOPHYSICAL DATA ACQUISITION

Seismic Reflection

To meet the contract specifications a chirp sub-bottom profiler (GeoAcoustics – Chirp II) was mobilized on the vessel and tested on the site on August 26. The data from the chirp system showed very little penetration and it is believed that the system may have lacked adequate power, or had too high a frequency content, to penetrate the site materials. The chirp system was secured and the Geopulse boomer was installed. The primary seismic source for this survey was an Applied Acoustics CSP300 transceiver and a boomer plate. The center frequency of the system is approximately 700 – 1000 Hz. The boomer plate was mounted on the starboard side of the vessel at a draft of 1.5 feet. The boomer plate was fired on the 300 - joule setting at a 500 milli-second interval. The returning acoustic signals were received by two separate receivers, a short hydrophone streamer deployed from the port bow and a “line-in-cone” array deployed from the port quarter. The “line-in-cone” was developed to improve shallow water reception of seismic signals and to reduce interference from out-of-plane reflections and towing noise (i.e. flow noise). However, the line-in-cone electronics sustained damage while deployed and, due to time constraints, repairs could not be effected. The streamer data was then output to an EPC recorder and the ISIS image processing system.

Geophysical data was collected using the boomer system on August 27 and 28. During acquisition on the morning of August 28, a very strong reflective layer was encountered within the water column that blocked a significant portion of the seismic signal and interfered with the clarity of the records. It is believed that this water column reflector was caused by very dense biological activity (i.e., schools of small fish). As the tide conditions changed throughout the morning the layer “broke-up” and the record

quality improved. Several lines were re-shot prior to departing the work area to take advantage of the improved conditions.

4.0 DATA INTERPRETATION

4.1 ACCURACY AND LIMITATIONS OF DATA

The primary goal of the survey was to delineate material changes down to 40 feet below the bottom. Based on the system used, medium-low frequency seismic, it appears the zone of interest in the survey area is fairly consistent. Laterally, there appears to be no significant changes in acoustic character, which would be expected with drastic differences in material. Vertically, the region appears to consist of a homogenous upper unit in which the return is basically weak and chaotic with some noise from out of the plane biota mixed in. This section is probably comprised of massive sands with little or no internal structure evident. The system achieved good penetration as evidenced by deep return that climbs toward the seafloor as the vessel transited toward the rock outcrops at Cape Disappointment (see Figure 1). This horizon, which is detectable to elevation 175 feet MLLW, is interpreted as top of bedrock. The top of bedrock was mapped with the ISIS image processing system, which output a file of events and milliseconds to interpreted horizon. These files were then adjusted for two-way travel time using an assumed velocity of 5500 feet/second, draft corrected for source and streamer towing depth and tide corrected. The final depths were correlated with XY positions at each event and contoured using Terramodel software. The interpreted bedrock contour map is depicted in Sheet 1 of this report. The elevation values associated with the interpreted horizon are believed to be accurate to +/- 3 feet.

The USACE provided two vibrocore logs, 204 and 205, taken shortly after the seismic survey. The locations of these cores are shown on both drawings. The data at each location was compared with the seismic records, however the distinction between the very-fine to fine sands in 204 and the fine to med sands in 205 was not discernable. Seismic signals are reflected off of interfaces where there is a change in the acoustic impedance of the contacting materials. The higher the contrast in acoustic impedance between materials the better the interface will act as a reflector for the seismic signal and have a higher “reflection coefficient”. A slightly greater contrast in grain size would most likely have yielded a reflection coefficient detectable by the boomer system. Results of the vibratory coring are detailed in a report to the USACE titled “Vibrocore Investigation at the MCR”, Washington Department of Ecology, October 2003, by George Kaminsky.

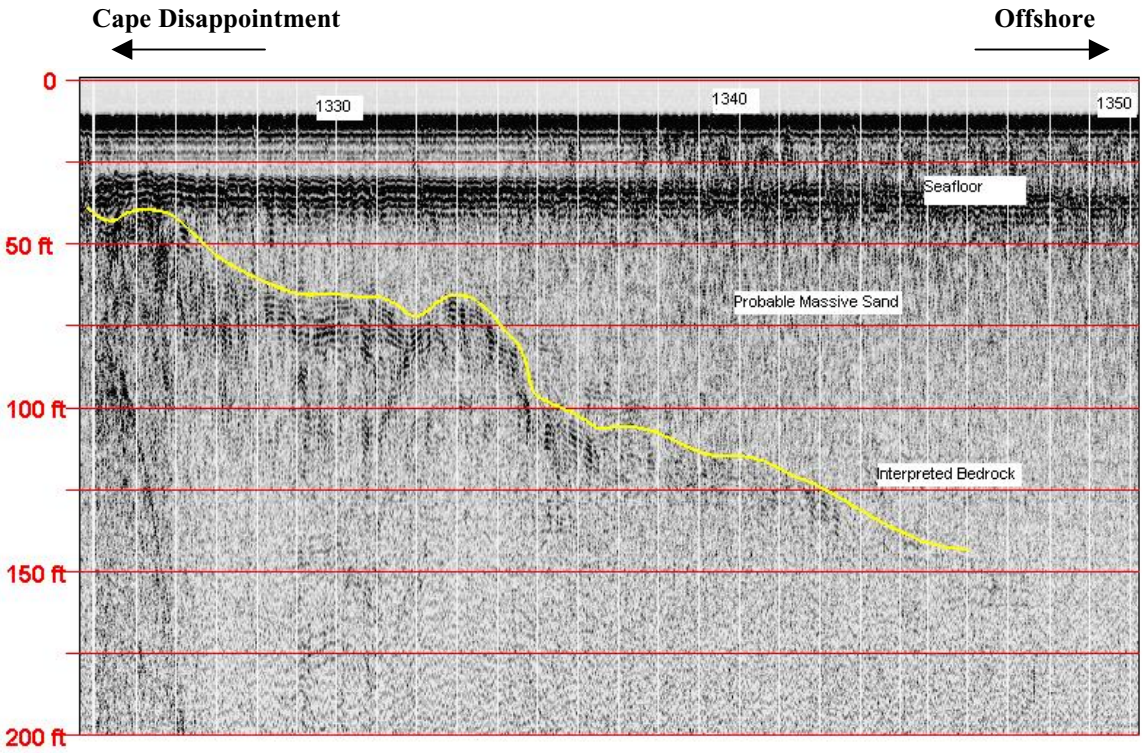

Figure 1*:* **Representative boomer record near North Jetty in the Columbia River. Interpretation shows massive sands over bedrock.**

5.0 RECOMMENDATIONS

The geopulse system was successful in penetrating the deep sands encountered at the survey site and detected bedrock within the zone of interest (40 feet below the seafloor, approximate elevation –70 feet MLLW). However, this system was not able to discern the subtle grain size differences detected in the two vibrocores taken in the survey area. It is difficult to resolve subtle grain size differences with acoustic systems. A more extensive bottom-sampling program would provide better delineation of these subtle differences.