

Dredged Material Management Plan

**RESULTS OF THE OCTOBER 2000 BATHYMETRIC SURVEY AT
CANDIDATE DISPOSAL SITE 1 IN BUZZARDS BAY**

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Dredged Material Management Plan Phase 2C
MEPA Scope Item III

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EXECUTIVE SUMMARY

Areas in Buzzards Bay having water depths greater than about 12 m have been identified as preferred locations for dredged material disposal, because such areas have the potential to limit sediment resuspension and maximize long-term capacity, while accommodating access by deep draft hopper dredges. A May 1998 bathymetric survey at the historic Cleveland Ledge Disposal Site in eastern Buzzards Bay revealed the presence two distinct seafloor basins having water depths greater than 12 m; these basins were subsequently selected as potential dredged material disposal locations. Candidate disposal Site 1 is a square area measuring 1600 m × 1600 m, while candidate Site 2 is a rectangular area measuring 1000 m × 1700 m.

The May 1998 bathymetric survey encompassed all of candidate Site 2, but only a portion of Site 1. Therefore, a second survey was conducted in October 2000 to obtain high-resolution bathymetric data encompassing all of Site 1 and its immediate surrounding area. This bathymetric survey was part of a larger study to collect baseline physical and biological characterization data at candidate Sites 1 and 2 and nearby reference areas, in support of the overall disposal site designation effort.

Most of the seafloor area within and south of candidate Site 1 was found to consist of a relatively broad topographic depression or basin. Within the boundary of candidate Site 1, the bottom sloped gently downward from northwest to southeast, with depths of 11 m in the northwest corner increasing to 14 m in the southeast corner. Almost all of the area within the boundary of candidate Site 1 had water depths greater than 12 m, with the majority of the site having depths between 13 and 14 m. It was hypothesized that the basin within Site 1 is largely depositional, because it is protected from the effects of storm waves and currents by shallower seafloor areas located to the west, north, and east. Candidate Site 2 likewise is located over a topographic depression that appears to be relatively well-protected by surrounding, shallower seafloor areas.

The area surveyed in October 2000 partially overlapped the area surveyed in May 1998. In the area of overlap, there were no changes in bottom topography detected between the two bathymetric surveys. These results indicate a lack of significant sediment erosion or accumulation in this area over the 29-month period between the two surveys. If candidate Site 1 were to be filled with dredged material until reaching a uniform water depth of 6 m across the site, its capacity was estimated to be 23,990,175 yd³ (18,341,113 m³). Likewise, if candidate Site 2 were to be filled to a uniform depth of 6 m, its capacity was estimated to be 16,423,673 yd³ (12,556,325 m³).

1.0 INTRODUCTION

1.1 Background

In 1995, the Massachusetts Department of Environmental Management (DEM) proposed to designate an open-water dredged material disposal site within the area of the former Cleveland Ledge Disposal Site (CLDS) in eastern Buzzards Bay (Figure 1-1). On 8 March 1995, the DEM filed an Environmental Notification Form (ENF) describing the proposed site, a circular area having a diameter of 500 yards centered at 41° 36.00' N, 70° 41.00' W, corresponding to the location of the former Buzzards Bay Disposal Site (BBDS) used by U.S. Army Corps of Engineers (Figure 1-2). In the ENF, the DEM indicated that the proposed new BBDS would be designated for the receipt of coarse-grained dredged material only (i.e., silt-clay fraction of 20% or less). Following regulatory response and public comment, the Secretary of Environmental Affairs issued a Certificate on the ENF on May 10, 1995, requiring the preparation of an Environmental Impact Report (EIR) pursuant to the Massachusetts Environmental Policy Act (MEPA). The required scope for the EIR is described in the Certificate (referred to herein as the MEPA Scope).

As part of a larger project to develop a Dredged Material Management Plan (DMMP) for the state of Massachusetts, the Massachusetts Coastal Zone Management Agency (MCZM) has assumed responsibility for addressing the MEPA Scope and preparing the EIR. In March 1998, MCZM filed a Notice of Project Change, proposing to designate the BBDS for all physical categories of dredged material deemed suitable for open ocean disposal (from fine- to coarse-grained), rather than limiting the designation to coarse-grained material only.

In fulfillment of MEPA Scope Item I, MCZM sponsored a Needs Analysis that documented the regional need for a disposal site, estimated the types and quantities of dredged material to be generated, and identified local, regional and state dredged material use and disposal policies (Maguire Group Inc., 1998a). Under MEPA Scope Item II, an Alternatives Analysis was completed to evaluate: 1) the potential environmental benefits and drawbacks of opening an historic disposal site versus identifying a new site, and 2) the feasibility of using the existing Massachusetts Bay Disposal Site (MBDS) or Cape Cod Disposal Site (CCDS; Maguire Group Inc., 1998b).

The Alternatives Analysis concluded that while the CCDS could be used for disposal of material from dredging projects in the northern end of Buzzards Bay, the significant transit distances generally precluded the use of either the CCDS or MBDS as cost-effective options. The Alternatives Analysis also identified several drawbacks to the BBDS as originally proposed by DEM in 1995 (Figure 1-2), including the potential for erosion of fine-grained sediment, limited access by deeper draft hopper dredges, and inadequate long-term capacity. To overcome these drawbacks, it was recommended that deeper and larger areas within and near the historic Cleveland Ledge Disposal Site be considered as potential disposal site locations.

Under MEPA Scope Item III, MCZM is required to collect data to determine the physical and biological characteristics of any proposed disposal site(s), including bathymetry, sediment grain size and chemistry, benthic community structure, bottom currents, fisheries, and water

column chemistry. Under contract to MCZM, SAIC conducted a survey in May 1998 involving high-resolution bathymetry and side-scan sonar across a relatively large area encompassing the southern half of the historic Cleveland Ledge Disposal Site (Maguire Group Inc., 1998c). The objective of this reconnaissance survey was to gather data on the physical characteristics of the seafloor to facilitate optimal siting of the proposed BBDS.

In general, the May 1998 study identified areas having water depths greater than 12 m as being preferred disposal locations, because such areas have the potential to limit sediment resuspension and maximize long-term capacity, while accommodating access by deep draft hopper dredges. The May 1998 bathymetric data revealed two locations in the surveyed area having water depths greater than 12 m: a basin located near the eastern boundary of the historic Cleveland Ledge Disposal Site (“eastern basin”) and an area near the southern boundary (“southern basin”; Figure 1-3). The eastern basin was recommended for further study as a potential disposal site, because it appears to be a depositional area with sufficient water depth and capacity, and has already been affected by past dredged material disposal. However, this site has the drawback of being close to shallow areas (e.g., Gifford Ledge to the east and the historic Cleveland Ledge “dump top” to the west), which could limit access by deeper draft vessels and potentially represent a hazard to navigation.

The deeper parts of the southern basin occur just outside the southern boundary of Cleveland Ledge Disposal Site (Figure 1-3). Since deeper areas within Buzzards Bay have the greatest potential to act as containment sites for deposited dredged material, a decision was made to establish a candidate disposal site centered near this deeper part of the Southern Basin.

1.2 Survey Objectives

The two candidate disposal sites selected for further study under MEPA Scope Item III have been designated as Sites 1 and 2 (Figure 1-4). Site 1 is a square area measuring 1600 m x 1600 m that is located over the southern basin shown in Figure 1-3, while Site 2 is a rectangular area measuring 1000 m x 1700 m that is centered over the eastern basin (Figure 1-5). The high-resolution bathymetric survey of the area performed by SAIC in May 1998 encompassed all of Site 2, but only a portion of Site 1 (Figure 1-5). Therefore, the objective of the October 2000 bathymetric survey reported here was to obtain additional high-resolution bathymetric data encompassing all of Site 1 and its immediate surrounding area. This bathymetric survey was part of a larger study to collect baseline physical and biological characterization data at candidate Sites 1 and 2 and nearby reference areas, in support of the overall disposal site designation effort.

2.0 METHODS

SAIC conducted the bathymetric field operations in Buzzards Bay aboard the R/V *Cyrpinodon* on October 18, 20, and 23, 2000. The bathymetric survey was centered at Candidate Site 1 and covered an area measuring 3200 m × 3200 m (Figure 2-1). The survey consisted of 64 lines orientated in a north-south direction and spaced at 50 m intervals, sufficient to encompass all of candidate Site 1 and the area immediately surrounding this site (Figure 2-1). The area covered in the October 2000 bathymetric survey partially overlapped with the area covered in the previous bathymetric survey of May 1998 (Figure 2-1).

2.1 Navigation

Differentially corrected Global Positioning System (DGPS) data in conjunction with Coastal Oceanographic's HYPACK[®] navigation and survey software were used to provide real-time navigation to an accuracy of ±3 m. A Trimble DSM212L Differential/GPS receiver was used to obtain raw satellite data and provide vessel position information in the horizontal control of North American Datum of 1983 (NAD 83). The Trimble receiver is a dual function unit, bringing in differential corrections as well as GPS data, to improve overall accuracy of the satellite data to the necessary tolerances. The U.S. Coast Guard differential beacon broadcasting from Chatham, MA (325 KHz) was utilized for real-time satellite corrections due to its geographic position relative to the survey area in eastern Buzzards Bay.

The DGPS data were ported to HYPACK[®] data acquisition software for position logging and helm display. The bathymetric survey lines were established before the commencement of survey operations and stored in a project database. The position of each depth sounding was logged with a line number and time stamp in Universal Time Coordinate (UTC); these were saved electronically in the HYPACK[®] acquisition computer for post processing.

2.2 Bathymetric Data Collection and Processing

HYPACK[®] was interfaced with a Raytheon DE719D MK2 survey fathometer for the collection of depth soundings over the predetermined survey lines to characterize the seafloor topography. The fathometer uses a narrow beam (3°), 208 kHz transducer. Approximately 10 measured depth values were collected at a resolution of 1.0 cm, adjusted for transducer depth (draft), and transmitted to HYPACK[®] within a one-second interval. The fathometer data recorded by HYPACK[®] were averaged, merged with time and DGPS position information, and written to a series of navigation log files at a frequency of 2Hz. At the conclusion of the survey, raw depth soundings were plotted over the survey lines to re-create vessel track and verify data quality.

To adjust the soundings for variation of sound velocity through the water column, a Seabird Instruments, Inc. SEACAT SBE 19-01 Conductivity, Temperature, and Depth (CTD) probe was used to obtain sound velocity profiles at the start, midpoint, and end of each survey day. A mean sound velocity was calculated for each day from the profile data and entered into HYPACK[®]. The sound velocity data were then used to develop a depth correction factor, based on the ratio of actual sound velocity within the water column to the fathometer setting.

The bathymetric data were later processed and analyzed using HYPACK's single beam data processing module. Each raw bathymetric survey line was corrected for outliers caused by cavitation or excess noise in the water column. The soundings were then corrected for sound velocity within the water column, and standardized to Mean Lower Low Water (MLLW) using National Oceanographic and Atmospheric Administration (NOAA) observed tides.

Observed tidal data were obtained through NOAA's Ocean and Lake Levels Division's (OLLD) National Water Level Observation Network. This network is composed of water level stations located throughout the continental United States and abroad that are equipped with the Next Generation Water Level Measurement System tide gauges and satellite transmitters. A large number of these stations have collected and transmitted tide data to the central NOAA facility every six minutes since 1 January 1994. Tidal data are available 1 to 6 hours from the time of collection in station datum or referenced to Mean Lower Low Water (MLLW) and based on Universal Time Coordinate (UTC). The NOAA 6-minute tide data were downloaded in the MLLW datum and corrected for tidal offsets. SAIC utilized the water level data from station 8452660 in Newport, RI and applied time and height corrections based on Buzzard's Bay.

Upon completion of all of the processing steps applied to the bathymetric soundings, the data was spatially sorted (selected soundings) to reduce along track data concentration. This process was conducted within HYPACK[®] and is designed to reduce a large bathymetric dataset by taking a predefined radius and applying one sounding to that area along a line. The search area used for this survey was 10 m, and was derived based upon the low relief characteristics of the topography in Site 1. If the survey area had more topographic relief, such as shallow peaks and deep basins, a smaller search area would have been used. The sorting process is not necessary, but is included to produce a streamlined dataset to facilitate the gridding process.

After the data set had been reduced through the selected soundings process, all of the survey lines were exported out of HYPACK[®] into a comma delimited XYZ file. This file was imported into the ArcView Geographic Information System (GIS) for data gridding and for graphic generation. The dataset was gridded at a 50 m cell size using the "nearest neighbor" gridding routine, to allow representative modeling of the bathymetric survey area. The gridding process takes the data and averages it within a 50 m cell. The 50 m cell size was chosen because it provided a good representation of the actual soundings and allowed comparisons to be made with the May 1998 data set.

3.0 RESULTS

The color contour map shows that water depths across the surveyed area range from 8 to 16 m (26 to 54 feet; Figure 3-1). The shallowest area (8 m) occurs at the apex of a small mound feature located south of the former BBDS; this is the former Cleveland Ledge Disposal Site “dump top” that has been observed consistently in this location in previous surveys. Overall, depths within the surveyed area increase gradually from north to south. Average depths in the northern part of the surveyed area, within the Cleveland Ledge Disposal Site boundary, range from 11 to 12 m, with depths increasing to 14 m moving toward the southeast, away from the former disposal site boundary.

The southern half of the surveyed area appears to represent a large topographic depression, or basin, feature. There is a narrow, “submerged channel” feature with a depth of 16 m located on the eastern edge of the surveyed area, and this feature connects with and opens up onto the northern half of the basin, where depths of about 13 m are encountered (Figure 3-1). The width of the basin increases moving southeasterly across the surveyed area, with depths of 14 m encountered in the southeast corner of the survey. A three-dimensional perspective of the survey results helps to illustrate the bottom topography (Figure 3-2).

Within the boundary of candidate Site 1, the bottom slopes gently downward from northwest to southeast, with depths of 11 m in the northwest corner increasing to 14 m in the southeast corner (Figures 3-1 and 3-2). Almost all of the area within the boundary of candidate Site 1 has water depths greater than 12 m, with the majority of the site having depths between 13 and 14 m. A close examination of the outer edges of the surveyed area in Figure 3-1 shows good agreement between the depths measured in the October 2000 bathymetric survey and those depicted on the underlying NOAA chart. For example, the depth of 14 m in the southeast corner of the surveyed area matches the depth of 46 ft shown on the NOAA chart, while the depth of 11 m in the southwest corner matches the nearby NOAA chart depth of 33 ft (Figure 3-1).

The area surveyed in October 2000 partially overlapped the area surveyed in May 1998 (Figure 3-3). In the area of overlap, the results of the two surveys were compared to determine if there were any significant changes in bottom topography in the intervening time period. Two small areas of apparent depth change were calculated over locations representing topographic high points, having vertical relief greater than that found on the surrounding seafloor (Figure 3-4). In such locations, it is known that minor deviations in depth measurements can become exaggerated when successive bathymetric surveys are compared. These apparent depth changes are considered to be exaggerations or artifacts of the depth differencing procedure. Therefore, the “depth difference” comparison was interpreted as showing no significant topographic changes between the two consecutive surveys (Figure 3-4).

Because there were no significant changes in depth between the May 1998 and October 2000 surveys, two- and three-dimensional maps of the composite survey results were prepared (Figures 3-5 and 3-6). These maps serve to illustrate how the locations of candidate Sites 1 and 2 correspond with the areas of bottom having depths greater than 12 m. Candidate Site 2 is located over a relatively deep trough located in the southeast corner of the historic Cleveland Ledge Disposal Site, where maximum depths reach 16 m (Figures 3-5 and 3-6). However, this

trough is bounded closely by the “dump top” mound feature (depth = 8 m at the mound apex) to the west and by Gifford Ledge (depth = roughly 3 m) to the east. As previously indicated, most of candidate Site 1 is located over bottom having a depth of 13 to 14 m.

4.0 DISCUSSION

The results of the October 2000 bathymetric survey provide a detailed characterization of the bottom topography both within and surrounding candidate Site 1. These results serve to confirm the prediction that the water depths of greater than 12 m observed in May 1998 near the southern boundary of the historic Cleveland Ledge Disposal Site would continue southward. The October 2000 survey shows that most of the area within and south of candidate Site 1 represents a relatively broad, gradually-sloping topographic depression (Figure 3-1). The 3-dimensional views (Figures 3-2 and 3-6) suggest that this depression potentially would be protected from the effects of storm waves and higher-energy bottom currents by shallower areas located to the west, north, and east. Based on the bathymetric results alone, candidate Site 1 appears to be located in a potential depositional or quiescent area of seafloor.

Candidate Site 2 likewise is located over a topographic depression that appears to be relatively well-protected by surrounding, shallower seafloor areas. The western and southern “walls” of this depression are sloped steeply, while the bottom slopes downward more gradually moving across the site from north to south (Figures 3-5 and 3-6). As previously indicated, both the “dump top” mound feature located immediately west of candidate Site 2 and Gifford Ledge to the east are relatively shallow areas which could represent potential hazards to navigation for barges and/or larger hopper dredges moving into or out of a disposal site in this location.

The bathymetric results and candidate site boundaries shown in Figure 3-5 can be used to develop some rough capacity estimates for candidate Sites 1 and 2. If candidate Site 1 were to be filled with dredged material to a uniform depth of 6 m across the site, its estimated capacity would be 23,990,175 yd³ (18,341,113 m³). Likewise, if candidate Site 2 were to be filled to a uniform depth of 6 m, its estimated capacity would be 16,423,673 yd³ (12,556,325 m³).

Using different fill levels and site configurations, any number of capacity estimates can be generated in the future. The bathymetric survey results presented here will be useful for this purpose, as development of the EIR proceeds and siting of the BBDS is optimized. In addition, the May 1998 and October 2000 bathymetric surveys at candidate Sites 1 and 2 provide basic information on seafloor topography that will be instrumental in interpreting the results of other site studies being conducted in support of the EIR (e.g., sediment-profile imaging, sediment chemistry, benthic community structure, bottom currents).

5.0 REFERENCES

Maguire Group, Inc. 1998a. MEPA Scope I: Needs Analysis. Submitted to MCZM under Phase 2 of the Dredged Material Management Plan (in association with SAIC).

Maguire Group, Inc. 1998b. MEPA Scope II: Alternatives Analysis. Submitted to MCZM under Phase 2 of the Dredged Material Management Plan (in association with SAIC).

Maguire Group, Inc. 1998c. Physical Characterization of the Proposed Buzzards Bay Disposal Site. Submitted to MCZM under Phase 2 of the Dredged Material Management Plan (in association with SAIC).

FIGURES

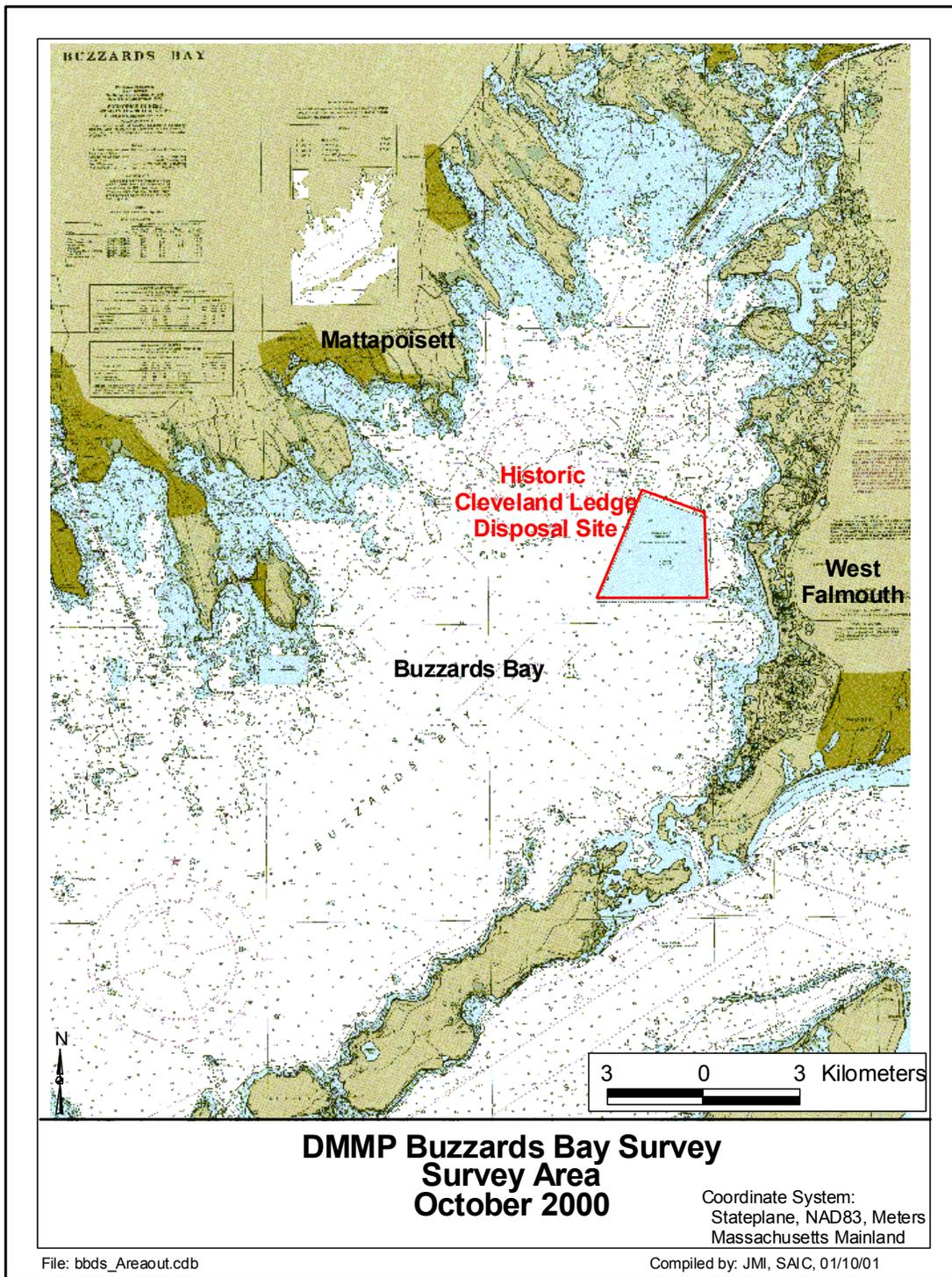


Figure 1-1. General location map showing the boundary of the historic Cleveland Ledge Disposal Site on the eastern side of Buzzards Bay, off of West Falmouth (from NOAA Nautical Chart 13229).

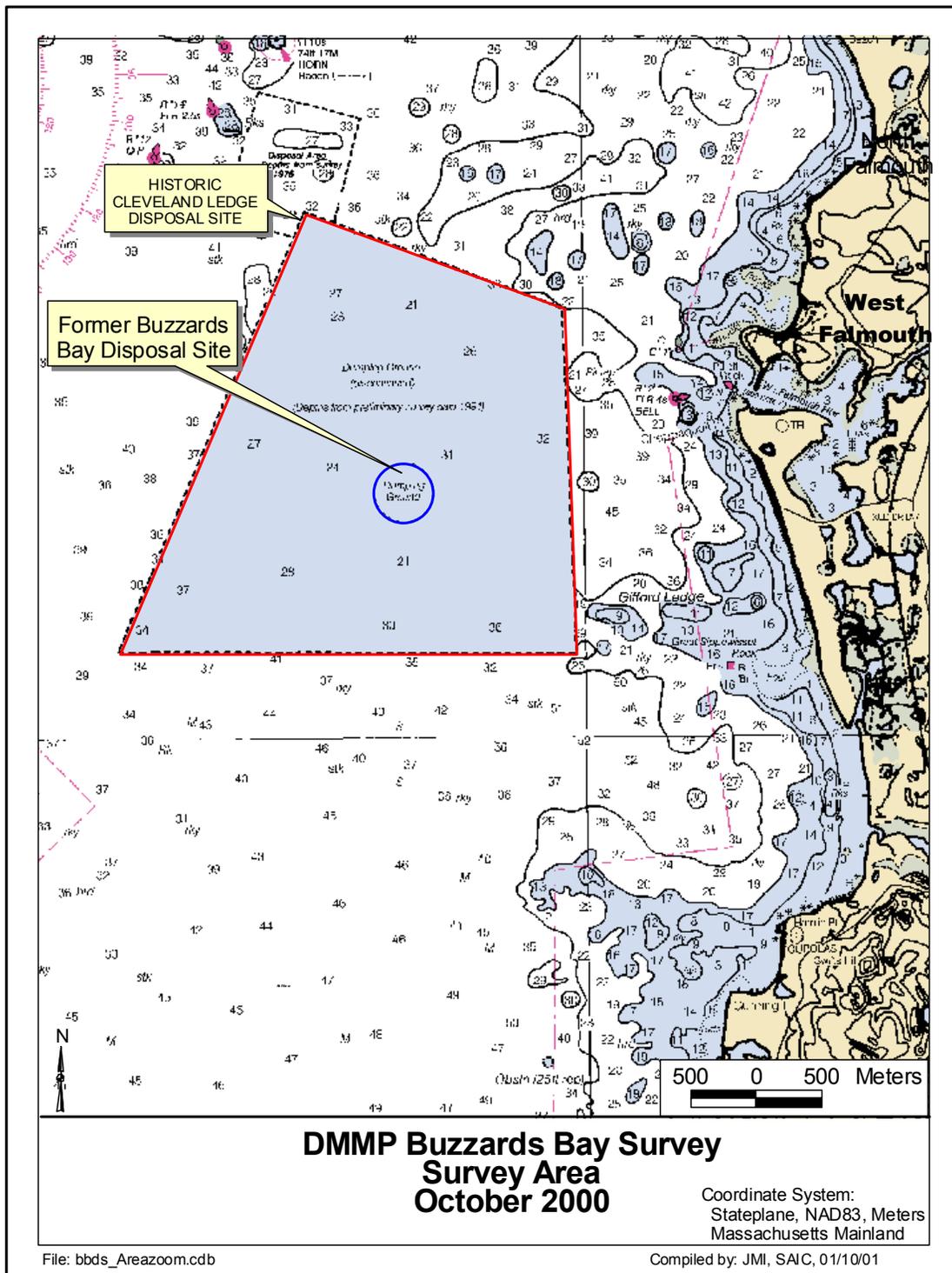


Figure 1-2. Map of the historic Cleveland Ledge Disposal Site showing the location of the former Buzzards Bay Disposal Site (BBDS). In 1995, Massachusetts DEM proposed the designation of a new BBDS in the same location.

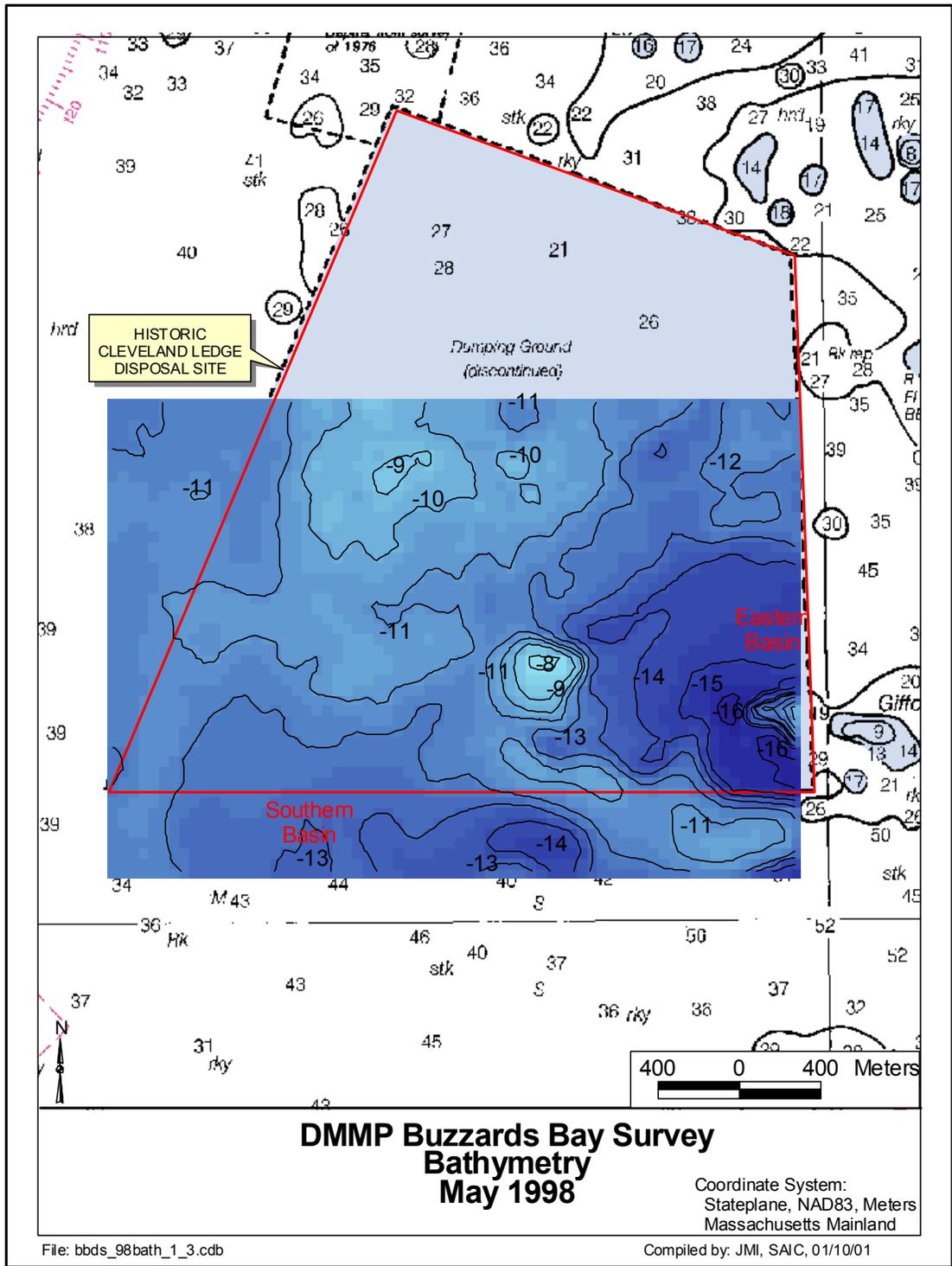


Figure 1-3. Results of the high-resolution bathymetric survey conducted across the southern half of the Cleveland Ledge Disposal Site in May 1998, superimposed on NOAA Nautical Chart 13229. Depths from the bathymetric survey are in meters; nautical chart depth soundings are in feet.

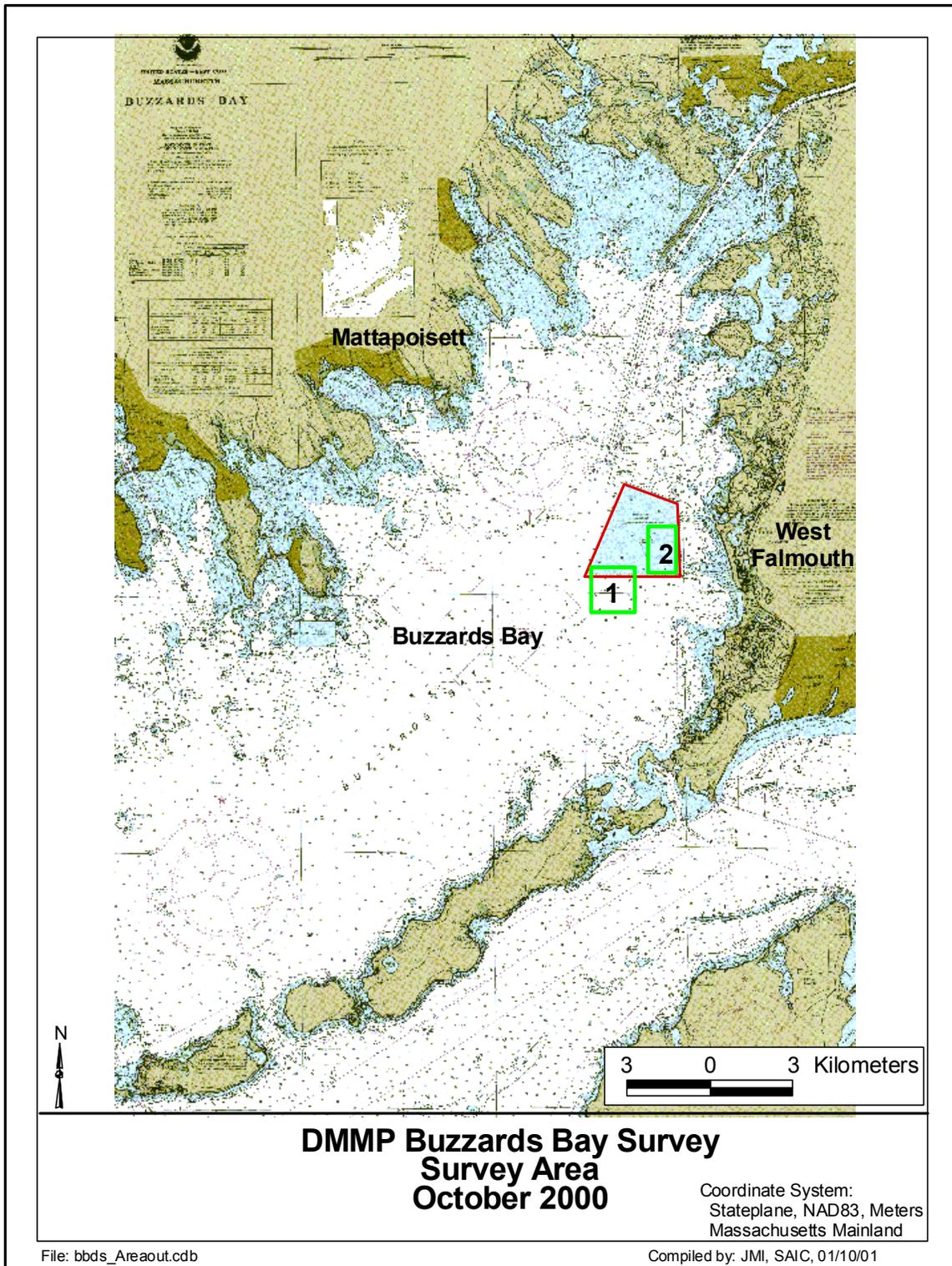


Figure 1-4. Map showing the general location of candidate Sites 1 and 2 in eastern Buzzards Bay and in relation to the boundary of the historic Cleveland Ledge Disposal Site.

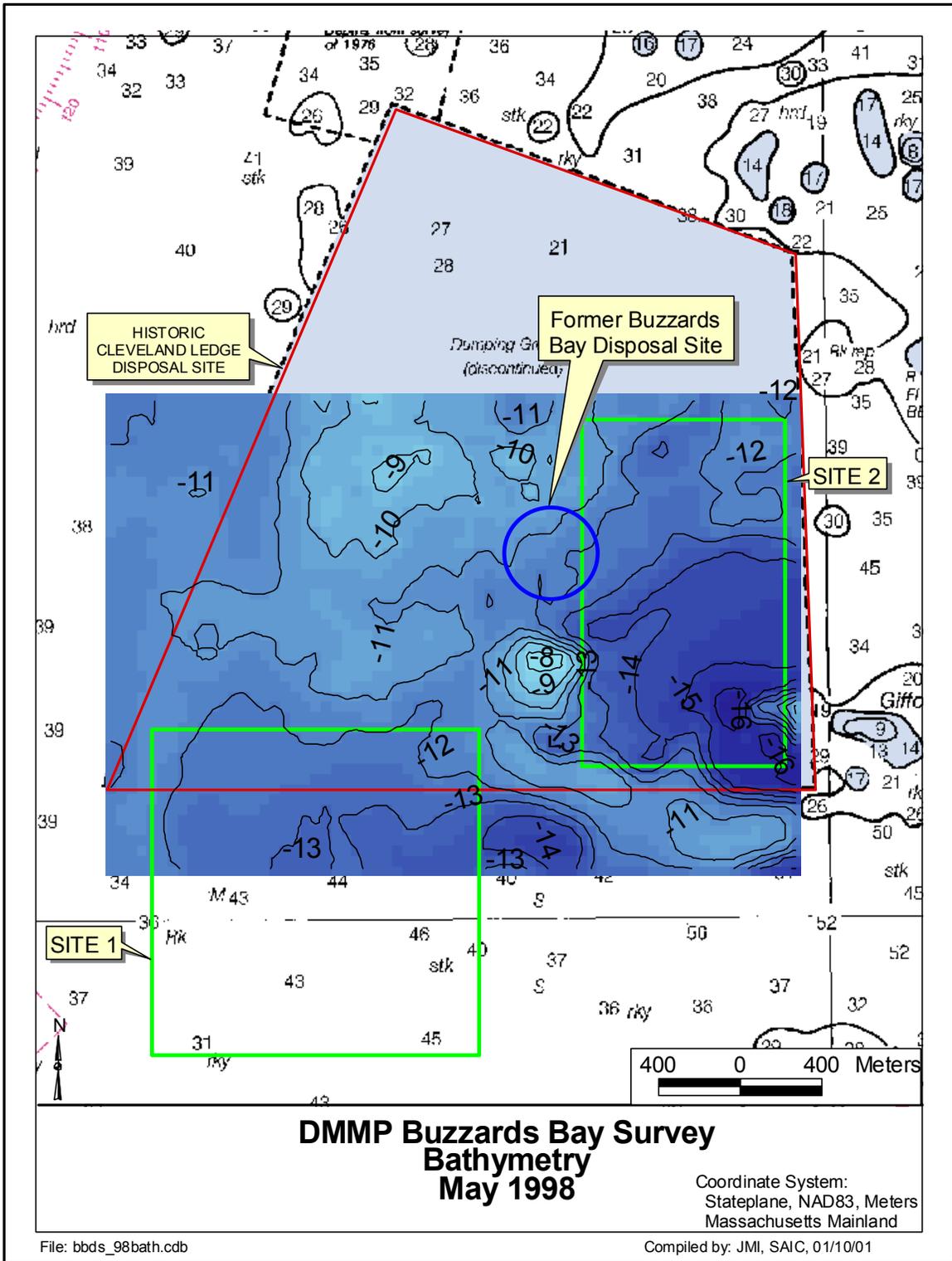


Figure 1-5. Close-up view showing the locations of candidate Sites 1 and 2 in relation to the May 1998 bathymetric survey results.

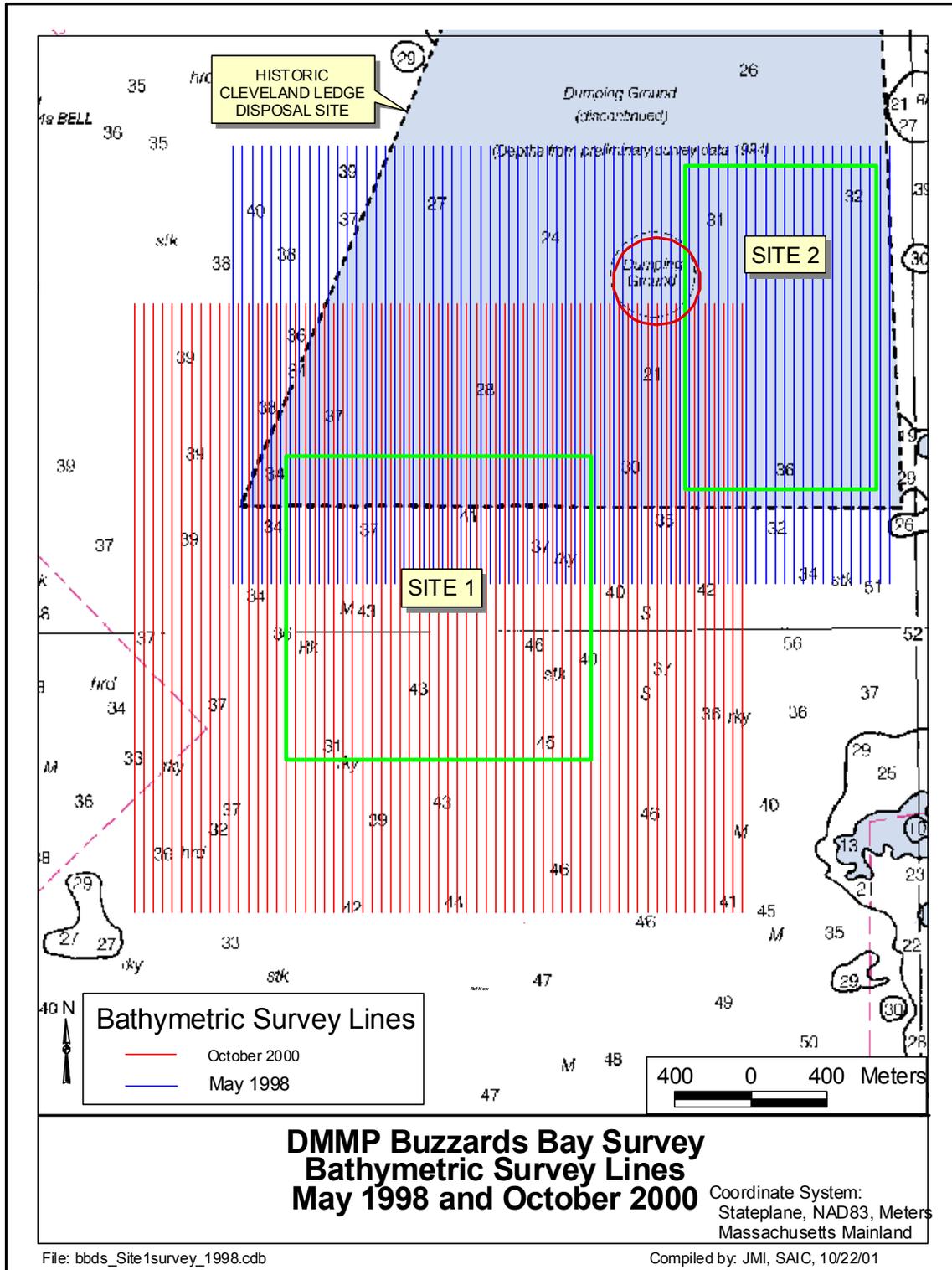


Figure 2-1. Map showing bathymetric survey lines occupied around Site 1 in October 2000 (red) and the survey lines from the May 1998 bathymetric survey (blue).

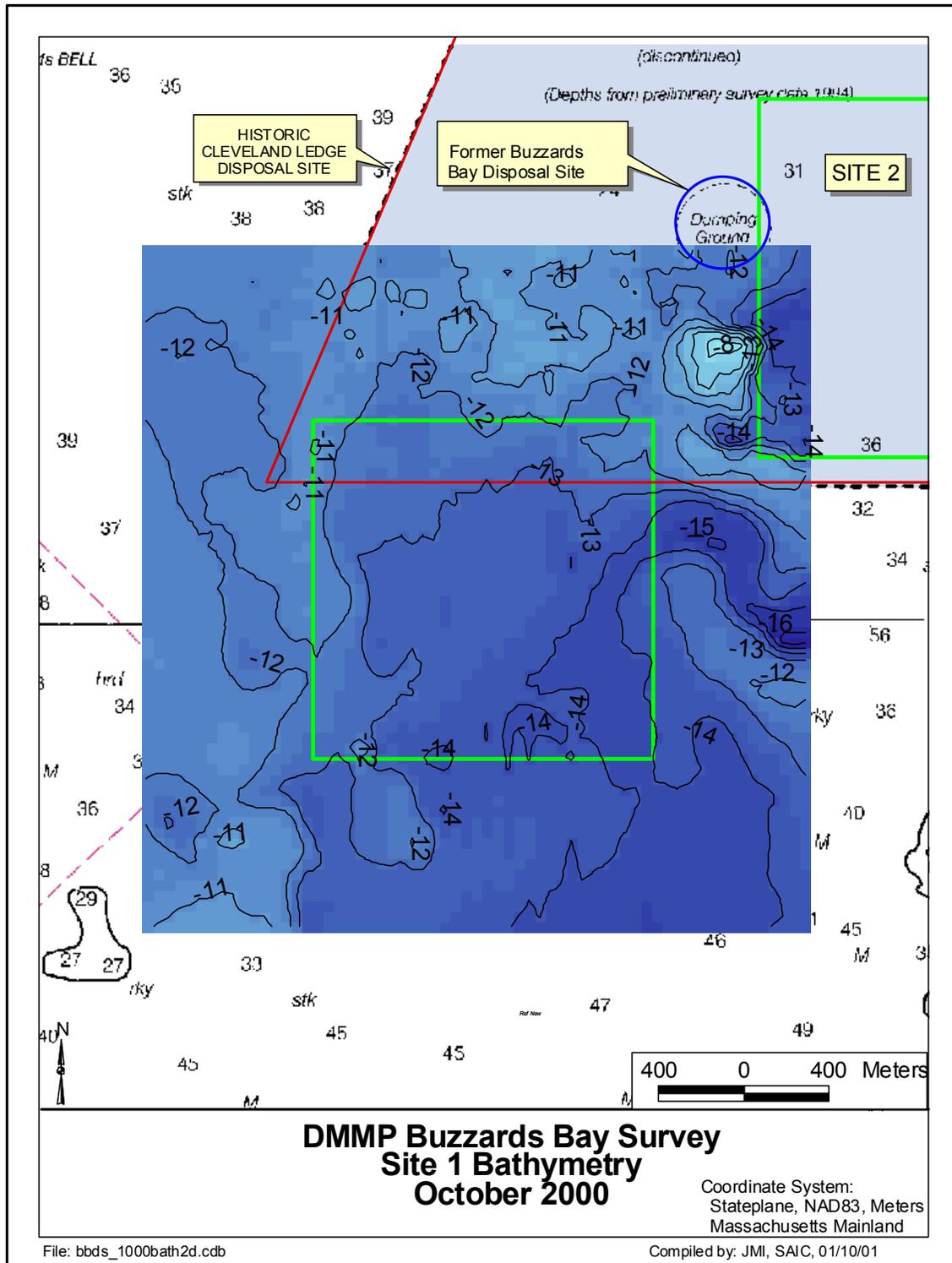


Figure 3-1. Map showing depth contours (in meters) in and around candidate Site 1, superimposed on NOAA Nautical Chart 13229. Depth soundings on the underlying NOAA chart are in feet.

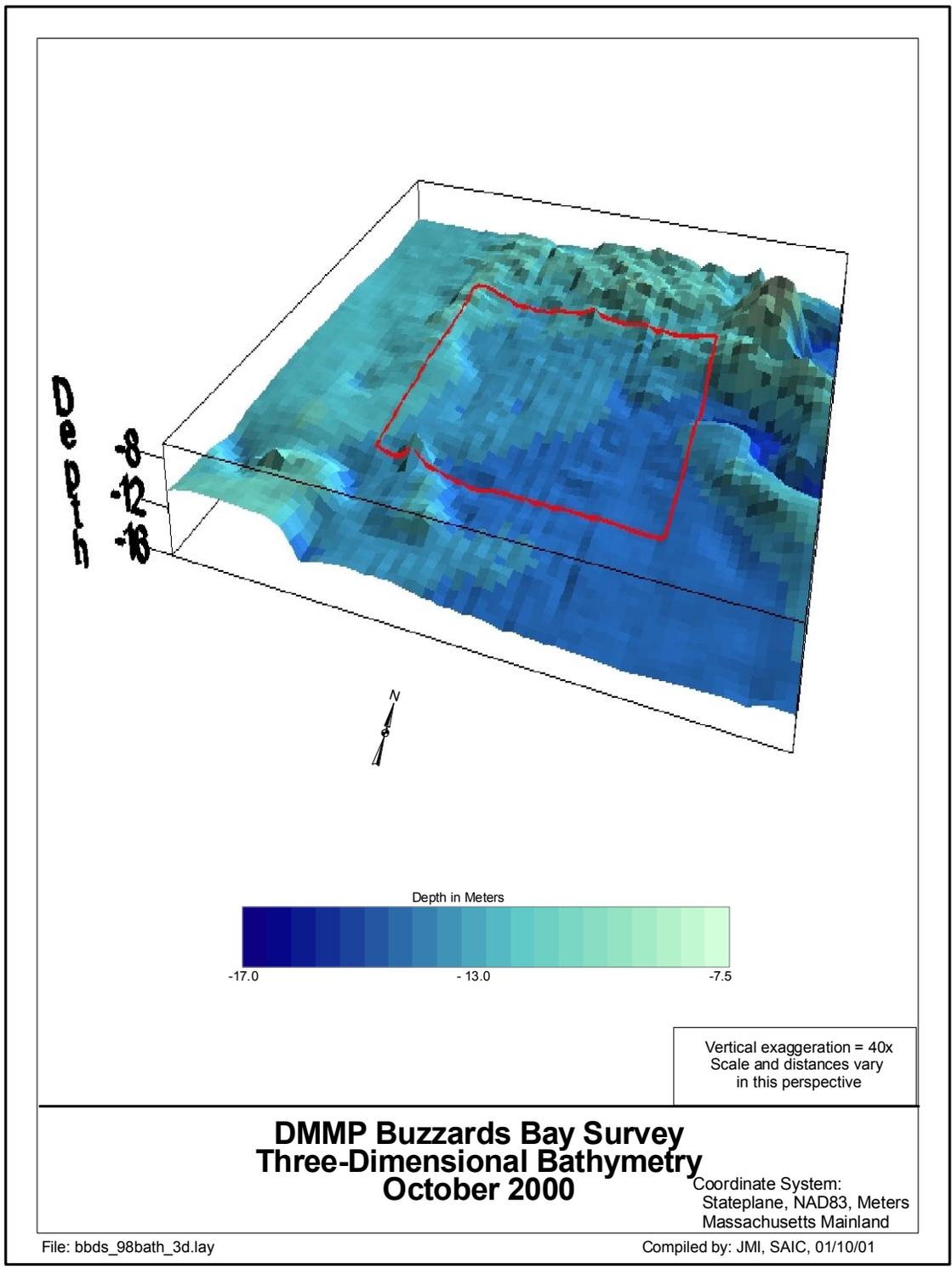


Figure 3-2. Three-dimensional representation of the October 2000 bathymetric survey results at candidate Site 1 (note: vertical exaggeration of 40X causes scale and distances to be distorted in this perspective).

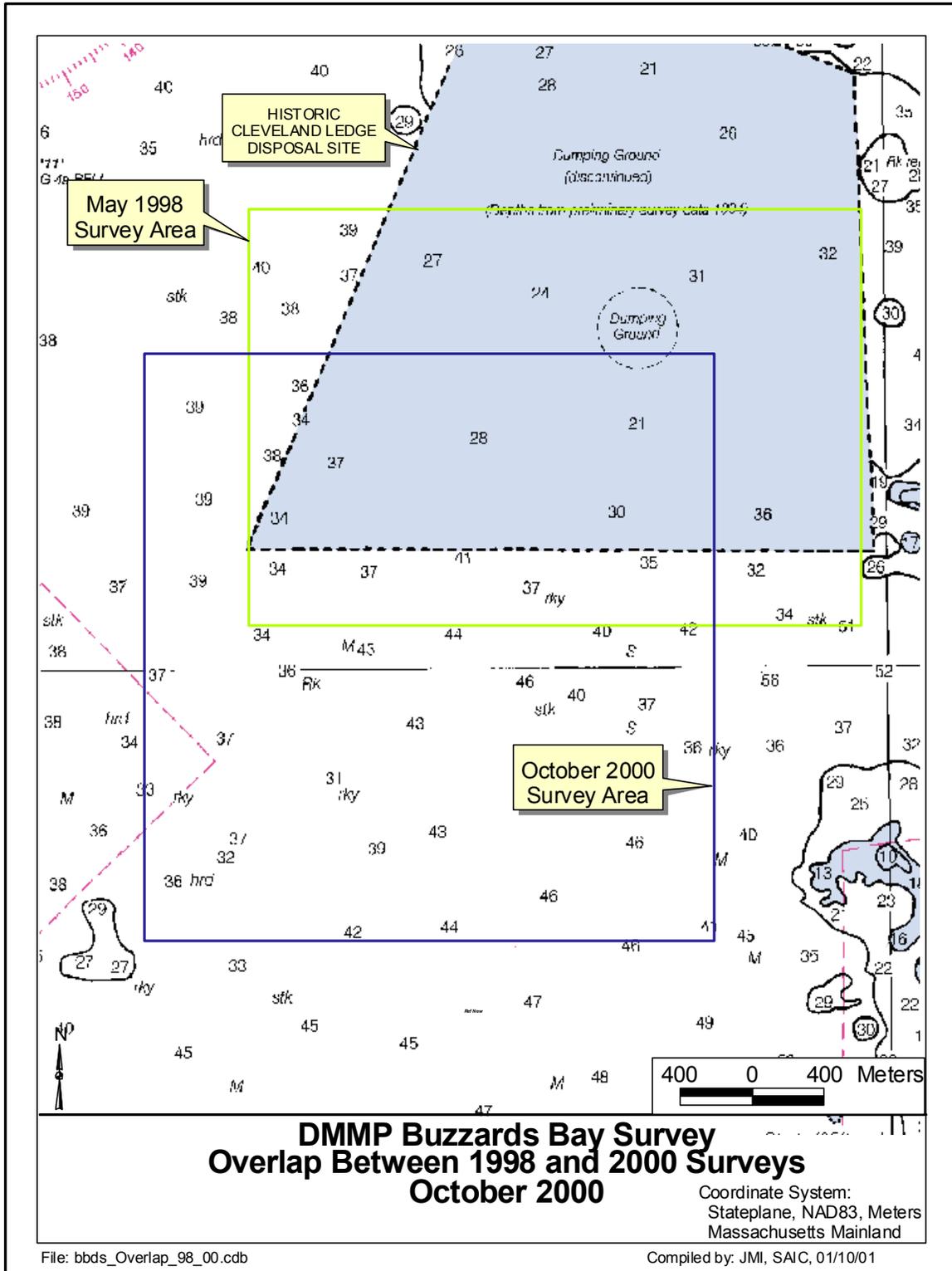


Figure 3-3. Map showing the area of overlap between the October 2000 and May 1998 bathymetric surveys at the historic Cleveland Ledge Disposal Site.

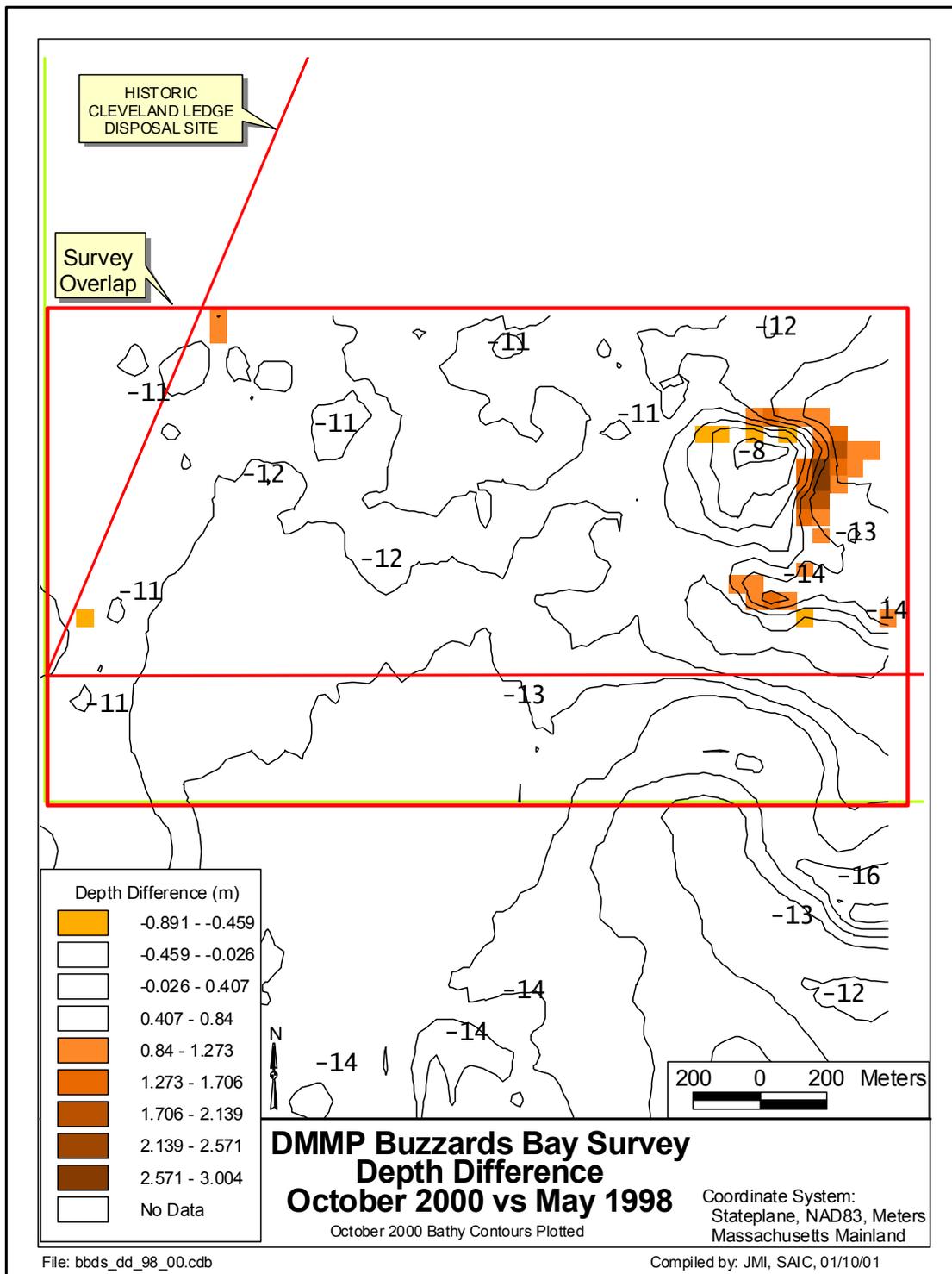


Figure 3-4. Map showing the results of the depth difference comparison between the October 2000 and May 1998 bathymetric surveys. The depth difference results (in meters) are superimposed on the bathymetric contours from the October 2000 survey.

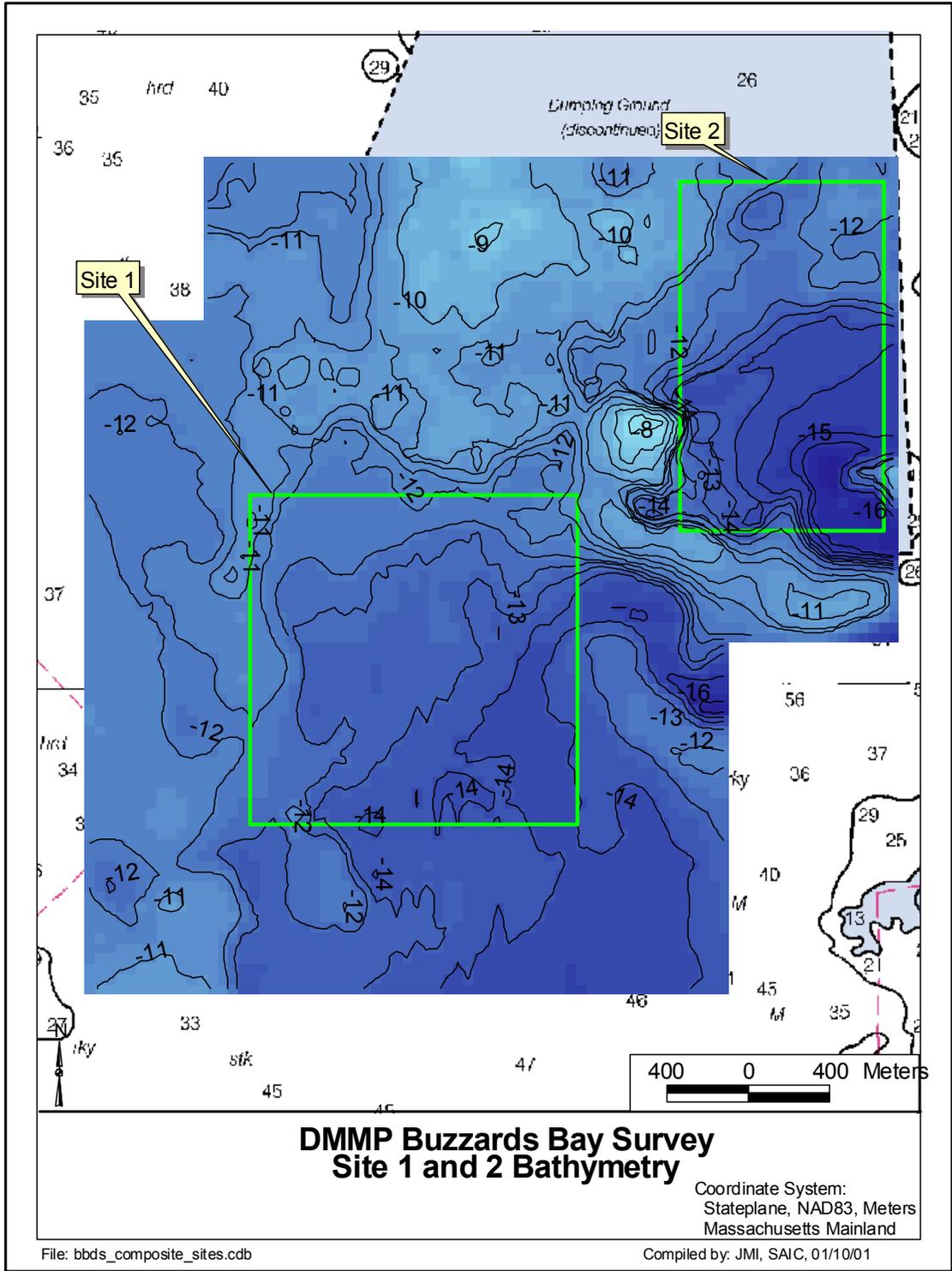


Figure 3-5. Two-dimensional contour map showing bottom topography in and around candidate disposal Sites 1 and 2 based on the combined results of the May 1998 and October 2000 bathymetric surveys.

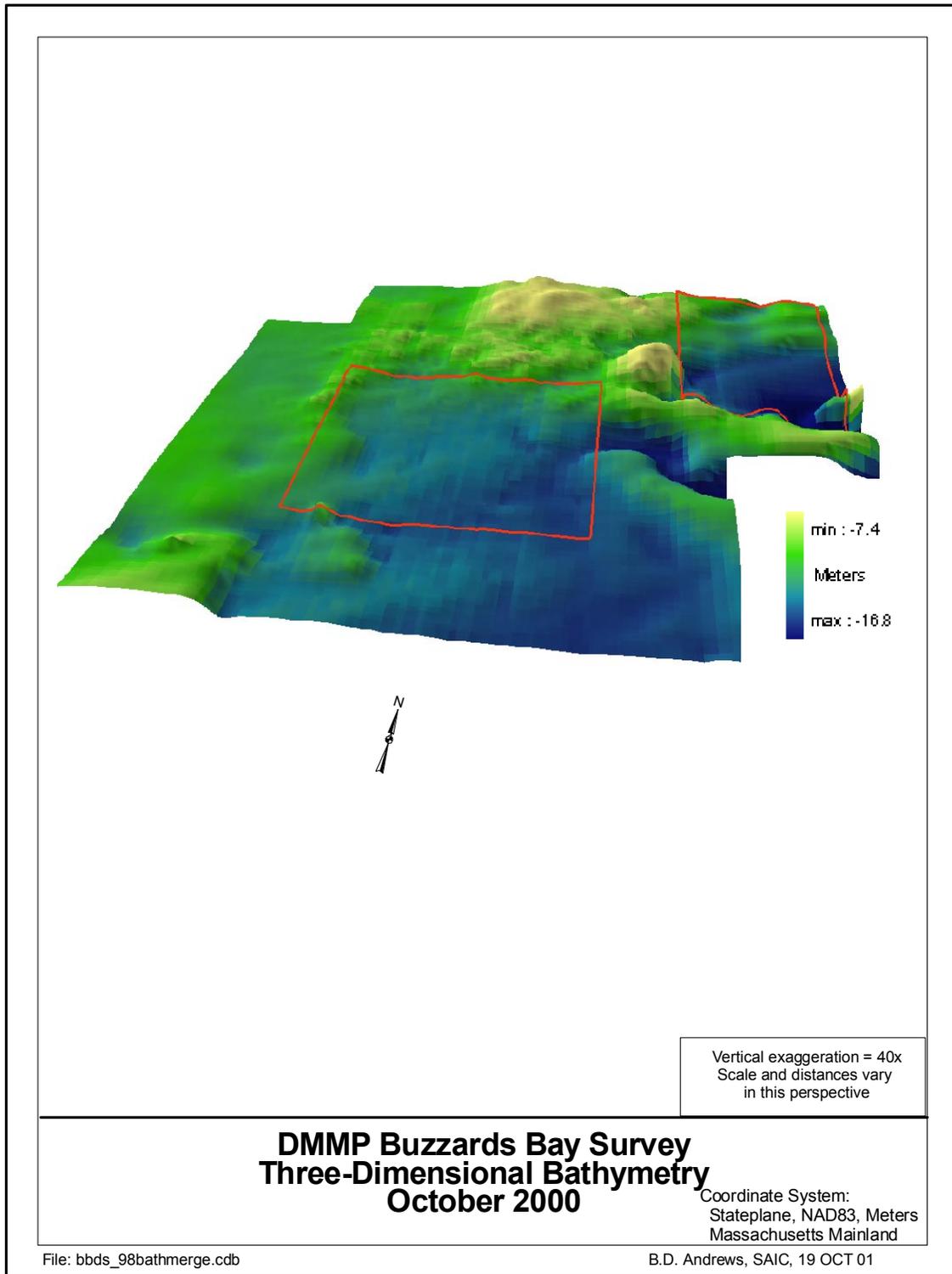


Figure 3-6. Three-dimensional map showing bottom topography in and around candidate disposal Sites 1 and 2 based on the combined results of the May 1998 and October 2000 bathymetric surveys (vertical exaggeration = 40x).