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Report of Water Masses Receiving Wastes from Ocean Dumping at the 106-Mile Dumpsite

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ABSTRACT

The 106-Mile Dumpsite, a deep ocean site located 106 miles southeast of New York, receives sewage-treatment sludge from the municipality of New York City. The site is occupied predominantly by slope water, however incursions of shelf water and warm-core rings occur periodically. Satellite infrared data are used to determine which water masses are present at the time of each dump. Records of sewage sludge dumping at the site are obtained from the Environmental Protection Agency (EPA).

This report correlates data regarding volumes and dates of dumps at the site with information on the water masses present at each dump. It is the latest in a series of summaries covering the last fifteen years. A summary of the amounts of wastes received by each of the three principal water masses for 1991 is presented.

In 1991, 1538.8 X 10^6 gallons of sewage sludge were dumped at the 106-mile site. Approximately 72 percent (by volume) of the sludge was disposed of in slope water, 7 percent in shelf water, and the remaining 21 percent was received by warm-core rings.

INTRODUCTION

The 106-Mile dumpsite is a deep ocean dumpsite in water deeper than 2000 m located between 38°40'N to 39°00'N and 72°00'W to 72°30'W. As a result of regulations imposed by the Environmental Protection Agency, part of the 106-mile site has been designated to receive municipal sewage-treatment sludge earlier scheduled to be dumped at the 12-Mile site (located in the New York Bight area, see Figure 1). The municipal sludge site is an area bounded by coordinates 38°40'N to 39°00'N and 72°00'W to 72°05'W (76.83 square nautical miles, see Figure 1). Sludge disposal began at this site in 1986 and has continued through 1991, with municipalities of New Jersey and New York the authorized dumpers. New Jersey ceased dumping in March 1991.

Oceanographic conditions in the area of the 106-Mile site were discussed by Ingham *et al.* (1977) with respect to shelf, slope, and Gulf Stream waters. The site is occupied predominantly by slope water, although incursions of other water masses occur periodically. Shelf-water incursions into the region occur most often in the spring when fresh-water runoff and increased wind forcing causes offshore movement of the shelf/slope front (Hilland and Armstrong 1980). Northward meandering of the Gulf Stream occasionally results in Gulf Stream water moving into the dumpsite region. More commonly, warm-core Gulf Stream rings may traverse the region from northeast to southwest, bringing strong currents and Gulf Stream or Sargasso Sea water to the site. Figure 1 is a schematic drawing of the dumpsite in relation to the "average" locations of the water masses in the northwest Atlantic Ocean. Figure 2 is a chart of the actual conditions that existed at a particular time (10 May, 1991), illustrating that conditions in this region are complex and dynamic in contrast to "average conditions".

METHODS

The process of identifying water masses with respect to the dates of ocean dumping at the 106-mile site was divided into three steps: 1) the water mass present at the dumpsite was determined for each day of the year; 2) the amount of sludge disposed of each day was calculated; and 3) dumped amounts were matched with the receiving water masses. Annual totals were then calculated for amounts of sludge dumped into each water mass. Methods used in these steps are described next.

The primary method of identifying the water mass present at the site on a given day involves the use of high resolution (1 km) digital data collected by the Advanced Very High Resolution Radiometer(AVHRR) sensor onboard the NOAA-series of polar-orbiting satellites. As described by Barton(1987), the data are received by telecommunication links at the University of Rhode Island Oceanographic Remote Sensing Laboratory and are atmospherically and geographically corrected and enhanced to identify thermal features. The final product is a 512 X 512 pixel sea-surface temperature (SST) image, which can be viewed on a video display screen.

Every SST image was visually inspected to determine the water mass present at the dumpsite for each day of the year. Whenever the dumpsite area was free of clouds, a direct observation was made of the water mass present. This method provided water mass identifications for 52 percent of the days in 1991.

Whenever periods of cloudy weather obscured the satellite image of the sea surface, a second method was used to determine the water masses

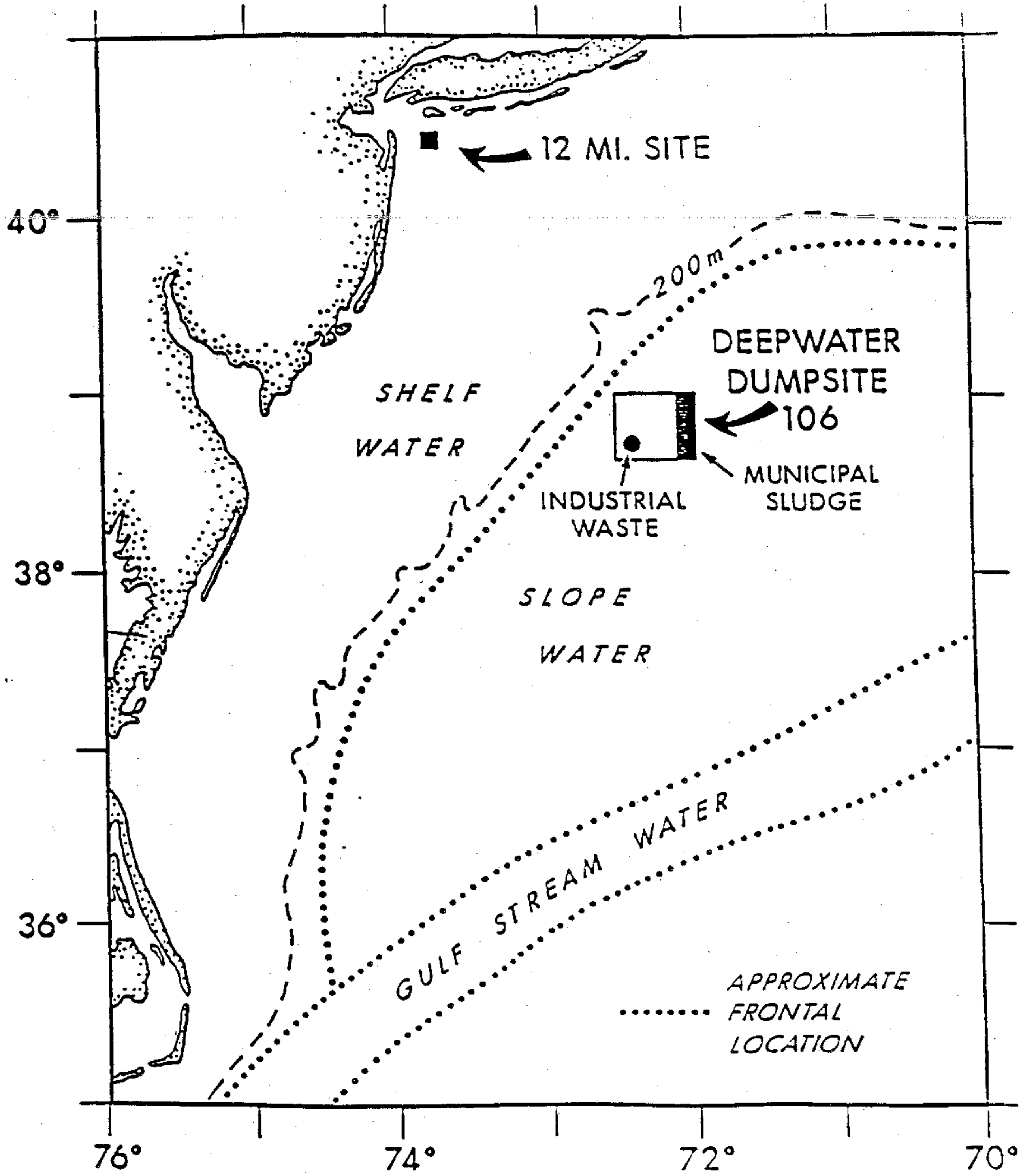

Figure 1. The 12-mile and 106-mile dumpsites and average locations of principal water masses in the New York Bight.

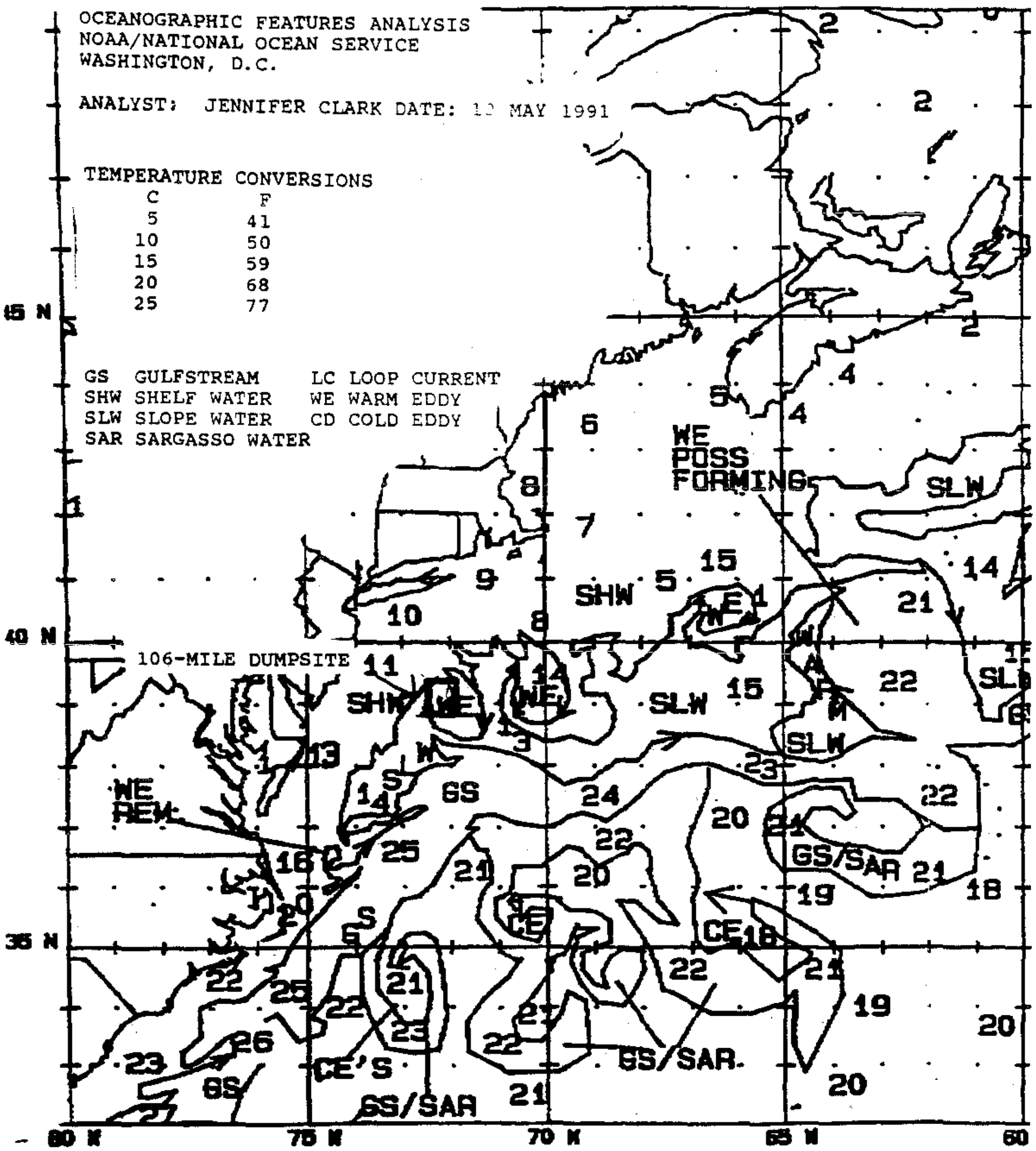

Figure 2. Oceanographic Features Analysis Chart showing sea surface thermal features and location of 106-mile dumpsite. Distributed by the National Ocean Service on 10 May 1991.

present at the dumpsite. This method, used in earlier reports (Bisagni 1985), was based on the weekly Oceanographic Feature Analysis Charts distributed by National Ocean Service (Figure 2, for example). While these charts were at a much lower resolution than the digital imagery, they provided acceptable approximations of water mass locations during cloudy periods. The dumpsite location was drawn on a transparent overlay and placed on each chart so the water mass present at the site could be noted. This method provided observations for about 18 percent of the days in the study period.

Water mass identifications for the remaining days were made using a combination of the two methods described above. This combined method was appropriate for days when the dumpsite was cloud covered but the surrounding areas were relatively clear. The combined method was also used when a given day was cloudy but the days before and after were sufficiently clear to interpolate between good images. In these cases, the estimates from imagery were confirmed by the Oceanographic Feature Analysis Charts for the same time period.

A visit was made to EPA, Region II, in New York City to examine and compile dumping records that were taken from the ocean dumping notification forms submitted by the dumpers (*i.e.*, each barge submits one form for each dump). All values were converted to units of gallons and were totaled for each day.

Finally, the amount of sludge dumped each day was matched to the water mass present for that day. Then, the total amounts dumped and percentage in each water mass were calculated. Also, the percentage of days that the site was occupied by each of the three water masses was calculated and compared to long-term means.

RESULTS AND DISCUSSION

A total of 1,538.8 X 10^6 gallons (6.58 X 10^6 wet tons) of sewage sludge were dumped at the site from 1 January to 31 December 1991. Approximately 72 percent of the sludge (by volume) was received by slope water, 21 percent by warm-core ring, and 7 percent by shelf water.

Temporally-blocked amounts of sludge dumped and the associated receiving water masses are listed in Tables 1 and 2. Table 1 lists the dates of sludge disposal, the receiving water mass, and the approximate volumes of sludge material that each water mass received. Table 2 includes the total amounts and percentages by volume of sludge and by number of dumps that each water mass received.

Slope water and warm-core rings occupied the site more frequently in 1991 (slope 71 percent, warm-core rings 22 percent) than the long-term mean (slope 66.6 percent, warm-core rings 12.1 percent) while the percentage of time shelf water was present in 1991 (7 percent) was less than the long-term mean(18.5 percent).

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Table 1. Range of dates and volumes of sewage sludge discharged into each water mass from 1 January to 31 December 1991

Range of Dates	Volume Discharged		Receiving
Month/Day/Year	10^6 Gallons	10^6 Wet Tons[1]	Water Mass
01/09/91-01/30/91	98.728	(0.422)	Slope
02/03/91-04/11/91	302.048	(1.291)	"
05/29/91-06/11/91	58.831	(0.251)	"
06/18/91-07/08/91	77.672	(0.332)	"
08/10/91-09/01/91	87.788	(0.375)	"
09/12/91-12/31/91	477.158	(2.039)	"
Total	**1102.225**	**(4.710)**	
01/31/91-02/02/91	24.605	(0.105)	Shelf
04/12/91-04/19/91	13.971	(0.060)	"
05/25/91-05/28/91	19.751	(0.084)	"
09/02/91-09/11/91	45.572	(0.195)	"
Total	**103.899**	**(0.444)**	
01/01/91-01/08/91	37.410	(0.159)	Ring
04/20/91-05/24/91	133.278	(0.570)	"
06/12/91-06/17/91	18.156	(0.078)	"
07/09/91-08/09/91	143.841	(0.615)	"
Total	**332.685**	**(1.422)**	

[1] **234 gallons to 1 wet ton was the conversion used throughout this paper.**

Table 2. Volume (gallons) and number of dumps made into each water mass from 1 January to 31 December 1991

Water Mass Type	Volume	% Volume Dumped	Number of Dumps	% Number Dumps
Slope water	1102.2 X 10^6	(71.6%)	338	(74.4%)
Shelf water	103.9 X 10^6	(06.8%)	27	(06.0%)
Warm core ring	332.7 X 10^6	(21.6%)	89	(19.6%)
Total	**1538.8 X 10^6**	**(100.0%)**	**454**	**(100.0%)**

Table 3. Number of days and percentage of days each water mass occupied the dumpsite in 1991 and long-term mean percentages taken from Bisagni(1985)

Water Mass	1991		Long-Term Mean[1]
	Number of Days	% Days	
Slope water	259	71%	66.6%
Shelf water	25	7%	18.5%
Warm core ring	81	22%	12.1%

[1] **Remaining 2.8 percent either Gulf Stream or unknown due to lack of clear imagery.**