National Oceanographic Data Center Internal Report 14

WORLD OCEAN DATABASE 1998

Documentation and Quality Control

Version 2.0

Ocean Climate Laboratory
National Oceanographic Data Center

Silver Spring, MD
December, 1999

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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National Oceanographic Data Center

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For updates on the documentation and additional information about the WOD98 please refer to:
http://www.nodc.noaa /OC5/
click on: Products
click on: WOD98

National Oceanographic Data Center Internal Report 14

WORLD OCEAN DATABASE 1998

CD-ROM Data Set Documentation

Version 2.0

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December, 1999

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Dear Colleague:

World Ocean Database 1998 Version 2 is an updated version of World Ocean Database 1998 (WOD98) released in May, 1998. Since the first release of WOD98, the staff at the Ocean Climate Laboratory (OCL) have performed additional quality control on the database and placed corrections to the data on the OCL web page (http://www.nodc.noaa.gov/OC5/cor98.html).

Some of these corrections were identified by:

- scientists who encountered problems when using the database;
- additional quality control performed during the preparation of World Ocean Atlas 1998 (WOA98) which contains analyzed fields and statistics of the WOD98 variables;
- improved duplicate checking procedures.

All on-line corrections to the data have been incorporated into this version of WOD98. In addition, the World Ocean Circulation Experiment (WOCE) Version 1.5 CD-ROM data set was added.

To facilitate the use of this product, the Ocean Data View (ODV4.0) software developed and distributed by Dr. Reiner Schlitzer of the Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany (http://www.awi-bremerhaven.de/GEO/ODV/) is included. This software will decompress files from WOD98 and allow the user to plot scatter or station plots of selected areas or cruises, property-property plots, and many other data viewing utilities like property distributions along sections or on surfaces.

We would like to thank users of WOD98 who have enhanced this product by bringing problems to our attention, and all users who have contributed data to the National Oceanographic Data Center and World Data Center A for Oceanography. Also thanks to Dr. Schlitzer who, with the development of ODV4.0, has made this database more accessible to users.

Thank you
The NODC Ocean Climate Laboratory

DECOMPRESSING AND READING DATA FROM WORLD OCEAN DATABASE 1998

gzip Directory

The **UTIL** directory of each CD-ROM contains a **GZIP** directory with two files used for decompressing the data on the WOD98 CD-ROMs. The first (gzip124.exe) is a self-extracting DOS executable file and the second gzip1.2.4.tar is a tar'd file containing source code for UNIX users. To uncompress the WOD98 files, it is easiest to copy the files to the hard disk. Use gzip to uncompress selected files, or a directory and all of it's subdirectories with one command (see page 28 of this documentation for further details.)

Special Note for UNIX Users

The DOS CR-LF (Carriage Return-Line Feed) indicates the end of a record and may cause problems when working in a UNIX environment. Many systems have a "dos2unix" program which removes these characters from an ASCII file. Files can also be chanched by transferring from DOS/WINDOWS using FTP(File Transfer Protocol). The UNIX "tr" or "perl" utilities will also remove the CR-LF (see page 29 of this documentation for further details.)

programs Directory

The **programs** directory of each CD-ROM contains sample programs for reading the data and writing the output in various formats. These include Fortran, C, IDL, Matlab (column format), NODC P3 format (comma delimited format), and ICES format. Note that in order to use the C programs, the CR-LF characters must be removed regardless of what platform is used.

ODV Directory

The **ODV** directory contains the Ocean Data View software developed, by R. Schlitzer from the Alfred Wegener Institute. This software will uncompress selected files and offers the users several options for viewing the WOD98 data. This is a PC-based package. For more information, please refer to http://www.awi-bremerhaven.de/GEO/ODV/

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I. INTRODUCTION

The *World Ocean Database 1998* (WOD98) CD-ROMs, containing observed and standard level profile data, represent the first part of an extension of earlier work (*World Ocean Atlas 1994* - WOA94). The second part is the *World Ocean Atlas 1998* (WOA98) which presents objectively analyzed fields of many of the variables in WOD98.

WOD98 expands on WOA94 by including the additional variables nitrite, pH, alkalinity, chlorophyll, and plankton, as well as all available metadata and meteorology. During the past three years, the number of data sets received at NODC/WDC-A (National Oceanographic Data Center/World Data Center-A for Oceanography) has increased (see Table 1) as a result of the Intergovernmental Oceanographic Commission (IOC)/NODC Global Oceanographic Data Archaeology and Rescue project (GODAR), (Levitus *et al.*, 1998, Levitus *et al.*, 1994). The figures in Table 1 show the increase in data from 1982 to 1998. The reason the WOD98 total for MBT, XBT, and "Bottle and low resolution CTD" do not show even larger increases from WOD94, is that large numbers of duplicates were identified in these databases and removed since publication of WOA94. Whereas exact duplicate profiles are easy to identify and remove, "near" duplicates are more difficult. These can result from receiving the same data from different sources, where key variables such as latitude, longitude, or date/time were treated differently. As the procedures for identifying duplicate stations improved, more of these "near" duplicate stations were identified. NOAA atlases describing the distribution of the WOD98 data havel be prepared as part of WOD98 (see section VIII for a listing of the publications associated with WOD98).

Table 1. Comparison of the number of stations in WOD98 with previous world ocean databases.

DATA TYPE	*CLIMATOLOGICAL ATLAS OF THE WORLD OCEAN 1982*	*WORLD OCEAN ATLAS 1994*	*WORLD OCEAN DATABASE 1998*
Bottle and low resolution CTD stations	425,000	1,337,862	1,473,588
High resolution CTD stations	N.A.	N.A.	194,931
MBT and DBT profiles	775,000	1,947,185	2,062,735
XBT profiles	285,000	1,281,942	1,640,271

TOTAL STATIONS	**1,485,000**	**4,566,989**	**5,371,525**
Plankton only stations[1]	N.A.	N.A.	42,885
Surface only data[2]	N.A.	N.A.	181,886

[1]stations with only plankton or biomass data and no physical/chemical measurements

[2] includes ship-of-opportunity data

The format used in WOD98 is different from the format in WOA94, and is more space efficient. This change is necessary due to the increased amount of information contained in WOD98. The Ocean Climate Laboratory (OCL) invites comments on this format so improvements can be made toward achieving the goal of producing a general format that is useful to as wide a group as possible.

The CD-ROMs are formatted according to the ISO 9660 standard. Data are stored in ASCII format and are sorted geographically by World Meteorological Organization (WMO) squares. The data on the CD-ROMs are compressed using the universal "gzip" UNIX compression utility. This utility is provided on each CD-ROM under the directory "**utils/gzip**" for both Unix and DOS operating systems.

ABOUT THIS PRODUCT

The NODC/OCL has been expanding the *World Ocean Atlas 1994* database since its release. As can be seen from Table 1, the database has increased greatly. The OCL has attempted to ensure that the conversion from originator to OCL format was accurate, that duplicates were removed, and that "suspect" data were flagged. This last task is an ongoing effort. Every effort was made to identify and correct errors in the database. As scientists and data managers utilize the WOD98, and errors are identified, they will be corrected. Some data flagged as being in error or "suspicious" may not deserve this designation. The OCL requires the help of users of this product in identifying data which need to be flagged as beeing "suspicious" , and data were flagged and should not have been. As we receive input from users, corrections to the database will be placed on online each month at: http://www.nodc.noaa.gov/OC5/indprod.html. WOD98 Version 2 has incorporated the online corrections from June 1998-September 1999.

Included as part of this release is software contributed by various individuals which can be used as examples of how to read the data into different formats. These programs are preliminary and continue to be developed and improved. Any comments and suggestions for additional programs, which will increase the number of users who can benefit from this product, would be appreciated. Updates will be posted in the NODC/OCL World Wide Web site at: http://www.nodc.noaa.gov/OC5/

ACKNOWLEDGMENTS

The NODC/OCL is supported by the NOAA Climate and Global Change program, the NOAA Environmental Science Data and Information Management program (ESDIM), and the joint NOAA/NASA Global Change element, to produce scientifically quality controlled oceanographic databases, produce objectively analyzed global fields of oceanographic variables, and to perform diagnostic studies based on these databases.

The Intergovernmental Oceanographic Commission (IOC) supported the GODAR project which has resulted in the rescue of much historical ocean data. In particular, Dr. Iouri Oliounine has shared the enthusiasm for this project and has been critical to its success. The OCL expresses its thanks to all those who provided comments and helped develop an improved product. Special thanks to Steve Worley (National Center for Atmospheric Research, NCAR), Dr. Harry Dooley (International Council for the Exploration of the Sea, ICES) and Norm Hall (NODC) for testing the CD-ROMs prior to distribution. John E. O'Reilly (National Marine Fisheries Service, NMFS) contributed the conversion programs from the OCL ASCII format to IDL; Dr. Harry Dooley contributed the conversion program from OCL to

ICES/OceanPC format. Thanks also to Josh Malasheskie for formatting files to enter names into the ITIS database.

Many thanks to Dr. Reiner Schlitzer for the development of Ocean Data View and for allowing us to make this software available as part of WOD98.

The OCL would also like to acknowledge the help received over the years from our colleagues in the other divisions here at NODC, particularly Francis Mitchell (helped with all the code lists and accessions), Andrew Allegra (prepared the CD-ROMs), Robert VanWie (provided information on the archived NODC files), Melanie Hamilton (provided GTSPP data), J. D. Hardy (researched and documented the correct status of many plankton names), Sheri Phillips (helped Olga Baranova design the CD-ROM background), Mike Simmons and Maggie Dunklee (wrote the P3 format description), Ervin Trammell, Charlotte Sazama and Ron Moffatt (helped in locating data for rescue in the WDC-A archives), and Mary Hollinger, James Berger, Patricia Kirk, and Don Collins who distribute this product.

II. CD-ROM DISC CONTENTS

A. DATA SOURCES

The data used in this project are all the data found in the NODC archives as of the first quarter of 1994 as well as some of the data submitted to NODC since 1994. In addition, data gathered as a result of the IOC/IODE GODAR project, the NODC Global Ocean Database project and the IOC Global Temperature Salinity Profile Project (GTSPP) project, were included in this study.

There are nine different files associated with each WMO square. These files represent the different instruments (probes) used to sample profile data (XBT, MBT, High Resolution CTD, Bottle and Low Resolution CTD). In addition, for each probe type, the data are separated into the NODC archived data and the data received through projects such as the GODAR project. Table 2 presents the different file types which are further described in the following section.

Table 2. File types in the WOD98

FILE NAME	SOURCE
NBD	NODC archived bottle data and low resolution CTD
BD	Bottle data and low resolution CTD received from projects
BIO	Plankton data received from projects
NCT	NODC archived high resolution CTD data
CTD	High resolution CTD data received from projects
NMB	NODC archived MBT data
MBT	MBT data received from projects
NXB	NODC archived XBT data
XBT	XBT data received from projects

Flagged data types on the CD-ROM series include:

1. Bottle and low resolution CTD data

a. NODC Bottle Data (NBD)

Variables: This file also includes STD (salinity/temperature with depth), low resolution CTD data, and surface only data. Bottle data may have one or more of the following variables:

Table 3. Variables in the NODC Bottle Data File (NBD)

CODE	VARIABLE	UNIT/SCALE
1	Temperature (*in situ*)	C^o
2	Salinity	PSS and $^o/_{oo}$
3	Oxygen	ml/l
4	Phosphate	µM
6	Silicate	µM
7	Nitrite	µM
8	Nitrate	µM
9	pH	unitless

b. Project Bottle Data (BD)

Variables: This file includes low resolution CTD data, surface only data (mainly from ship-of-opportunity) and plankton/biomass data. Bottle data may have one or more of the following variables:

Table 4. Variables in the Project Bottle File (BD)

CODE	VARIABLE	UNIT/SCALE
1	Temperature (*in situ*)	C^o
2	Salinity	PSS and $^o/_{oo}$
3	Oxygen	ml/l
4	Phosphate	µM
6	Silicate	µM
7	Nitrite	µM
8	Nitrate	µM
9	pH	unitless
11	Chlorophyll	µg/l
none	Plankton/Biomass	various
17	Alkalinity	meq/l
25	Pressure	decibars

c. Project Plankton/Biomass variables (BIO)

Variables: Plankton taxa-specific and biomass measurements

2. High Resolution CTD Data (Conductivity, Temperature, Depth probe)

a. NODC High Resolution CTD/STD (NCT)

Source: NODC high resolution CTD data in the F022 format.
Variables: Temperature, salinity, oxygen, pressure

b. Project High Resolution CTD data (CTD)

Variables: Temperature, salinity, oxygen, chlorophyll, pressure

3. MBT Data (Mechanical Bathythermograph)

a. NODC MBT data (NMB)

Source: NODC MBT file (Includes MBT data from the NODC Selected Bathythermograph (SBT) file which contains data at selected depths)

Variable: Temperature

b. Project MBT (MBT)

Variable: Temperature. This file also includes Digital Bathythermograph (DBT) data.

4. XBT Data (Expendable Bathythermograph)

a. NODC XBT data (NXB)

Source: NODC XBT file. (Includes XBT data from the NODC SBT file)

Variable: Temperature

b. Project XBT data (XBT)

Variable: Temperature (includes GTSPP data which contains TAO buoy data)

Table 5 is an inventory of the data found in each of the files described. The WOD98 contains a total of 5,433,216 stations, of which 181,886 are surface only data (primarily in the project Bottle Data file - BD), and 83,609 are plankton observations in both the project Bottle data file (BD) and the Bio file (BIO).

Table 5. Inventory of Data for Each Probe

VARIABLES	BD	NBD	CTD	NCT	MBT	NMB	XBT	NXB	BIO
Temperature	710050	721173	95128	98871	932979	1129756	730921	909350	
Salinity	652440	678917	92127	97200					
Oxygen	214738	262906	21656	10263					
Phosphate	154384	124741							
Silicate	111668	75612							
Nitrite	77424	43527							
Nitrate	96824	48701							
pH	38703	64072							
Chlorophyll	131079		3878						
Biochem (Plankton)	62188								21421
Alkalinity	7235								
Pressure	56114		38961	53565					

TOTAL PER PROBE	790238	723620	96052	98879	932979	1129756	730921	909350	21421
TOTAL BY PROBE TYPE	1,513,858		194,931		2,062,735		1,640,271		21,421

B. STATION DESCRIPTION

In WOD98, a station is comprised of as many as six parts:

(1) Primary Header: contains all information vital to the identification of an individual profile, such as date, time, location, NODC country code, cruise code, and a unique station number;

(2) Character Data (originator's cruise codes and originator's station (codes) and Principal Investigator;

(3) Secondary Header: contains information such as meteorological data, water column characteristics (such as depth to bottom), information about the probe used, ship, institute, project, originator's units, and methods;

(4) Biological Header: contains information necessary to understand how biological data were sampled. "Biological" data are arbitrarily defined as plankton biomass (weights or volumes) and taxa-specific observations. It does not include chlorophyll data.

(5) Taxa-specific and Biomass Data: contains plankton weights, volumes, and/or concentrations, for an entire sample (biomass) or for individual groups of organisms (taxa-specific).

(6) Depth Dependent Measured Variables: temperature, salinity, oxygen, phosphate, silicate, nitrite, nitrate, pH, chlorophyll, alkalinity, and pressure data vs. depth.

1. Primary Header

The primary header contains information about the number of bytes in the station, a unique number which identifies each station, the country code (see code list in Appendix 1), a cruise number, date, time, position, and the number and type of variables in the station. Time and location are all written in the same format:

a) number of significant digits
b) total digits
c) precision of measurement
d) data value

Total digits will be one more than significant digits if the value is a negative number. Total digits will also be different than significant digits if a value has been converted or identified as a trace value (TR = 0.005). The station type identifies whether the data are at observed depth levels (0) or standard levels (1). The number and type of variables identifies the depth dependent variables in a station. Depth-dependent variables are listed with the number which identifies them in Table 4.

2. Character Data

Character data are used to report the originator's cruise identification and the originator's station identification, if provided. Under this heading, the Principal Investigators (PI) are also identified by numeric code and by variable code. The Principal Investigator is the person responsible for collecting the data and is included whenever available. A list of the numeric codes associated with each PI can be found in the **codes** directory of each CD-ROM (file name: pinames.txt). For the purpose of assigning PI codes, plankton data are identified as variable 14 for all plankton, -5002 for zooplankton, and -5006 for phytoplankton.

3. Secondary Header

The secondary header contains metadata (information about the data) and meteorological information associated with each station. Table 6 lists the different types of secondary header data we include for each station, when the information is available.

Many of the meteorological variables have World Meteorological Organization (WMO) code tables associated with them (see section VI for a list of acronyms used in this document). These code tables are grouped together in Appendix 2 and are also individually listed in the codes directory. The OCL secondary header information is always in numeric form, whereas some of the NODC codes are alphanumeric. Therefore, some of the code tables will have an OCL code and the equivalent NODC code.

Table 6. List of secondary header variables in WOD98.

The "App. #" column indicates the Appendix where the full code list is found, or if it is included in a separate file in the codes directory (the secondary header variables are listed in file = secondh.txt).

ID #	DESCRIPTION	App. #	ID #	DESCRIPTION	App. #
1	NODC Accession Number	file	31	Calibration Temperature	none
2	NODC Project Code	file	32	BT recorder (WMO 4770)	2L
3	OCL Platform Code	file	33	Depth fix	none
4	NODC Institution Code	file	34	Bottom Hit	none
5	Cast number	none	35	XBT Digitization Method (NODC 0612)	2M
6	WOD98 Unique Station Number	none	36	XBT Digitization Interval (NODC 0613)	2N
7	Originator's station number	none	37	XBT Data Treatment and Storage Method (NODC 0614)	2O
8	Depth precision	none	38	MBT Depth Correction	none
9	Ocean Weather Station Code	2A	39	MBT Temperature Correction	none
10	Bottom Depth (meters)	none	40	Instrument for reference temperature (NODC 0615)	2P
11	Cast Duration (hours)	none	41	Horizontal visibility (WMO Code 4300)	2Q
12	Cast Direction (down assumed)	2B	45	Absolute Humidity (g/m^3)	none
13	High resolution pairs	none	46	Reference/Sea Surface Temperature	none
14	Water Color	2C	47	Sea Surface Salinity	none
15	Water Transparency (Secchi disk)	none	48	Chlorophyll method	4A
16	Wave Direction (WMO 0877 or NODC 0110)	2D	49	Nutrient method	4B
17	Wave Height (WMO 1555 or NODC 0104)	2E	54	O_2 originator's unit	5A
18	Sea State (WMO 3700 or NODC 0109)	2F	55	Nutrient originator's unit	5B
19	Wind Force (Beaufort scale or NODC 0052)	2G	56	Chlorophyll originator's unit	5C
20	Wave Period (WMO 3155 or NODC 0378)	2H	58	Alkalinity originator's unit	5D
21	Wind Direction (WMO 0877 or NODC 0110)	2D	59	Filter type size	2R
22	Wind_Speed (knots)	none	60	Alkalinity method	4C
23	Barometric Pressure (millibars)	none	65	Conductivity standard (milliohms/cm)	none
24	Dry Bulb Temperature (degrees C)	none	67	O_2 method	4D
25	Wet Bulb Temperature (degrees C)	none	68	Salinity method	4E
26	Weather Conditions (WMO 4501 or 4677)	2I	69	Temperature method	4F

27	Cloud Type (WMO 0500 or NODC 0053)	2J	71	Radio signal	none
28	Cloud Amount (WMO 2700 or NODC 0105)	2K	72	XBT Wait	none
29	T-S Probe (Temperature/Salinity probe)	3	73	XBT Frequency	none
30	Calibration Depth	none			

The following is an explanation of the secondary header codes which do not have code tables associated with them:

- Code 1 NODC accession number: number assigned by NODC to each batch of data received;
- Code 3 Platform: code list identifies the platforms associated with the data. It should be noted that the database contains negative platforms which were assigned to unidentified ships from Russian and Ukrainian institutes for which we expect to receive the information in the near future. Negative platforms are unique only to the accession number where found (filename: shipname.txt);
- Code 5 Cast Number: sequential number representing each over-the-side operation or discrete sampling at a station;
- Code 6 OCL Unique Station Number: OCL assigned unique station numbers. This number will not change in future releases;
- Code 7 Originator's station number: station number assigned by the data submittor or data originator, if numeric;
- Code 8 Depth precision: precision of the depth field (number of digits to the right of the decimal);
- Code 10 Bottom depth: depth from water surface to sediment-water interface, in meters;
- Code 11 Cast duration: duration of the cast, in hours;
- Code 13 High resolution pairs: unique station number identifying where HCTD and Bottle data were sampled at the same station;
- Code 15 Water transparency: Secchi depth, in meters;
- Code 20 Wave Period: Note that NODC code 0378 is not equivalent to WMO 3155, therefore these data need to be used with caution unless the users can identify which code is being reported;
- Code 22 Wind speed: surface or near-surface wind speed, in knots;
- Code 23 Barometric pressure: the atmospheric pressure at sea level due to the gravitational force on the column of air above it (millibar);
- Code 24 Dry bulb temperature: identical to air temperature, in degrees Celsius;
- Code 25 Wet bulb temperature: the temperature a parcel of air would have if it were cooled adiabatically with no heat transfer, in degrees Celsius;

- Code 30 Calibration depth: deviation on an XBT from the zero depth. This difference between points was used to adjust the profile when it was digitized;
- Code 31 Calibration temperature: deviation on an XBT from a 16.7C reference point. This difference between points was used to adjust the profile when it was digitized;
- Code 33 Depth fix: a one (1) is assigned if a depth correction was applied to XBT using recalculated drop rate;
- Code 34 Bottom hit: a one (1) is assigned if the probe hits the bottom;
- Code 38 Depth correction: average difference between the surface trace and the surface depth line of the grid for an MBT;
- Code 39 Temperature correction: correction for difference between reference temperature and MBT reading or correction to the original data by the submittor - in some cases the correction has already been applied;
- Code 45 Absolute Humidity (g/m^3): sometimes referred to as the vapor density because it is the ratio of the mass of water vapor present to the volume occupied by the moist air mixture present in the atmosphere;
- Code 46 Reference/Sea Surface Temperature: temperature used to check the probe or a separate measure of sea surface temperature;
- Code 47 Sea Surface Salinity: the salinity of the layer of sea water nearest to the atmosphere;
- Code 65 Conductivity standard: conductivity value of seawater, at salinity 35 P.S.S. and temperature 15 C, used to calculate the conductivity ratio. The conductivity ratio is then used to calculate salinity. Code is included when only conductivity is submitted. Units are milliohms/cm;
- Code 71 Radio signal (code 71): identifies whether data is received from a radio signal (real time data), identified with a one (1);
- Code 72 XBT Wait: Wait is the time difference between the launch of the probe and the time it begins recording data;
- Code 73 XBT Frequency: Frequency is the sampling rate of the recorder.

Appendix 3 lists the different codes associated with the T-S probe type (temperature-salinity). Also listed in **codes**/tsprobe.txt in the CD-ROMs.

Appendix 4 lists the methods associated with each variable measured. This list represent the methods reported with the data submitted and is not a comprehensive list of variable methods. Also listed in **codes**/methods.txt in the CD-ROMs.

Appendix 5 lists the units codes which identify the submittor's original units. Also listed in **codes**/methods.txt in the CD-ROMs.

4. Biological Header

The biological header section contains any metadata (information about the data) for the taxonomic and biomass measurements at a station. Table 7 lists the different types of biological header data we include for each station, if the information is available. Similar to the secondary header information, much of the information is represented by code

lists. Appendix 6 includes these lists.

5. Taxa-specific And Biomass Data

Two types of data are represented in this portion of the station: biomass measurements and taxa-specific variables (see Table 8 for a list of these variables). Biomass are data for the entire sample or net haul (*e.g.*, displacement volume of total haul), whereas taxa-specific data refers to a group or species (*e.g.*, number of *Calanus* per sample).

Table 7. List of biological header variables.

All code tables are listed in Appendix 6 (the biological headers are listed in file = bioheadr.txt).

ID #	DESCRIPTION	App. #	ID #	DESCRIPTION	App. #
1	Water volume filtered (m^3)	none	14	Tow distance (meters)	none
2	Sampling duration (minutes)	none	15	Average tow speed (knots)	none
3	Mesh size (µm)	none	16	Sampling start time (GMT)	none
4	Type of tow	6A	17	NOT USED	-
5	Large removed volume (ml)	none	18	Flowmeter type	6B
6	Large plankters removed?	none	19	Flowmeter calibration	6F
7	Gear code	6B	20	Counting institution	file
8	Sampler volume (liters)	none	21	Voucher institution	file
9	Net mouth area (m^2)	none	22	Wire angle start (degrees)	none
10	Preservation	6C	23	Wire angle end (degrees)	none
11	Weight method	6D	24	Depth determined	6G
12	Large removed length (cm)	none	25	Volume method	6H
13	Count method	6E			

The following is a description of the biological header codes. [**Note that values were stored as provided and were only calculated for net mouth area**]:

- Code 1 Water volume filtered: total volume of water filtered by the sampling gear, in m^3;
- Code 2 Sampling duration: time over which the sampling gear was towed, in minutes;
- Code 3 Mesh size: pore size of the sampling device, in micrometers;
- Code 5 Large removed volume: the minimum volume criteria for removing large plankters, in ml, see also code 12;
- Code 6 Large plankters removed: if large plankters were specified as being removed (1) or not removed (2), this code is marked. See also code 5 and code 12;
- Code 8 Sampler volume: internal volume of the sampling gear (*e.g.*, volume of Niskin bottle), in liters;
- Code 9 Net mouth area: mouth or opening area of the sampling gear, in m^2. If mouth diameter was provided, area was calculated (area = $(\text{diameter} \div 2)^2$);
- Code 12 Large removed length: the minimum size/length criteria for removing large plankters, in cm, see also code 5;
- Code 14 Tow distance: distance over which sampling gear was used, in meters;
- Code 15 Average tow speed: average speed used to tow the sampling gear, in knots;
- Code 16 Sampling start time: in GMT;
- Code 22 Wire angle start: wire angle of the towing apparatus at sampling start, in degrees;

- Code 23 Wire angle end: wire angle of the towing apparatus at sampling end, in degrees.

Table 8. List of biomass and taxa-specific variables.
Code tables for these variables are listed in Appendix 7 (biomass and taxa variables are listed in file = taxvar.txt).

ID #	DESCRIPTION	App #	ID #	DESCRIPTION	App
1	Parameter number (>0 ITIS tsn tax code, -200 biomass code, -5000 group code)	file	13	Taxon wet weight (µg/UNIT)	none
2	Upper depth (meters)	none	14	Taxon dry weight (µg/UNIT)	none
3	Lower depth (meters)	none	15	Taxon ash-free weight (µg/UNIT)	none
4	Biomass value	none	16	Taxon feature (code table)	7F
5	Taxon lifestage (code table)	7A	17	Taxon modifier (code table)	7G
6	Taxon sex code (code table)	7B	18	Size min (mm)	none
7	Taxon present (code table)	7C	19	Size max (mm)	none
8	Taxon troph (code table)	7D	20	Unit	5
9	Taxon realm (code table)	7E	21	Taxon radius (µm)	none
10	Taxon count (count of taxon / UNIT)	none	22	Taxon length (µm)	none
11	NOT USED		23	Taxon width (µm)	none
12	Taxon volume (ml/UNIT)	none			

The following is a description of biomass and taxa-specific variables:

- Code 1 Parameter number: type of taxon or biomass sampled, represented with an ITIS taxonomic serial number (> 0), a group code (<5000) , or a biomass parameter code (< -201 and > -210) (Table 9);
- Code 2 Upper depth: the upper depth sampled, in meters;
- Code 3 Lower depth: the lower depth sampled, in meters;
- Code 4 Biomass value: contains biomass value measured, units are specified by the biomass parameter code (code 1, Table 9);
- Code 10 Taxon count: the number of an individual taxon counted, in count per unit (as specified by code 20);
- Code 12 Taxon volume: the volume of an individual taxon counted, in ml per unit (as specified by code 20);
- Code 13 Taxon wet weight: the wet weight of an individual taxon counted, in µg per unit (as specified by code 20);
- Code 14 Taxon dry weight: the dry weight of an individual taxon counted, in µg per unit (as specified by code 20);
- Code 15 Taxon ash-free dry weight: the ash-free dry weight of an individual taxon counted, in µg per unit (as specified by code 20);
- Code 18 Minimum size range description: the smaller size range used in a taxonomic description, in mm;
- Code 19 Maximum size range description: the larger size range used in a taxonomic description, in mm;
- Code 20 Unit: additional unit identifier for biomass and taxa-specific measurements (listed in Appendix 5);
- Code 21 Taxon radius description: the radius (diameter ÷ 2) size used in a taxonomic description, in µm;
- Code 22 Taxon length description: the length or height used in a taxonomic description , in µm;
- Code 23 Taxon width description: the width or shortest-dimension used in a taxonomic description, in µm.

Taxa-specific data is information about a specific group of plankton. The group can be described by a scientific taxon name (*e.g.*, *Calanus finmarchicus*), or by a descriptive phrase (*e.g.*, heterotrophic nanoflagellates). The data for taxa-specific measurements are the relative abundance, the concentration, the volume, or the weight of the group observed. The total set of plankton descriptors are included in a small number of categories: name, lifestage, sex, trophic mode, realm, features, minimum size, maximum size, length, width, radius, and special modifier. The special modifier category retains qualifying terms like 'other', 'sp.' or 'spp.'. Appendix 7 includes more details about these categories.

Measurement identifiers (*i.e.* what group, species or type of biomass was measured) are stored as a code number in the *Parameter number* field (code 1). Biomass measurements are represented with code values of -201 though -210 (see Table 9). Scientific taxa names were translated using ITIS (Integrated Taxonomic Information System, http://www.itis.usda.gov/itis) as an authority list, and are represented in the WOD98 under the proper ITIS taxonomic serial number (see code-file "itistsn.txt"). When a vague, or broad, taxonomic group or general description was used (*e.g.*, "fish", "plankton", "crabs"), a non-taxonomic 'group code' was assigned for the group, starting at a value of -5000 (see code-file "nontaxsn.txt" and Appendix 8). Codes -206 to -210 were assigned to biomass values which exceeded $1xE^9$ ml or mg.

Table 9. List of biomass parameter codes (file = biomass.txt)

Parameter Number	DESCRIPTION
-201	Total displacement volume, ml
-202	Total settled volume, ml
-203	Total wet weight, mg
-204	Total dry weight, mg
-205	Total ashfree dry weight, mg
-206	Total displacement vol, m^3
-207	Total settled volume, m^3
-208	Total wet weight, kg
-209	Total dry weight, kg
-210	Total ashfree dry weight, kg

Unlike depth-dependent variable data (*e.g.*, temperature, oxygen, nitrate, etc.), taxa-specific and biomass data are stored in sets of unique observations, called "taxa-sets", with each set containing upper and lower depths and all of its associated taxa-specific or biomass variables. For biomass measurements, this usually includes a *Parameter number*, a *Biomass value*, a *Unit*, an *Upper depth*, and a *Lower depth*. For taxa-specific measurements, this usually includes a *Parameter number*, a *taxon measurement* (*e.g.*, Taxon count, Taxon wet weight), a *Unit*, an *Upper depth*, a *Lower depth*, and an associated special *Taxonomic descriptors* (*e.g.*, Life stage, Sex code, special Modifier, etc.).

Examples of taxa-sets:

- Biomass (displacement volume) measured from 0-100m, and 200-500m, will have two taxa-sets, one for each depth range.
- Biomass (displacement volume and wet weight) measured from 0-250m will have two taxa-sets, one for each type of biomass measurement.
- A taxa-specific measurement of a single species, counted at five bottle depths, will have five taxa-sets, one for each depth.
- A taxa-specific measurement of ten species, counted at five bottle depths, will have 50 taxa-sets, five depths × ten species.

Note that taxa with different taxonomic descriptors (*e.g.*, life stage, sex code, etc.) are treated as different taxa, and therefore are stored in different taxa-sets. For example: *Calanus* eggs, *Calanus* juveniles, *Calanus* adults (male), and *Calanus* adults (female) would be stored as four separate observations, each with the same parameter number, but differing in their life stage and sex code values.

6. Depth Dependent Measured Variables

The number of variables and the type of variable are identified in the primary header, as well as with an error code for

each variable if all values of that variable in the station have been flagged. Table 4 lists the variables and their identifying codes. Appendix 9 lists the flags assigned to each variable.

Stations with data on pressure surfaces have their depths computed, so depth is always present and the pressure value is stored. Some data were reported with both depth and pressure in which case both are stored. Similarly, stations which come in with conductivity readings have salinity computed. Some stations may be reported on standard depth levels (see Table 10) such as most of the Japanese and Former Soviet Union (F.S.U.) data. It is uncertain whether these data were originally measured at standard levels or interpolated to standard depth levels.

Included under this category, are surface only data which are also mostly from ships-of-opportunity.

III. QUALITY CONTROL PROCEDURES

The quality control procedures are fully documented in section IX of this document. This section is a brief summary of the procedures used. These procedures were used to identify possible problems with the data by examining the entire database. The OCL continues to quality control the data and requests input from the users as to possible problems identified when using the data.

Observed level data were checked for quality prior to interpolation to standard levels. For many analysis purposes, it is necessary to interpolate from observed levels to standard depth levels. The standard depth analysis levels selected for this study are listed in Table 10 and include the 30 NODC standard depths and additional levels at 3500, 4500, 5500, 6000, 6500, 7000, 7500, 8000, 8500, and 9000 meters.

Table 10. Standard levels and depths (meters)

Depth	Level	Depth	Level	Depth	Level	Depth	Level
0	1	250	11	1200	21	4500	31
10	2	300	12	1300	22	5000	32
20	3	400	13	1400	23	5500	33
30	4	500	14	1500	24	6000	34
50	5	600	15	1750	25	6500	35
75	6	700	16	2000	26	7000	36
100	7	800	17	2500	27	7500	37
125	8	900	18	3000	28	8000	38
150	9	1000	19	3500	29	8500	39
200	10	1100	20	4000	30	9000	40

The quality of the observed and standard level data were checked using the following procedures:

1. Various checks to ensure the conversion from originator to OCL format was correct (*e.g.*, comparison between converted stations and original data);

2. Preliminary checks - checks for duplicate stations, depth inversions, range checks of primary- and secondary-header variables, cruise integrity checks (*i.e.*, ship speed, cruise duration, duplication or overlap with existing cruises within the database);

3. Range check of the observed level data for each major basin as a function of depth;

4. Large inversion and gradient checks for all variables; [Note: An additional gradient check, called a "zero anomaly check", was used to locate large gradients due to an anomalous value of " 0.00 " within a station. These instances were often due to the use of " 0.00 " as a missing value indicator, and had to be carefully distinguished from " 0.00 " as a data value];

5. Density inversion check on the standard level data;

6. XBT drop rate correction before interpolation of observed level to standard level data for T4, T6, and T7 probes (Hanawa *et al.*, 1994);

7. Standard deviation check;

8. Check for unrealistic features after an initial computation of the objective analysis.

Explanation of error flags

Data observations and profiles determined to be "non-representative", "suspect", or "erroneous" by the quality control were flagged using the criteria summarized below. In most cases, only the specific observations are flagged (*e.g.,* a single range outlier or a depth level inversion). In cases where a systematic problem is found to exist throughout the entire profile (*e.g.,* multiple depth problems or standard deviation outliers), then the entire profile may be flagged. A description of the flags can be found in Appendix 9.

1. Check for depth inversions and duplicate depths

Depth error flags are assigned if:

(A) the second of two successive depths is shallower than the first (a depth inversion), the second depth will be marked with a flag value = 1.

(B) three successive depths are shallower than the first depth, every depth reading in the profile following the first will be marked with a flag value = 1.

(C) two successive depth readings are equal, the second reading will be marked with a flag value = 1.

All correct depths are marked with a flag value = 0.

2. Standard deviation check on standard level data

This check calculates the mean and standard deviation of data by five-degree square latitude-longitude boxes for annual (all variables), seasonal (temperature, salinity, oxygen, chlorophyll, nitrate, phosphate, silicate), and monthly (temperature and salinity) periods at each standard level. Data are flagged if:

(A) a value is five standard deviations away from the mean in coastal waters (defined as any one-degree grid box adjacent to a land grid point or any one-degree grid box with a bottom depth of less than 200 m).

(B) a value is four standard deviations away from the mean in near coastal waters or near the ocean floor (defined as any one-degree grid point where the depth is equal to or less than the depth in an adjacent one-degree box) or any adjacent five-degree grid box is designated coastal.

(C) a value is three standard deviations away from the mean in the open ocean.

(D) if a station contains two or more standard deviation failures, the whole station is flagged.

3. Density and stability checks for temperature and salinity stations

The criterion for an instability is described by Levitus (1982). Flags are assigned:

(A) for density inversions at the depths where they occur in the observed and standard level stations.

(B) when two or more density inversions (or instabilities) occur in a standard level station. The entire station is then flagged. [Note: Stability checks were performed on observed as well as standard level data. Observed level flags are included for information only, since they were not used to exclude any data from the station data sets. Whole-station flags for stability and standard deviation checks are for standard level data only. For informational purposes, if a standard level station includes a whole station density flag (or standard deviation flag), the observed level data will also include a whole station flag.]

4. Range outlier, gradient, inversion, and zero anomaly flags

Observed level data that fell above or below variable-specific ranges were flagged (flag = 1) as range outliers, per Boyer *et al.* (1994) and Conkright *et al.* (1994). Suspiciously large decreases (gradients, flag = 3) and increases (inversions, flag = 2) of observed level data over depth were flagged if they were larger or smaller than maximums set for the entire world ocean. Large gradients followed by a large inversion due to a value of "0.00" were marked as a "zero anomaly" (flag = 4). Combinations of range outliers and gradient/inversion/"zero anomaly" are flagged as in Appendix 9.

5. Cruise flags

Indicates all stations from a cruise have anomalous data. If an entire accession number is found to have anomalous data, all cruises for that accession will be assigned a cruise flag. This flag also was used to identify data submitted as MBT with dates prior to 1941 and XBT data with dates prior to 1966.

6. Bullseye flags

Flags individual values which cause unrealistic features such as "bullseyes" in the contoured objectively analyzed data. This flag is assigned to the observed and standard level data if any value is identified as "incorrect".

IV. CD-ROM DISC STRUCTURE

The WOD98 is comprised of five CD-ROMs containing profile and plankton/biomass data in compressed format. WOD98-01 through WOD98-04 contain observed level data, WOD98-05 contains all the standard level data. The data are organized by ten-degree latitude-longitude squares numbered using the WMO ten-degree square numbering scheme (illustrated in Appendices 10A-10B). Within each of the WMO subdirectories are four files containing the NODC archived data NBD, NCT, NXB, and NMB and five PROJECT data files named BD, CTD, MBT, XBT and BIO (these are in separate files since they have not yet been archived at the NODC). Stations in each file are sorted by date. Appendix 11 shows an inventory of the contents in each probe type. Table 11 shows the contents of WOD98-01 - WOD98-05.

WOD98-01 contains observed level data for the North Atlantic from 30°-90°N and includes the Mediterranean Sea, Baltic Sea, North Sea, and the Arctic Ocean from 100°W to 100°E. WOD98-02 includes observed level data for the North Atlantic 0-30°N and the South Atlantic. WOD98-03 contains observed level data for the North Pacific from 20°N-90°N including the Arctic Ocean from 100°E-100°W. WOD98-04 contains observed level data for the North Pacific 0-20°N, the South Pacific Ocean, the Indian Ocean, Red Sea, and Persian Gulf.

WMOs 7007, 7008, 7108 and 7109 are duplicated in WOD98-02 and WOD98-04 since the North Atlantic and North Pacific Oceans overlap in these areas.

All the standard level data are on WOD98-05. As with the observed level data, the data are organized by WMO square. Within each WMO square are eight files containing the data associated with each probe or instrument type (the data in BIO do not have standard levels).

[Note: Some of the WMO files listed in the CD-ROMs contain no data since they correspond to land areas.] A positive longitude in the data denotes the Eastern Hemisphere, a negative longitude denotes the Western Hemisphere, a positive latitude denotes North and a negative latitude denotes South.

Table 11. Contents of the WOD98-01 through WOD98-05

CD-ROM	CONTENT
WOD98-01	North Atlantic 30° N-90° N
WOD98-02	North Atlantic 0°-30° N South Atlantic
WOD98-03	North Pacific 20° N-90° N
WOD98-04	North Pacific 0°-20° N South Pacific North Indian South Indian
WOD98-05	Standard level data for all ocean basins

V. FILE STRUCTURE FORMAT

All observed and standard level data files are written as a series of 80 character length ASCII records. For UNIX users, note that the ASCII records contain a DOS CR-LF (Carriage Return-Line Feed) end-of-record marker which may need to be stripped (see section V - *Special Note for UNIX Users*).

A detailed record layout for the data can be found in Table 12. There is a carriage return after each 80 bytes (CR-LF). Each station begins on a new line. Each section of a station (*e.g.*, character data, secondary header, biological header) begins with a total byte count for that section. If there are no data for that section, the byte count is zero. If there are data for that section, the byte count can be used to skip over sections which are of no interest to the user.

The header includes the country code (see Appendix 1 for a listing of these codes), NODC cruise number, position, date-time, OCL unique station number, the number of observed or standard depth levels, an identifier for observed or standard level data, number of variables, variable codes, and a flag if all of a variable's data in that station fails a quality control check (see Appendix 9 for a description of the flags). Appendix 12 shows the byte count for each probe type.

Appendix 13 shows sample data output from Station 67064, using the program ocldemo.f, found on the WOD98-03 CD-ROM in file wod98-03\data\npac2090\7617\BD07617. This file contains temperature, salinity, oxygen, phosphate, silicate, nitrite, and taxonomic/biomass data ("f" denotes the flad assigned to the variable; numbers in parenthesis represent the number of significant digits in the value; "ERR" identifies whole profile flags for each variable).

For compactness, each variable (other than most in the first header), is written in this fashion: STPVVVVVV[E]

where:

S = Number of significant digits in a value;

T = Total number of digits in a value. This is usually the same as [S], but can vary in cases of negative numbers, converted values, and data in which the values are reported

with more precision than a probe is capable of recording;

P = Precision of a variable (number of places to the right of the decimal point);

V = The actual value. This is read in using [T] and [P];

E = Error code. This is not used for all variables.

For example: A salinity value, written as

[553338910]

means that S = 5, T = 5, P = 3. Using this information, there are five bytes in the salinity reading, with a precision of three, so V(sal) = 33.891, and E = 0.

A missing value in this data format is always represented with an S = '-' (the minus character). That is, when the number of significant digits in read in, the character encountered will be a negative sign. This tells the user that no value was recorded and to skip to the next value.

The file naming convention is redundant so that files downloaded from the CD-ROM to DOS or UNIX storage devices can be completely identified from their names. For example, an NBD (NODC Bottle data) file from the North Atlantic will have a fully qualified name such as \NATL3090\5008\5008NBDO.gz (if observed level data) and \NATL3090 \5008\5008NBDS.gz (if standard level data).

TABLE 12. DESCRIPTION OF THE OCL ASCII FORMAT.
OCL ASCII FORMAT FOR PRIMARY HEADER

FIELD	LENGTH	FORMAT	DESCRIPTION
1. Bytes in field (2)	1	I1	
2. Bytes in station	from (1)	Integer	
3. Bytes in field (4)	1	I1	
4. OCL station number	from (3)	Integer	OCL station identification
5. Country code	2	A2	NODC country codes (Appendix 1)
6. Bytes in field (7)	1	I1	
7. Cruise number	from (6)	Integer	NODC/OCL number
8. Year	4	I4	
9. Month	2	I2	
10. Day	2	I2	
11. Time - if time is missing its denoted as (-) in the Sig.Fig. field - if so, skip to (12)			
a. Sig. digits	1	I1	(-)if time missing
b. Total digits	1	I1	not present if a is (-)
c. Precision	1	I1	not present if a is (-)
d. Value	based on (b)	based on (a-c)	not present if a is (-)
12. Latitude - if latitude is missing its denoted as (-) in the Sig.Fig. field - if so, skip to (13)			
a. Sig. digits	1	I1	(-)if missing
b. Total digits	1	I1	not present if a is (-)

c. Precision	1	I1	not present if a is (-)
d. Value	based on (b)	based on (a-c)	not present if a is (-)
13. Longitude - if longitude is missing its denoted as (-) in the Sig.Fig. field - if so, skip to (14)			
a. Sig. digits	1	I1	(-)if missing
b. Total digits	1	I1	not present if a is (-)
c. Precision	1	I1	not present if a is (-)
d. Value	based on (b)	based on (a-c)	not present if a is (-)
14. Bytes in field (15)	1	I1	
15. Number of Levels	from (14)	Integer	Number of depths
16. Station type	1	I1	(0)Obs, (1)Std
17. # of Variables in station (N)	2	I2	read (18-20) N times
18. Bytes in field (19)	1	I1	
19. Variable codes	from (18)	Integer	OCL variable codes (Table 4)
20. Error code per variable.	1	I1	see Appendix 9

^ denotes blank space

OCL ASCII FORMAT FOR CHARACTER DATA, SECONDARY AND BIOLOGICAL HEADER

FIELD	LENGTH	FORMAT	DESCRIPTION
CHARACTER DATA AND PRINCIPAL INVESTIGATOR			
1. Bytes in field (2)	1	I1	if "0" go to secondary header
2. Total bytes for character data	from (1)	Variable	
3. Number of types of data (N)	1	I1	orig. cruise and/or orig. sta. and/or PI
IF FIELD (4) IS 1=Originators Cruise, OR 2=Originators station code (read fields 4-6 N times)			
4. Type of data	1	I1	(1)orig. cruise (2)orig. station
5. Bytes in field (6)	2	I2	
6. Character data	from (5)	A	
IF FIELD (4) IS 3=Principal investigator			
4. Type of data	1	I1	always 3
5. Number of P.I. names	2	I2	read fields 6-9 N times
6. Bytes field (7)	1	I1	
7. Variable code	from (6)	Integer	OCL code (Table 4)
8. Bytes in field (9)	1	I1	
9. P.I. code	based on (8)	Integer	OCL code (file=pinames.txt)
SECONDARY HEADER			
1. Bytes in field (2)	1	I1	if "0" go to biological header
2. Total bytes for secondary headers	based on (1)	Variable	
3. Bytes in field (4)	1	I1	
4. Number of entries (N)	based on (3)	Integer	read fields 5-10 N times
5. Bytes in field (6)	1	I1	
6. Secondary header code	based on (5)	Integer	OCL code (Table 6)
7. Significant digits	1	I1	
8. Total digits	1	I1	
9. Precision of value	1	I1	

10. Value	based on (9)	based on (7-9)	
BIOLOGICAL HEADER - entries (5-10) repeated based on number read in (4)			
1. Bytes in field (2)	1	I1	if "0" go to station data
2. Total bytes for biology	based on (1)	Integer	
3. Bytes in field (4)	1	I1	
4. Number of entries (N)	based on (3)	Integer	read 5-10 N times
5. Bytes in field (6)	1	I1	
6. Biological header code	based on (5)	Integer	OCL code (Table 7)
7. Significant digits	1	I1	
8. Total digits	1	I1	
9. Precision of value	1	I1	
10. Value	based on (5)	based on (7-9)	

OCL ASCII FORMAT FOR BIOMASS AND TAXONOMIC DATA

FIELD	LENGTH	FORMAT	DESCRIPTION
TAXONOMIC AND BIOMASS DATA SETS			
1. Bytes in next field	2	I1	if biological header "0", this section skipped
2. Number of taxa sets	based on (1)	Integer	
3. Bytes in next field	1	I1	
4. Number of entries per taxa set	based on (3)	Integer	steps 3-11 repeated based on step 2
5. Bytes in next field	1	I1	
6. Taxa or biomass variable code	based on (5)	Integer	steps 5-11 repeated based on step 4 (Table 8 and Table 9)
7. significant digits	1	I1	
8. Total digits	1	I1	
9. Precision	1	I1	
10. Value	based on (5)	based on (4-6)	
11. Error code for value	1	I1	always "0"
STATION DATA - all steps repeated based on number of levels listed in the primary header			
1. Number depth sig. digits	1	I1	
2. Total digits in depth	1	I1	
3. Precision of depth value	1	I1	
4. Depth value	based on (2)	based on (1-3)	
5. Depth error code	1	I1	
6. Number variable sig. digits	1	I1	
7. Total digits in variable	1	I1	
8. Precision of variable	1	I1	
9. Variable value	based on (7)	based on (6-8)	
10. Variable error code	1	I1	Appendix 9

A. DESCRIPTION OF THE CD-ROM DOCUMENTATION

Each CD-ROM contains three files a **readme.txt** file, which describes the contents of the CD, a **wmotot.txt** file, (with tallies of the amount of Kbytes/instrument for each WMO), a **readme.odv** (with instructions on how to install Ocean Data View) and six directories named:

- **codes** - contains codes associated with the secondary header, biological header, and taxa data;
- **data** - contains the data;
- **doc** - contains the documentation;
- **programs** - contains sample programs for reading the data and programs which allow the user to convert the data so it can be read into IDL (prepared by John E. O'Reilly, NMFS), OceanPC (prepared by Harry Dooley, ICES), Matlab (prepared by Cathy Stephens, NODC), and the NODC station database format P3 (prepared by Tim Boyer, NODC).
- **utils** - contains the utilities necessary to convert from DOS to Unix and to decompress the data.
- **ODV** - contains the Ocean Data View software for viewing the WOD98 data (developed by R.Schlitzer, AWI, for PC's only).

The following is a description of the files contained in **doc, codes, programs, ODV,** and **utils**.

Files in the directory **doc** of every CD-ROM:

---

doc.txt - description of the files in this directory

format.txt - ASCII table describing the format of the data
format.htm - HTML table describing the format of the data
format.wpd - Word Perfect 6.0 table describing the format of the data
format.doc - Microsoft Word for Windows 2.0 table describing the format of the data
readmev2.txt - ASCII version of this document
readmev2.htm - HTML version of this document
readmev2.wpd -Word Perfect 6.0 version of this document
readmev2.doc - Microsoft Word for Windows 2.0 version of this document
readme.odv - ASCII document describing the installation of ODV

The following "gif" images are also contained in this directory as they are needed when viewing the HTML version of the documentation.

atlwmo.gif - WMO squares of the Atlantic and Indian Oceans
pacwmo.gif - WMO squares of the Pacific Ocean
doclogo.gif - Department of Commerce logo
noaabw.gif - NOAA logo in black/white
services.gif - information about the NODC

Files in the directory **programs** of every CD-ROM:

---

programs.txt - description of the files in this directory
The following subdirectories containing sample converters from the OCL format to other formats, are included in this directory:

- column - *Written by C. Stephens and J. Antonov, NODC*
  - readme.mat - describes the use of matlab.f
  - matlab.f - prints output in columns which can be read by MATLAB
  - readme.gr - file describing how to display the output from matlab.f in GRAPHER
  - sample.grf - GRAPHER template
  - sample.mat - sample output data from matlab.f
- comma - *Written by T. Boyer , NODC*
  - formatp3.wpd - Word Perfect for Windows description of the NODC P3 format
  - formatp3.htm - HTML description of the NODC P3 format
  - ocltop3.c - C program reads OCL data and prints output in the NODC P3 format
  - oclread.dir - contains all functions for reading OCL formatted data
  - ocltop3.dir - contains all functions for writing data in P3 format

    - readme.p3 - describes the programs in this directory

- ices - *Written by Dr. Harry Dooley, ICES*

    - readme.ic - description of files in this directory
    - cdw98-ic.exe - BASIC executable which reads the OCL data and converts it to ICES format - **NOTE - THIS PROGRAM ONLY RUNS IN DOS**
    - ices_src.txt - source code in BASIC for cdw98-ic.exe
    - oclnodcc.txt - OCL and NODC ship codes used by cdw98-ic.exe

- idl - *Written by John E. O'Reilly, NMFS*

    - readme.idl - describes IDL programs and shows examples
    - ocl2idl.pro - contains subroutines which extract the data
    - oclbro.pro - opens and reads a WOD98 ASCII file, plots profile and metadata
    - oclopen.pro - opens a WOD98 ASCII file
    - oclplot.pro - plots station data
    - oclread.pro - reads a station from a WOD98 ASCII file
    - oclstr.pro - creates an IDL structure for the data
    - oclwrite.pro - produces comma separated output file of a profile
    - sample.csv - an example of a comma separated output file
    - sample.gif - a gif image of the sample output file

- ocl - *Written by T. Boyer and T. O'Brien, NODC*

    - ocldemo.f - sample FORTRAN program for reading the data
    - ocldemo.c - sample C program for reading the data
    - readme.ocl - readme file describing the ocldemo programs
    - sample.ocl - sample of run output for OCLDEMO.F

Files in the directory **codes** of every CD-ROM:

NOTE: all files in this directory are in ASCII format

codes.txt - description of the files in this directory

- accession.txt - list of accession numbers, submitting institutes, submitting investigator, and date of receipt of data
- bioheadr.txt - code table identifying the biological headers
- biomass.txt - code table identifying the plankton biomass parameter codes
- castdir.txt - code table identifying cast direction
- cloudamt.txt - code table identifying the cloud amount (WMO-2700 or NODC-0052)
- cloudtyp.txt - code table identifying the cloud type (WMO-0500 or NODC-0053)
- cntmeth.txt - code table identifying the counting methods
- country.txt - code table identifying countries (NODC codes)
- datatr.txt - code table identifying data treatment (NODC-0614)
- depthdet.txt - how the upper and lower depths were determined for biological observations
- digitint.txt - code table identifying digitization interval (NODC-0613)
- digitmet.txt - code table identifying digitization method (NODC-0612)
- filter.txt- code table identifying filter codes
- flags.txt - code table identifying flags assigned to the data
- flowcal.txt - code table identifying flowmeter calibration methods
- gear.txt - biological sampling gear and flowmeter types
- inst.txt - code table identifying institutes (OCL codes)
- itistsn.txt - Taxonomic serial numbers and associated names based on the ITIS taxonomic code list
- methods.txt - code table identifying methods for the station data
- nontaxsn.txt - biological group codes assigned by OCL
- owscodes.txt - code table identifying the ocean weather stations

- pinames.txt - code table for identifying the Principal Investigator
- preserv.txt - code table identifying sample preservatives used
- projects.txt - code table identifying projects
- recorder.txt - code table identifying the recorder type (WMO-4770)
- reftype.txt - code table identifying the reference type (WMO-0615)
- seastate.txt - code table identifying the sea state (WMO-3700 or NODC-0109)
- seconddh.txt - code table identifying the secondary header variables
- shipname.txt - code table identifying the ships
- taxabund.txt - taxon presence, absence, and relative abundance terms
- taxfeatr.txt - code table identifying taxon shape or other features (*e.g.,* 'truncate conical')
- taxlife.txt - table identifying taxon life stages
- taxmodif.txt - code table identifying the taxon modifying terms (*e.g.,* 'sp.')
- taxrealm.txt- code table identifying the taxon realm (*e.g.,* 'benthic')
- taxsex.txt- code table identifying the taxon sex
- taxsize.txt - code table identifying the taxon size delimiters
- taxtroph.txt - code table identifying the taxon trophic mode
- taxvar.txt - code table listing the biomass/taxa-specific variable codes
- towtype.txt - code table identifying the gear towing method
- tsprobe.txt - code table identifying the Temperature/Salinity instrument type
- units.txt - code table identifying originator's variable units
- varmeas.txt - code table for measured variables
- visibil.txt - code table identifying visibility (WMO-4300)
- volumeth.txt - code table identifying volume determination methods
- watercol.txt - code table identifying water color (Forel-Ule scale 00-21)
- wavehgt.txt - code table identifying wave height (WMO-1555 or NODC-0104)
- waveper.txt - code table identifying wave period (WMO-3155 or NODC-0378)
- weather1.txt - code table identifying weather (WMO-4501)
- weather2.txt - code table identifying weather (WMO-04677)
- windfor.txt - code table identifying wind force (Beaufort scale or NODC-0052)
- winwaved.txt - code table identifying wind/wave direction (WMO-0877 or NODC-0110)
- wtmeth.txt - code table identifying weight determination methods

Subdirectories in the directory **ODV** of every CD-ROM:

The ODV directory contains readme.txt file with further instructions on content and installation instructions.

- readme.txt installation instructions for the ODV 4.0 (PC only) program.
- ODV40.ZIP main ODV installation file set (compressed via zip).
- history.ODV history file of ODV development and versions
- pkunzip.exe PC executable for unzipping the ODV40.ZIP file.
- wod98*.lst each WOD98 CD-ROM contains a sample multiple-file loading "*.lst" file, specific to that CD-ROM. The example will load a 2x2 WMO set of WOD98 bottle data (BD and NBD) into ODV. These files may need to be modified if PC's CD-ROM drive is not "d:".
- OptPack this directory contains the ETOPO.zip and globhr.zip optional packages. These files are described in the "options.lst" file, also in the directory.

B. util DIRECTORY

1. GZIP Directory

Within the **util** directory of each CD-ROM there is a **gzip** directory which contains two files used for decompressing the data on the WOD98. The first (gzip124.exe) is a self-extracting DOS executable and the second (gzip1.2.4.tar) is a tar'd file containing source code for UNIX users.

a. Installing gzip For the First Time

DOS Users:

The file gzip124.exe is a self-extracting DOS executable. Copy gzip124.exe to your hard disk; preferably into a directory listed in your path. Run gzip124.exe and use the file gzip.exe to uncompress data from the WOD98 CD-ROMs as described below.

UNIX Users:

Copy gzip1.2.4.tar to your UNIX system.
Run the following commands:

```
uncompress gzip1.2.4.tar
tar xvf gzip1.2.4.tar
```

These commands will create a directory named gzip1.2.4 which include the gzip source code and documentation on copyrights, compression methods and how to compile and install the gzip code.

Read through the README file and when ready to build the gzip executable, follow the instructions in the install file.

b. Decompressing Data From WOD98

To uncompress the WOD98 files, it is easier to copy the files to the hard disk. Use gzip to uncompress selected files or a directory and all of it's subdirectories with one command.

gzip has a limited help menu accessible with the -h option (*i.e.*, gzip -h)

To uncompress a single file:

```
gzip -nd <filename>
```

To uncompress the contents of a directory and all of it's subdirectories:

```
gzip -dr <directoryname>
```

If an older version of gzip is used, the -n option is required in order to preserve the correct file names.

Special Note for UNIX Users

The DOS CR-LF (Carriage Return-Line Feed) indicates the end of a record and may cause problems when working in a UNIX environment. Many systems have a "dos2unix" program which removes these characters from an ASCII file. Files can also be converted by transferring from DOS/WINDOWS using FTP (File Transfer Protocol). The UNIX "tr" or "perl" utilities will also remove the CR-LF.

(a) To use the UNIX translate utility, "tr":

```
tr -d '\r' < original_filename > new_filename
```

(Note that the "<" and ">" must be typed for this command to work).

(b) To use the UNIX perl utility:

```
perl -pi -e 's/\r\n/\n/g' filename
```

C. SYSTEM REQUIREMENTS

The minimum hardware requirements for accessing data and information from the CD-ROMs are:
CD-ROM reader capable of accessing a disc formatted with the ISO 9660 standard;
Microsoft MS-DOS Extensions for CD-ROM, Version 2.0 or higher for DOS machines.

Using the Ocean Data View 4.0 software, for PC's only, has additional requirements,

which are addressed at the ODV web site: http://www.awi-bremerhaven.de/GEO/ODV/

VI. LIST OF ACRONYMS USED IN THE CD-ROM DOCUMENTATION

BT	Bottle Data
CTD	Conductivity, Temperature, Depth probe
DBT	Digital Bathythermograph
ESDIM	Environmental Science Data and Information Management
FSU	Former Soviet Union
GODAR	Global Oceanographic Data Archaeology and Rescue project
GTSPP	Global Temperature Salinity Profile Project
ICES	International Council for the Exploration of the Seas
IOC	Intergovernmental Oceanographic Commission
IODE	International Ocean Data Exchange
ITIS	Integrated Taxonomic Information System
MBT	Mechanical Bathythermograph
meq	Milli-equivalents
NMFS	National Marine Fisheries Service
NOAA	National Oceanic adn Atmospheric Administration
NODC	National Oceanographic Data Center
OCL	Ocean Climate Laboratory
ODV	Ocean Data View (included PC software)
PSS	Practical Salinity Scale
TSN	Taxonomic Serial Number
SBT	Selected Bathythermograph
STD	Salinity/Temperature with Depth
TAO	Tropical Atmosphere-Ocean
uM	Micromolar
UCAR	University Corporation for Atmospheric Research
WOA94	World Ocean Atlas, 1994
WOD98	World Ocean Database 1998
WDC-A	World Data Center A for Oceanography
WMO	World Meteorological Organization
XBT	Expendable Bathythermograph

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*These references are listed in Appendix 4 - Codes for Methods

VIII. REFERENCES ASSOCIATED WITH WOD98

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APPENDIX 1. NODC COUNTRY CODES

CODE	COUNTRY	CODE	COUNTRY
06	GERMANY, FEDERAL REPUBLIC OF	60	JAPAN
07	GERMANY, DEMOCRATIC REPUBLIC OF	61	NEW ZEALAND
08	ARGENTINA	62	PAKISTAN
09	AUSTRALIA	64	NETHERLANDS
10	AUSTRIA	65	PERU
11	BELGIUM	66	PHILIPPINES
12	BURMA	67	POLAND
13	BOLIVIA	68	PORTUGAL
14	BRAZIL	70	DOMINICAN REPUBLIC
15	BULGARIA	72	ALBANIA

18	CANADA	74	UNITED KINGDOM
19	SRI LANKA	75	EL SALVADOR
20	CHILE	76	CHINA, THE PEOPLES REPUBLIC OF
21	TAIWAN	77	SWEDEN
22	COLUMBIA	78	SWITZERLAND
24	KOREA, REPUBLIC OF	79	SURINAM
26	DENMARK	80	SYRIA
27	ARAB REPUBLIC OF EQYPT	86	THAILAND
28	ECUADOR	87	TOGO
29	SPAIN	88	TUNISIA
31	UNITED STATES	89	TURKEY
32	UNITED STATES	90	UNION OF SOVIET SOCIALIST REPUBLICS
33	UNITED STATES	91	SOUTH AFRICA
34	FINLAND	92	URUGUAY
35	FRANCE	93	VENEZUELA
36	GREECE	94	VIET-NAM
37	GUATEMALA	95	YUGOSLAVIA
38	HAITI	99	UNKNOWN
41	INDIA	AG	ANTIGUA
42	INDONESIA	AL	ALGERIA
43	IRAQ	AN	ANGOLA
44	IRAN	BA	BARBADOS
45	IRELAND	BH	BAHAMAS
46	ICELAND	BN	BONAIRE
47	ISRAEL	CA	CURACAO
48	ITALY	CI	CAYMAN ISLANDS
49	JAPAN	CR	COSTA RICA
50	JORDAN	CU	CUBA
51	JAPAN	CV	CAPE VERDE
52	LEBANON	CY	CYPRUS
53	LIBYA	ES	ESTONIA
54	LIBERIA	ET	ETHIOPIA
55	MALAGASY REPUBLIC	FJ	FIJI ISLANDS
56	MOROCCO	GA	GABON
57	MEXICO	GH	GHANA
58	NORWAY	GM	GAMBIA
59	NEW CALEDONIA	GN	GUINEA-BISSAU
GR	GRENADA	QA	QUATAR
GU	GUINEA	RC	CONGO
GY	GUYANA	RU	RUSSIA
HO	HONDURAS	SA	SAUDI ARABIA
HK	HONG KONG	SC	SEYCHELLES
IC	IVORY COAST	SE	SENEGAL
IN	INTERNATIONAL	SI	SINGAPORE
JA	JAMAICA	SL	SIERRA LEONE

KE	KENYA	SM	SOMALIA
KU	KUWAIT	SO	SOLOMAN ISLANDS
LA	LATVIA	SU	SUDAN
LT	LITHUANIA	SV	SAINT VINCENT
MA	MAURITIUS	TN	TONGA
ML	MALTA	TT	TRINIDAD/TOBAGO
MO	MONACO	UA	U.ARAB EMIRATES
MS	MALAYSIA	UR	UKRAINE
MU	MAURITANIA	WS	WESTERN SAMOA
MZ	MOZAMBIQUE	YM	YEMEN
NC	NICARAGUA	ZA	TANZANIA
NI	NIGERIA	ZZ	MISC. ORGANIZATIONAL UNITS
OM	OMAN	PA	PANAMA

APPENDIX 2.

NODC SECONDARY HEADER CODE TABLES.

The first column in the tables contains the code used by the OCL to identify the variable. Sometimes, the second column contains the code used by NODC. The final column contains the code description.

2A. OCEAN WEATHER STATION - SECONDARY HEADER CODE 9*

CODE	**LETTER**	**1942-1952**	1 Apr. 1952 - 29 Feb. 1956	**1 March 1956 - present**
1	A	Able	Alfa	Alfa
2	B	Baker	Bravo	Bravo
3	C	Charlie	Coca	Charlie
4	D	Dog	Delta	Delta
5	E	Easy	Echo	Echo
6	F	Fox	Foxtrot	Foxtrot
7	G	George	Golf	Golf
8	H	How	Hotel	Hotel
9	I	Item	India	India
10	J	Jig	Juliet	Juliet
11	K	King	Kilo	Kilo
12	L	Love	Lima	Lima
13	M	Mike	Metro	Mike
14	N	Nan	Nectar	November
15	O	Oboe	Oscar	Oscar
16	P	Peter	Papa	Papa
17	Q	Queen	Quebec	Quebec
18	R	Roger	Romeo	Romeo
19	S	Sugar	Sierra	Sierra
20	T	Taro	Tango	Tango
21	U	Uncle	Union	Uniform
22	V	Victor	Victor	Victor

23	W	William	Whisky	Whisky
24	X	Xray	Extra	Xray
25	Y	Yoke	Yankee	Yankee
26	Z	Zebra	Zulu	Zulu

***** from Lumby and Saelen, 1957 (Report on Oceanographical work from Ocean Weather Ships, Association D'Oceanographie Physique, Publication Scientifique No. 16).

2B. CAST DIRECTION - SECONDARY HEADER CODE 11

OCL CODE	NODC CODE	DESCRIPTION
1	(U)	UPCAST
2	(A)	AVERAGE OF UP AND DOWN CASTS

2C. WATER COLOR - SECONDARY HEADER CODE 14

CODE	DESCRIPTION	CODE	DESCRIPTION
1	PERCENT YELLOW 0 FOREL-ULE	15	PERCENT BROWN 14 FOREL-ULE
2	PERCENT YELLOW 2 FOREL-ULE	16	PERCENT BROWN 20 FOREL-ULE
3	PERCENT YELLOW 5 FOREL-ULE	17	PERCENT BROWN 27 FOREL-ULE
4	PERCENT YELLOW 9 FOREL-ULE	18	PERCENT BROWN 35 FOREL-ULE
5	PERCENT YELLOW 14 FOREL-ULE	19	PERCENT BROWN 44 FOREL-ULE
6	PERCENT YELLOW 20 FOREL-ULE	20	PERCENT BROWN 54 FOREL-ULE
7	PERCENT YELLOW 27 FOREL-ULE	21	PERCENT BROWN 65 FOREL-ULE
8	PERCENT YELLOW 35 FOREL-ULE	31	GREEN
9	PERCENT YELLOW 44 FOREL-ULE	32	BLUE
10	PERCENT YELLOW 54 FOREL-ULE	33	GREY
11	PERCENT YELLOW 65 PERCENT BROWN 0	34	RED
12	PERCENT BROWN 2 FOREL-ULE	35	CHALKY
13	PERCENT BROWN 5 FOREL-ULE	36	BROWN
14	PERCENT BROWN 9 FOREL-ULE	37	LUMINESCENT

2D. WIND-WAVE DIRECTION (WMO-0877) - SECONDARY HEADER CODE 16/21

CODE	DESCRIPTION		
0	CALM (NO WAVES-NO MOTION)		
1	5 DEGREES - 14 DEGREES	19	185 DEGREES - 194 DEGREES
2	15 DEGREES - 24 DEGREES	20	195 DEGREES - 204 DEGREES
3	25 DEGREES - 34 DEGREES	21	205 DEGREES - 214 DEGREES
4	35 DEGREES - 44 DEGREES	22	215 DEGREES - 224 DEGREES
5	45 DEGREES - 54 DEGREES	23	225 DEGREES - 234 DEGREES
6	55 DEGREES - 64 DEGREES	24	235 DEGREES - 244 DEGREES
7	65 DEGREES - 74 DEGREES	25	245 DEGREES - 254 DEGREES
8	75 DEGREES - 84 DEGREES	26	255 DEGREES - 264 DEGREES
9	85 DEGREES - 94 DEGREES	27	265 DEGREES - 274 DEGREES
10	95 DEGREES - 104 DEGREES	28	275 DEGREES - 284 DEGREES

11	105 DEGREES - 114 DEGREES	29	285 DEGREES - 294 DEGREES
12	115 DEGREES - 124 DEGREES	30	295 DEGREES - 304 DEGREES
13	125 DEGREES - 134 DEGREES	31	305 DEGREES - 314 DEGREES
14	135 DEGREES - 144 DEGREES	32	315 DEGREES - 324 DEGREES
15	145 DEGREES - 154 DEGREES	33	325 DEGREES - 334 DEGREES
16	155 DEGREES - 164 DEGREES	34	335 DEGREES - 344 DEGREES
17	165 DEGREES - 174 DEGREES	35	345 DEGREES - 354 DEGREES
18	175 DEGREES - 184 DEGREES	36	355 DEGREES - 4 DEGREES
49	WAVES CONFUSED, DIRECTION INDETERMINATE (WAVES EQUAL TO OR LESS THAN 4 3/4 METERS)		
99	WAVES CONFUSED, DIRECTION INDETERMINATE (WAVES GREATER THAN 4 3/4 METERS) WINDS VARIABLE, OR ALL DIRECTIONS OR UNKNOWN		

2E. WAVE HEIGHT (WMO-1555) - SECONDARY HEADER CODE 17

CODE	DESCRIPTION	CODE	DESCRIPTION
0	CALM	14	7 METER
1	0.5 METER	15	7.5 METER
2	1 METER	16	8 METER
3	1.5 METER	17	8.5 METER
4	2 METER	18	9 METER
5	2.5 METER	19	9.5 METER
6	3 METER	20	10 METER
7	3.5 METER	21	10.5 METER
8	4 METER	22	11 METER
9	4.5 METER	23	11.5 METER
10	5 METER	24	12 METER
11	5.5 METER	25	12.5 METER
12	6 METER	26	13 METER
13	6.5 METER	27	> 13 METERS

2F. SEA STATE (WMO3700) - SECONDARY HEADER CODE 18

CODE	DESCRIPTION
0	CALM-GLASSY 0 FT (0 METERS)
1	CALM-RIPPLED 0-1/3 FT (0-.1METERS)
2	SMOOTH-WAVELET 1/3-1 2/3 FT (.1-.5 METERS)
3	SLIGHT 1 2/3 - 4 FT(.5-1.25 METERS)
4	MODERATE 4-8 FT(1.25-2.50 METERS)
5	ROUGH 8-13 FT(2.50-4.0 METERS)
6	VERY ROUGH 13-20 FT(4-6 METERS)
7	HIGH 20-30 FT(6-9 METERS)
8	VERY HIGH 30-45 FT(9-14 METERS)
9	PHENOMENAL >45 FT (>14 METERS)

2G. WIND FORCE (BEAUFORT) - SECONDARY HEADER CODE 19

CODE	DESCRIPTION

0	Calm (mean velocity in knots <1; in meters/sec 0-0.2; in km/h <1; in m.p.h. <1) /wave ht < .25 ft
1	Light air (mean velocity in knots 1-3; meters/sec 0.3-1.5; Km/h 1-5; m.p.h. 1-3) /wave ht= .25 ft
2	Light breeze (mean velocity in knots 4-6; meters/sec 1.6-3.3; Km/h 6-11; m.p.h. 4-7) /wave ht = .5 ft
3	Gentle breeze (mean velocity in knots 7-10; meters/sec 3.4-5.4; km/h 12-19; m.p.h. 8-12) /wave ht = 2 ft
4	Moderate breeze (mean velocity in knots 11-16; meters/sec 5.5-7.9; km/h 20-28; m.p.h. 13-18) wave ht = 4 ft
5	Fresh breeze (mean velocity in knots 17-21; meters/sec 8.0-10.7; km/h 29-38; m.p.h. 19-24) wave ht = 6 ft
6	Strong breeze (mean velocity in knots 22-27; meters/sec 10.8-13.8; km/h 39-49; m.p.h. 25-31) /wave ht = 10ft
7	Near gale (mean velocity in knots 28-33; meters/sec 13.9-17.1; Km/h 50-61; m.p.h. 32-38) /wave ht = 14 ft
8	Gale (mean velocity in knots 34-40; meters/sec 17.2-20.7; Km/h 62-74; m.p.h. 39-46) /wave ht = 18 ft
9	Strong gale (mean velocity in knots 41-47; meters/sec 20.8-24.4; km/h 75-88; m.p.h. 47-54) /wave ht = 23 ft

2H. WAVE PERIOD (WMO 3155) - SECONDARY HEADER CODE 20

NODC CODE 0378		WMO 3155	
CODE	**DESCRIPTION**	**CODE**	**DESCRIPTION**
0	20 OR 21 SECONDS	0	10 SECONDS
1	OVER 21 SECONDS	1	11 SECONDS
2	5 SECONDS OR LESS	2	12 SECONDS
3	6 OR 7 SECONDS	3	13 SECONDS
4	8 OR 9 SECONDS	4	14 SECONDS
5	10 OR 11 SECONDS	5	5 SECONDS OR LESS
6	12 OR 13 SECONDS	6	6 SECONDS
7	14 OR 15 SECONDS	7	7 SECONDS
8	16 OR 17 SECONDS	8	8 SECONDS
9	18 OR 19 SECONDS	9	9 SECONDS

2Ia. WEATHER (WMO 4501) - SECONDARY HEADER CODE 26 - (See below for WMO 4677)

OCL CODE	NODC CODE	DESCRIPTION
0	-	CLEAR (NO CLOUD AT ANY LEVEL)
-1	1	PARTLY CLOUDY (SCATTERED OR BROKEN)
-2	2	CONTINUOUS LAYER(S) OF CLOUD(S)
-3	3	SANDSTORM, DUST STORM, OR BLOWING SNOW
-4	4	FOG, THICK DUST OR HAZE
-5	5	DRIZZLE
-6	6	RAIN
-7	7	SNOW, OR RAIN AND SNOW MIXED
-8	8	SHOWER(S)

-9	9	THUNDERSTORM(S)

2Ib. WEATHER (WMO 4677) - SECONDARY HEADER CODE 26

0 - cloud develop. Not observed or not observable-char. change of the state of sky during past hour

1 - clouds generally dissolving of becoming less developed-char. change of state of sky during past hr.

2 - state of sky on the whole unchanged-char. change of the state of sky during the past hour

3 - clouds generally forming or developing-char. change of the state of sky during the past hour

4 - visibility reduced by smoke, *e.g.*, veldt of forest fires, industrial smoke or volcanic ashes

5 - haze

6 - widespread dust in suspension in the air, raised by wind at or near time of obs.

7 - dust or sand raised by wind at or near the station at the time of observation, but no well developed dust whirl(s) or sand whirl(s), and no dust storm or sandstorm seen

8 - well developed dust whirl(s) or sand whirl(s) seen at or near station during the preceding hour or at the time of observation, but no dust storm or sand storm

9 - dust storm or sand storm within sight at the time of observation, or at station during preceding hour

10 - mist

11 - patches of shallow fog or ice fog at the station, whether on land or sea, not deeper than about 2 meters on land or 10 meters at sea

12 - more or less continuous shallow fog or ice fog at the station, whether on land or sea, not deeper than about 2 m on land or 10 m at sea

13 - lightning visible, no thunder heard

14 - precipitation within sight, not reaching the ground or the surface of the sea

15 - precipitation within sight, reaching the ground or the surface of the sea, but distant(*i.e.* estimated to be more than 5 km) from the station

16 - precipitation within sight, reaching ground or surface of the sea, near to, but not at the station

17 - thunderstorm, but no precipitation at the time of observation

18 - squalls at or within sight of the station during the preceding hour or at time of observation

19 - funnel cloud(s) at or within sight of station during preceding hour or at the time of observation

20 - drizzle (not freezing) or snow grains - not falling as shower(s)

21 - rain (not freezing) - not falling as shower(s)

22 - snow - not falling as shower(s)

23 - rain and snow or ice pellets, type (a) - not falling as shower(s)

24 - freezing drizzle or freezing rain - not falling as shower(s)

25 - shower(s) of rain - not falling as shower(s)

26 - shower(s) of snow, or of rain and snow - not falling as shower(s)

27 - shower(s) of hail, or of rain and hail - not falling as shower(s)

28 - fog or ice fog - not falling as shower(s)

29 - thunderstorm (with or without precipitation)

30 - slight or moderate dust storm or sandstorm-has decreased during the preceding hour

31 - slight or moderate dust storm or sandstorm-no appreciable change during the preceding hour

32 - slight or moderate dust storm or sandstorm-has begun or has increased during the preceding hour

33 - severe dust storm or sandstorm-has decreased during the preceding hour

34 - severe dust storm or sandstorm-no appreciable change during the preceding hour

35 - severe dust storm or sandstorm-has begun or has increased during the preceding hour

36 - slight or moderate blowing snow-generally low (below eye level)

37 - heavy drifting snow-generally low (below eye level)

38 - slight or moderate blowing snow-generally high (above eye level)

39 - heavy blowing snow-generally high (above eye level)

40 - fog or ice fog at a distance at time of observation, but not at the station during the preceding hour, the fog or ice fog extending to a level above that of the observer

41 - fog or ice fog in patches

42 - fog or ice fog, sky visible-has become thinner during the preceding hour

43 - fog or ice fog, sky invisible-has become thinner during the preceding hour

44 - fog or ice fog, sky visible-no appreciable change during the preceding hour

45 - fog or ice fog, sky invisible-no appreciable change during the preceding hour

46 - fog or ice fog, sky visible-has begun or has become thicker during the preceding hour

47 - fog or ice fog, sky invisible-has begun or has become thicker during the preceding hour

48 - fog, depositing rime, sky visible

49 - fog, depositing rime, sky invisible

50 - drizzle, not freezing, intermittent-slight at time of observation

51 - drizzle, not freezing, continuous-slight at time of observation

52 - drizzle, not freezing, intermittent-moderate at time of observation

53 - drizzle, not freezing, continuous-moderate at time of observation

54 - drizzle, not freezing, intermittent-heavy (dense) at time of observation

55 - drizzle, not freezing, continuous-heavy (dense) at time of observation

56 - drizzle, freezing, slight

57 - drizzle, freezing, moderate or heavy (dense)

58 - drizzle and rain, slight

59 - drizzle and rain, moderate or heavy

60 - rain, not freezing, intermittent-slight at time of observation

61 - rain, not freezing, continuous-slight at time of observation

62 - rain, not freezing, intermittent-moderate at time of observation

63 - rain, not freezing, continuous-moderate at time of observation

64 - rain, not freezing, intermittent-heavy at time of observation

65 - rain, not freezing, continuous-heavy at time of observation

66 - rain, freezing, slight

67 - rain, freezing, moderate or heavy

68 - rain or drizzle and snow, slight

69 - rain or drizzle and snow, moderate or heavy

70 - intermittent fall of snow flakes-slight at time of observation

71 - continuous fall of snow flakes-slight at time of observation

72 - intermittent fall of snow flakes-moderate at time of observation

73 - continuous fall of snow flakes-moderate at time of observation

74 - intermittent fall of snow flakes-heavy at time of observation

75 - continuous fall of snow flakes-heavy at time of observation

76 - ice prisms (with or without fog)

77 - snow grains (with or without fog)

78 - isolated starlike snow crystals (with or without fog)

79 - ice pellets, type (a)

80 - rain shower(s), slight

81 - rain shower(s), moderate or heavy

82 - rain shower(s), violent

83 - shower(s) of rain and snow mixed, slight

84 - shower(s) of rain and snow mixed, moderate or heavy

85 - snow shower(s), slight

86 - show shower(s), moderate or heavy

87 - shower(s) of snow pellets or ice pellets, type(b), with/without rain and snow mixed-slight

88 - shower(s) of snow pellets or ice pellets, type(b), with/without rain or rain and snow mixed- moderate or heavy

89 - shower(s) of hail, with or without rain or rain and snow mixed, not assoc. with thunder-slight

90 - shower(s) of hail, with/without rain or rain and snow mixed, not assoc. w/thunder-moderate or heavy

91 - slight rain at time of observation-thunderstorm during the preceding hour but not at time of obs.

92 - moderate or heavy rain at time of observation.-thunderstorm during preceding hr. but not at time of obs.

93 - slight snow, or rain and snow mixed or hail at time of observation.-thunderstorm during the preceding hour but not at time of observation

94 - moderate or heavy snow, or rain and snow mixed or hail at time of observation-thunderstorm during the preceding hour but not at time of observation

95 - thunderstorm, slight or moderate, without hail, but w/rain and/or snow at time of observation

96 - thunderstorm, slight or moderate, with hail at time of observation

97 - thunderstorm, heavy, without hail, but with rain and/or snow at time of observation

98 - thunderstorm combined with dust storm or sandstorm at time of observation

99 - thunderstorm, heavy, with hail at time of observation

2J. CLOUD TYPE (WMO500) - SECONDARY HEADER CODE 27

CODE	DESCRIPTION
0	CIRRUS (CI)
1	CIRROCUMULUS (CC)
2	CIRROSTRATUS (CS)
3	ALTOCUMULUS (AC)
4	ALTOSTRATUS (AS)
5	NIMBOSTRATUS (NS)
6	STRATOCUMULUS (SC)
7	STRATUS (ST)
8	CUMULUS (CU)
9	CUMULONIMBUS (CB)
10	CLOUD NOT VISIBLE OWING TO DARKNESS, FOG, DUST STORM, SANDSTORM, OR OTHER ANALOGOUS PHENOMENA

2K. CLOUD COVER (WMO2700) - SECONDARY HEADER CODE 28

CODE	DESCRIPTION
0	0 (ZERO)
1	1 OKTA OR LESS, BUT NOT ZERO (1/10 OR LESS, BUT NOT ZERO)
2	2 OKTAS or 2/10-3/10
3	3 OKTAS or 4/10
4	4 OKTAS or 5/10
5	5 OKTAS or 6/10
6	6 OKTAS or 7/10-8/10
7	7 OKTAS OR MORE, BUT NOT 8 OKTAS (9/10 OR MORE, BUT NOT 10/10)
8	8 OKTAS or 10/10
9	SKY OBSCURED, OR CLOUD AMOUNT CANNOT BE ESTIMATED

2L. RECORDER TYPE (BT - WMO-4770) - SECONDARY HEADER CODE 32

CODE	DESCRIPTION
1	SIPPICAN STRIP CHART RECORDER
2	SIPPICAN MK2A/SSQ-61
3	SIPPICAN MK-9
4	SIPPICAN AN/BHQ-7/MKS
5	SIPPICAN MK-12
6	MK5
7	MK8 LINEAR RECORDER
10	SPARTAN SOC-BT/SV PROCESSOR MODEL 100
20	ARGOS XBT-ST
21	CLS-ARGOS/PROTECNO XBT-ST MODEL 1
22	CLS-ARGOS/PROTECNO XBT-ST MODEL 2
30	BATHY SYSTEMS SA-810
31	SCRIPPS METROBYTE CONTROLLER
32	MURAYAMA DENKI Z-60-16 III
33	MURAYAMA DENKI Z-60-16 II
34	PROTECNO ETSM2
35	NAUTILUS MARINE SERVICE NMS-XBT
40	TSK MK-2A
41	TSK MK-2S
42	TSK MK-30
43	TSK MK-30N

2M. DIGITIZATION METHOD (NODC-0612) - SECONDARY HEADER CODE 35

CODE	DESCRIPTION
1	MANUAL
2	A-D CONVERSION FROM ORIGINAL
3	A-D CONVERSION FROM COPIES
4	OPTICAL SCANNING
5	DIRECT DIGITAL OUTPUT UNKNOWN
6	DIRECT DIGITAL OUTPUT BATHY
7	DIRECT DIGITAL OUTPUT SUTRON
8	DIRECT DIGITAL OUTPUT FROM SIPPICAN MARK 9

2N. DIGITIZATION INTERVAL (NODC-0613) - SECONDARY HEADER CODE 36

LE = less than or equal to; GT = greater than; LT = less than; DEG C = degrees Celsius

CODE	DESCRIPTION
1	FIXED INTERVAL LE 0.1 METER AND LE 0.1 DEG C

2	FIXED INTERVAL GT 1 METER BUT LE 3 METERS AND LE 0. 1 DEG C
3	FIXED INTERVAL GT 3 METERS BUT LE 6 METERS AND LE 0 .1 DEG C
4	FIXED INTERVAL GT 6 METERS AND LE 0.1 DEG C
11	FIXED INTERVAL LE 1 METER AND LE 0.2 DEG C
12	FIXED INTERVAL GT 1 METER BUT LE 3 METERS AND LE 0. 2 DEG C
13	FIXED INTERVAL GT 3 METERS AND LE 6 METERS AND LE 0.2 DEG C
31	VARIABLE INTERVAL - MANUALLY DETERMINED
32	VARIABLE INTERVAL - STATISTICALLY DETERMINED
33	VARIABLE INTERVAL - PHYSICALLY DETERMINED
34	FIXED INTERVAL GT 3 METERS BUT LT 6 METERS AND LE 0.2 DEG C

2O. DATA TREATMENT AND STORAGE (NODC-0614) - SECONDARY HEADER CODE 37

CODE	DESCRIPTION
1	SINGLE DIGITIZATION; STORED AS DIGITIZED
2	SINGLE DIGITIZATION; COMPRESSION; FIT WITHIN 0.05 DEG C
3	SINGLE DIGITIZATION; COMPRESSION; FIT WITHIN 0.1 DEG C
4	SINGLE DIGITIZATION; COMPRESSION; FIT WITHIN 0.2 DEG C
5	SINGLE DIGITIZATION; COMPRESSION; FIT WITHIN 0.3 DEG C
6	SINGLE DIGITIZATION; COMPRESSION; FIT WITHIN 0.7 DEG C
21	DUAL DIGITIZATION AND AVERAGING; STORED AS DIGITIZED
22	DUAL DIGITIZATION AND AVERAGING; COMPRESSION; FIT WITHIN 0.05 DEG C
23	DUAL DIGITIZATION AND AVERAGING; COMPRESSION; FIT WITHIN 0.1 DEG C
24	DUAL DIGITIZATION AND AVERAGING; COMPRESSION; FIT WITHIN 0.2 DEG C
25	DUAL DIGITIZATION AND AVERAGING; COMPRESSION; FIT WITHIN 0.3 DEG C
26	DUAL DIGITIZATION AND AVERAGING; COMPRESSION; FIT WITHIN 0.5 DEG C
27	DATA POINTS AT FIXED INTERVALS OR SELECTED INTERVALS RETAINED AND STORED

2P. INSTRUMENT FOR REFERENCE TEMPERATURE (NODC-0615) - SECONDARY HEADER CODE 40

CODE	DESCRIPTION
1	BUCKET
2	INJECTION, OR UNVERIFIED BUCKET NOTATION, OR UNKNOWN
3	NANSEN CAST (REVERSING THERMOMETER)
4	THERMOGRAPH
5	SPECIAL CALIBRATION THERMOMETER OR EQUIPMENT
6	BT
7	STD
9	HULL CONTACT SENSOR
10	ENGINE INTAKE

2Q. HORIZONTAL VISIBILITY (WMO-4300) - SECONDARY HEADER CODE 41

CODE	DESCRIPTION
0	LESS THAN 50 METERS
1	50 - 200 METERS
2	200 - 500 METERS
3	500 - 1000 METERS
4	1 - 2 KM
5	2 - 4 KM
6	4 - 10 KM
7	10 - 20 KM
8	20 - 50 KM
9	50 KM OR MORE

2R. FILTER TYPE - SECONDARY HEADER CODE 59

100 GLASS-FIBER FILTER;	
101	Reeve Angel gf/f 984H
102	Whatman gf/f 24
103	Whatman gf/f 47 mm
104	Gelman gf/f 0.45u
105	Gelman gf/f 0.8u
106	GF/C
200 MILLIPORE	
300 NUCLEOPORE	
301	Nucleopore >10 micron
302	Nucleopore 2-10 micron
303	Nucleopore <2 micron
400 PAPER FILTER	
500 UNSPECIFIED FILTER-TYPE	
501	>10 micron (unspecified type)
502	2-10 micron (unspecified type)
503	<2 micron (unspecified type)
900 COMBINATION FILTER-TYPES	
901	Whatman GF/C and HA Millipore

APPENDIX 3.
CODE TABLES FOR TEMPERATURE-SALINITY PROBES (BOTTLE assumed if no code)

CODE	Instrument	Description
1	MBT	Mechanical Bathythermograph, TYPE UNKNOWN
2	XBT	Expendable Bathythermograph, TYPE UNKNOWN
3	DBT	Digital Bathythermograph, TYPE UNKNOWN
4	CTD	Conductivity/Temperature Device, TYPE
5	STD	Salinity/Temperature Device, TYPE UNKNOWN
6	XCTD	Expendable Conductivity/Temperature Device, TYPE
101	MBT	GM-39 (RUSSIA)
207	XBT	T7 (SIPPICAN)

208	XBT	T4 (SIPPICAN)
209	XBT	T6 (SIPPICAN)
210	XBT	T5 (SIPPICAN)
211	XBT	T10(SIPPICAN)
212	XBT	T11(SIPPICAN)
213	XBT	FAST DEEP (SIPPICAN) [formerly w/ MK5
214	XBT	DEEP BLUE (SIPPICAN) [formerly w/ MK8
215	XBT	T4 (TSK) [formerly RELEASED FROM
216	XBT	T6 (TSK) [formerly RELEASED FROM
217	XBT	T7 (TSK) [formerly RELEASED FROM
218	XBT	(MHI, ACADEMY OF SCIENCE, UKRAINE)
219	XBT	T5 (TSK)
220	XBT	T10 (TSK)
221	XBT	XBT-1 (SPARTAN)
222	XBT	XBT-3 (SPARTAN)
223	XBT	XBT-4 (SPARTAN)
224	XBT	XBT-5 (SPARTAN)
225	XBT	XBT-5DB (SPARTAN)
226	XBT	XBT-6 (SPARTAN)
227	XBT	XBT-7 (SPARTAN)
228	XBT	XBT-7DB (SPARTAN)
229	XBT	XBT-10 (SPARTAN)
230	XBT	XBT-20 (SPARTAN)
231	XBT	XBT-20DB (SPARTAN)
201	XBT	T7 (UNKNOWN BRAND)
202	XBT	T4 (UNKNOWN BRAND)
203	XBT	T6 (UNKNOWN BRAND)
204	XBT	T5 (UNKNOWN BRAND)
205	XBT	T10 (UNKNOWN BRAND)
206	XBT	T11 (UNKNOWN BRAND)
401	CTD	SBE-9 (Deep ocean precision CTD, Seabird
402	CTD	ISTOK
403	CTD	E.G.&G MARK III (E.G.&G Ocean products)
404	CTD	NEIL BROWN (MARK) IIIB
405	CTD	SEACAT (Seabird Electronics, unspecified model)
406	CTD	GUILDLINE (type unknown)
407	CTD	(MHI, ACADEMY OF SCIENCE, UKRAINE)
408	CTD	(Institute of Oceanography; Academy of Science,
409	CTD	STD (Krossbim Rosettes)
410	CTD	SEABIRD (Seabird Electronics, type unknown)
411	CTD	SBE-911 PLUS (Seabird Electronics)
412	CTD	BISSETT-BERMAN (type unknown)
413	CTD	JASUS (by M. Du Chaffaut and T. Labadie)
414	CTD	PLESSEY 9040
415	CTD	PLESSEY 9400

416	CTD	PLESSEY 9041
417	CTD	PLESSEY 9060
418	CTD	NEIL BROWN MARK III
419	CTD	Hydro Products 612/912S
420	CTD	NEIL BROWN SMART CTD
421	CTD	PLESSEY (type unknown)
422	CTD	PLESSEY/GRUNDY (type unknown; note that
423	CTD	NEIL BROWN DRCM
424	CTD	SBE-102 (Seabird Electronics)
425	CTD	SBE-911 (Seabird Electronics)
426	CTD	OCEAN CASSETTE
427	CTD	NEIL BROWN (type unknown)
428	CTD	BECKMAN RS5-3
429	CTD	SBE-19 (SEACAT stationary, Seabird Electronics)
430	CTD	GUILDLINE 8700 a.k.a. MARK II
431	CTD	GUILDLINE 8701 (analog CTD)
432	CTD	GUILDLINE 8701 MODIFIED
433	CTD	GUILDLINE 8705
434	CTD	GUILDLINE 8706
435	CTD	GUILDLINE 8709 (portable)
436	CTD	GUILDLINE 8755
437	CTD	GUILDLINE 8770 (portable)
438	CTD	GUILDLINE 8737 "WOCE" (WOCE-specifications)
439	CTD	FSI CTD (Falmouth Scientific, Inc.)
440	CTD	BISSETT-BERMAN 9006
441	CTD	BISSETT-BERMAN 9040-2A
501	STD	PLESSEY 9006
502	STD	PLESSEY 8400
503	STD	PLESSEY 9040
504	STD	PLESSEY 9041
505	STD	ED 9071
506	STD	APMCRO 12
507	STD	Hydrolab in situ salinometer (ca 1960's)
508	STD	AML STD-12 (a.k.a. AML CTD-12)
509	STD	BISSETT-BERMAN 9040
601	XCTD	STANDARD (SIPPICAN)
602	XCTD	DEEP (SIPPICAN)
603	XCTD	AXCTD (SIPPICAN)
604	XCTD	SXCTD (SIPPICAN)

APPENDIX 4.
CODES FOR METHODS

4A. PIGMENT (CHLOROPHYLL) METHODS (secondary header 48)

400	Spectrometric
413	JH75 (spectrophotometric - Jeffrey and Humphrey, 1975)
600	Fluorometric
601	Fluorescence (in-situ - Turner Fluorometer - Strickland and Parsons, 1972)
603	in situ CTD (CTD in-situ fluorometer)
700	HPLC (High Performance Liquid Chromatography)
860	Van Dorn (Japanese)
4B. NUTRIENT METHODS (secondary header 49)	
400	spectrometric- manual (Strickland and Parsons, 1972)
500	autoanalyzer (Strickland and Parsons, 1972)
501	Technicon Autoanalyzer (Murphy and Riley, 1962)
506	Sumigraph Autoanalyzer
4C. TOTAL ALKALINITY METHOD (secondary header 60)	
900	pH meter (potentiometric)
910	Ruppin (Ruppin's method -referenced in Zubov, 1937)
1300	Potentiometric (this includes Strickland and Parsons, 1972)
4D. OXYGEN METHODS (secondary header 67)	
300	Winkler method
321	Beckman POS -Beckman polarographic oxygen sensor (CTD)
4E. SALINITY METHODS (secondary header 68)	
201	Titration (Knudsen, 1902)
202	PSAL78
4F. TEMPERATURE METHODS (secondary header 69)	
102	T68
103	ITS-90

APPENDIX 5.
CODES FOR ORIGINATOR'S VARIABLE UNITS

5A. Oxygen originator's units (standard unit: ml/l - Secondary header 54)	
32	mg/l = ppm
37	mg-at/l
29	µmol/kg
7	µg-at/l = mmol/m^3 = µmol/l = µM
58	mg-at/kg
62	mmol/l
5B. Nutrients (standard unit: µg-at/l - Secondary header 55)	
36	µg/l
29	µmol/kg
39	ng/l
37	mg-at/l
58	mg-at/kg
34	µeq/kg = µmol/kg
51	µeq/l = µmol/l
54	meq/kg = mmol/kg
5C. Chlorophyll (standard unit: µg/l - Secondary header 56)	

33	µg/kg
39	ng/l
59	mg/kg
66	ng/kg
5D. Alkalinity (standard unit: meq/l - Secondary header 58)	
34	µeq/kg = µmol/kg
51	µeq/l = µmol/l
54	meq/kg = mmol/kg
5E. Biomass/taxonomic data (Taxa variable 20)	
68	per sample
69	per m^2
70	per m^3
71	per individual
72	per ml

APPENDIX 6. LIST OF CODE TABLES ASSOCIATED WITH THE BIOLOGICAL HEADERS

6A. TYPE OF TOW - BIOLOGICAL HEADER 4

CODE	DESCRIPTION	CODE	DESCRIPTION
1	HORIZONTAL	3	OTHER (oblique, double oblique)
2	VERTICAL	4	DEPTH STRATIFIED (*e.g.*, MOCNESS)

6B. GEAR AND FLOWMETER CODES - BIOLOGICAL HEADER 7

CODE	DESCRIPTION	CODE	DESCRIPTION
101	NORPAC Net	132	WP-2 (UNESCO Working Party 2)
102	Plankton Net (Muslin)	133	Nansen Surface Net
103	Plankton Net (Silk)	134	Heron Tranter Net
104	Marutoku B Net	135	N70 Net
105	Juday Net (Tropical or Large)	136	Organdie Net
106	Juday Net (Oceanic or JOM)	137	75M25 Net
107	Ring Net	138	TSK (flowmeter type)
108	Gulf IA Sampler	139	Hensen Egg Net
109	Gulf III Sampler	140	Beam Trawl
110	Gulf II (on-board CPR)	141	Marushi Net
111	Rectangular Midwater Trawl (RMT)	142	Foredeck Net
112	Plankton Net (type unknown)	143	Motoda MTD Net
113	Multiple Plankton Sampler (MPS)	144	Van Dorn Bottle
114	Bathypelagic Plankton Sampler (BPS)	145	GOM 2030 (Flowmeter type)
115	Indian Ocean Standard Net (IOSN)	146	POFI Net
116	Clarke-Bumpus Sampler	147	Micro Net (unspecified)
117	Neuston Net	148	Open Net (unspecified)
118	Bongo Net	149	Closing Net (Unspecified)
119	Water Pump	150	Speed Net (unspecified)

120	MOCNESS Net	151	Plankton Trap (unspecified)
121	BR 80/113 Net	152	NORPAC Net - Petersen
122	Continuous Plankton Recorder (Hardy)	153	NORPAC Net - Improved
123	Isaacs-Kidd Midwater Trawl (IKMT), depressor dimension unspecified	154	RGS (Flowmeter type)
124	Midwater Trawl	155	Flowmeter Used (type unspecified)
125	ORI Net	156	6-FT Isaacs Kidd Midwater Trawl
126	Kitahara Net	157	10-FT Isaacs Kidd Midwater Trawl
127	Bottle (Unspecified)	158	ATLAS (Flowmeter type)
128	Bottle (Niskin)	159	Tube Hai Net
129	Marutoku Net (Unspecified)	160	Continuous Plankton Sampler
130	Bottle (Go-Flos)	161	Double net (inner)
131	CalCOFI Net	162	Double net (outer)

6C. PRESERVATIVE CODES - BIOLOGICAL HEADER 10

CODE	DESCRIPTION
1	4-5% formalin, unbuffered
2	4-5% formalin, hexamine buffered
3	4-5% formalin, borax or borate buffered
4	10% formalin, seawater, buffered (unspecified type)
5	4-5% formalin, seawater (buffered/unbuffered unspecified)
6	4-5% formalin (no ref. to water-type or buffering, if any)
7	4%BUFFORMALIN(4-5% formalin, buffered (unspecified type)
8	10% filtered paraformaldehyde
9	2-10% formalin, seawater, buffered (unspecified type)
10	5-10% formalin, seawater, buffered (unspecified type)
11	1% formalin, buffered (unspecified type)
12	2% formalin, buffered (unspecified type)
13	3-5% formalin, seawater, unbuffered
14	5% formalin, seawater, borax buffered
15	4-5% formalin, seawater, sodium bicarbonate buffered
16	Liquid nitrogen
17	Acidified Lugol's Iodine solution
18	Formalin (no info on: %, buffering ,water type)
19	Preservative used, no additional information provided
20	10% formalin, buffered (unspecified type)

6D. WEIGHT METHOD - BIOLOGICAL HEADER CODE 11

CODE	DESCRIPTION	REFERENCE
1	TOTAL CATCH (wet weight of the total catch) ;	Bogorov, 1951. Trans. Inst. Oce. Acad. Sci. USSR 5:54-62. (Russian)
2	BOFS Mesoplankton Biomass Protocol	The BOFS North Atlantic Data Set, British Oceanographic Data Centre, 1994.

6E. COUNT METHOD - BIOLOGICAL HEADER CODE 13

CODE	DESCRIPTION
1	COUNTING CHAMBER
2	MICROSCOPE (Acid Lugol's stain)
3	MICROSCOPE (Autofluorescence)
4	MICROSCOPE (Epifluorescence, DAPI stained)
5	MUD OR MPN (Method of Ultimate Dilution or Most Probable Number)
6	MICROSCOPE (counted under a microscope at varying magnifications)
7	COMPLETE ENUMERATION
8	FOLSOM SPLITTER (complete enumeration, using Folsom Splitter to reduce sample to ~300-600 individuals)
9	MICROSCOPE, (Epifluorescence, staining unspecified)
10	CENTRIFUGE METHOD
11	ALIQUOT AND FULL (counted aliquout, then counted FULL sample for less frequent forms)
12	COULTER COUNTER
13	INVERTED MICROSCOPE

6F. FLOWMETER CALIBRATION - BIOLOGICAL HEADER CODE 19

CODE	DESCRIPTION
1	CRUISE START AND END
2	BY MANUFACTURER
3	SINGLE CALIBRATION TOW

6G. DEPTH DETERMINATION - BIOLOGICAL HEADER CODE 24

CODE	DESCRIPTION
1	OCL CALCULATED (Calculated by OCL from wire out and wire angle)
2	FIXED (One target depth reported by originator for all samples)

6H. VOLUME METHOD - BIOLOGICAL HEADER CODE 25

CODE	DESCRIPTION
1	Stored in 5% formalin solution, measured several months later after initial shrinkage occurred
2	WICKSTEAD (1965)
3	Settled 24 hrs in 50 ml graduated cylinder

APPENDIX 7. CODE TABLES USED TO DESCRIBED THE TAXONOMIC DATA

7A. TAXONOMIC LIFESTAGES - TAXA VARIABLE 5

(TSN = taxonomic serial number, if specific taxon implied)

CODE	DESCRIPTION	
1	EGG/OVA	code "gametes" below
2	NAUPLIUS	default TSN = 83677 CRUSTACEA
3	ZOEA	default TSN = 83677 CRUSTACEA

4	MEGALOPA	default TSN = 98276 BRACHYURA
5	VELIGER	default TSN = 69459 GASTROPODA
6	LARVA	
7	JUVENILE	
8	ADULT	
9	LARVA+JUV+ADULTS (6-8)	equals LARVAL + POST-LARVAL
10	COPEPODITE V	
11	POSTLARVAE (7-8)	
12	CYPHONAUTES larva	default TSN = 155469 BRYOZOA
13	PHYLLOSOMA larva	default TSN = 97646 PALINURIDAE
14	PILIDIUM larva	default TSN = 57411 NEMERTEA
15	TORNARIA larva	default TSN = 158617 ENTEROPNEUSTA
16	TROCHOPHORE larva	default TSN = -5002 ZOOPLANKTON
17	ARACHNACTIS larva	def 51985 CERIANTHIDAE
18	ACTINOTROCHA larva	def 155457 PHORONIDAE
19	EMBRYO	example: sea urchin embryo
20	CYPRIS larva	default TSN = 89433 CIRRIPEDIA (barnacle)
21	BIPINNARIA larva	default TSN = 156862 ASTEROIDEA
22	OPHIOPLUTEUS larva	default TSN = 157325 OPHIUROIDEA
23	ECHINOPLUTEUS larva	default TSN = 157821 ECHINOIDEA
24	hypnospores	refers to "resting stages", "cysts", etc.
25	COPEPODITE I	
26	COPEPODITE II	
27	COPEPODITE III	
28	COPEPODITE IV	
29	COPEPODITE	(without stage information)
30	CALYPTOPIS	default TSN = 95496 EUPHAUSIACEA
31	FURCILIA	default TSN = 95496 EUPHAUSIACEA
32	NAUPLIUS I	default TSN = 85257 COPEPODA
33	NAUPLIUS II	default TSN = 85257 COPEPODA
34	NAUPLIUS III	default TSN = 85257 COPEPODA
35	NAUPLIUS IV	default TSN = 85257 COPEPODA
36	NAUPLIUS V	default TSN = 85257 COPEPODA
37	METANAUPLIUS	default TSN = 85257 COPEPODA
38	POLYP	refers to Anthozoa, Scyphozoa, or Hydrozoa
39	MEDUSAE	if Genus not provided, code as "-5009"
40	INDETERMINABLE	
41	GAMETES	
42	ORTONAUPLIUS	
43	COPEPODITE I-V	all stages (1-5) were counted
44	DEAD or non-viable	
45	LIVING or viable	
46	MULLERS LARVA	default TSN = 53964 TURBELLARIA (class)
47	EGGS + LARVAE (1,6)	

7B. TAXONOMIC SEX CODE - TAXA VARIABLE 6

CODE	DESCRIPTION
1	MALE
2	FEMALE
3	HERMAPHRODITE
4	TRANSITIONAL
5	GROUPED, BOTH SEXES PRESENT
6	HERMAPHRODITIC, FUNCTIONAL FEMALE
7	HERMAPHRODITIC, FUNCTIONAL MALE
8	INDETERMINABLE
9	SEXUAL GENERATION
10	ASEXUAL GENERATION

7C. TAXONOMIC PRESENCE/ABUNDANCE CODES - TAXA VARIABLE 7

CODE	DESCRIPTION	EQUIVALENTS
1	PRESENT	(Present; +; some; also used when body parts observed, *e.g.,* spicules)
2	ABSENT	(Absent; not found; -; not observed)
3	COMMON	(++; many)
4	ABUNDANT	(CC)
5	VERY ABUNDANT	(CCC; +++)
6	PREDOMINANT	(CCCC)
7	RARE	-
8	VERY RARE	-
9	HIGHLY RARE	(RRR)
10	EXTREMELY RARE	(RRRR)
11	RED TIDE	(bloom)
12	EXCLUSIVELY	-

7D. TAXONOMIC TROPHIC LEVEL - TAXA VARIABLE 8

CODE	DESCRIPTION
1	AUTOTROPH (unspecified - also "holophytic")
2	AUTOTROPH-CHEMO
3	AUTOTROPH-PHOTO
4	HETEROTROPH (unspecified - also "holozoic")
5	HETEROTROPH-PARASITIC
6	HETEROTROPH-SAPROPHYTIC (obtains food by absorbing dissolved organics (decay))
7	PLASTIDIC (has plastids)
8	NON-PLASTIDIC (does not have plastids)
9	OLIGOTROPH

7E. TAXONOMIC REALM - TAXA VARIABLE 9

CODE	DESCRIPTION	
1	BENTHIC	-
2	EPIBIONT	(EPIZOIC, EPIPHYTIC, ...)
3	ENDOBIONT	(Intestinal, ENDOZOIC, ...)

4	MEROPLANKTONIC	(Adults are benthic or nektonic)

7F. TAXONOMIC FEATURES - TAXA VARIABLE 16

CODE	DESCRIPTION	
1	SPHERICAL/COCCOID	ball-shaped; 1-dimension; radius
2	ELLIPSOID	ellipsoid; 2-dimensions; long = length, short = radius
3	BACILLUS/ROD-SHAPED	long circular-column: 2-dimensions; long = length, short = radius
4	LENS-LIKE	lentil-shaped: 2-dimensions; long = radius, short = length (thickness)
5	SPINDLE-LIKE	needle-shaped; 2-3 dimensions; long = length, remaining = radius/width
6	TRUNCATED-CONICAL	trunc-cone; 2 dimensions; usually long = length, short = radius
7	ARMORED/THECATE	armoured, *e.g.,* dinoflagellates
8	UNARMORED/ATHECATE	unarmoured, *e.g.,* naked dinoflagellates
9	HOLOCOCCOLITH-IC	coccoliths made of same size/shape crystals
10	HETEROCOCCOLITH-IC	coccoliths made of different size/shape crystals
11	FILAMENT	algal filaments (rather than individual cells) the unit used
12	PAIRED SPHERE/COCCOID	Paired ball-shaped; 1-dimension; radius
13	SINGLE CHLOROPLAST	Has only one chloroplast, versus multiple

7G. TAXONOMIC MODIFIERS - TAXA VARIABLE 17

CODE	DESCRIPTION	
1	sp.	single species
2	spp.	multiple species
3	Other / unidentified / residue	-
4	sp. 1	originator designated
5	sp. 2	originator designated
6	sp. A	originator designated
7	sp. B	originator designated
8	sp. C	originator designated
9	sp. D	originator designated

APPENDIX 8.
BIOLOGICAL GROUP CODES

CODE	DESCRIPTION
-5001	(not used)
-5002	ZOOPLANKTON
-5003	(not used)
-5004	FISH
-5005	(not used)
-5006	PHYTOPLANKTON
-5007	SHRIMP

-5008	CRABS
-5009	JELLYFISH or MEDUSAE
-5010	WORMS
-5011	ALGAE
-5012	GELATINOUS ORGANISMS
-5013	(not used)
-5014	FLAGELLATES
-5015	SQUID
-5016	CILIATES
-5017	SESTON or PARTICULATES
-5018	PLANKTON

***Note: These are classifications assigned by the data submittor.**

APPENDIX 9. DEFINITION OF QUALITY CONTROL FLAGS

FLAGS FOR ENTIRE STATION (AS A FUNCTION OF VARIABLE)

0 - accepted station
1 - failed annual standard deviation check
2 - two or more density inversions (Levitus, 1982 criteria)
3 - flagged cruise
4 - failed seasonal standard deviation check
5 - failed monthly standard deviation check
6 - flag 1 and flag 4
7 - bullseye from standard level data or failed annual and monthly standard deviation check
8 - failed seasonal and monthly standard deviation check
9 - failed annual, seasonal and monthly standard deviation check
FLAGS ON INDIVIDUAL OBSERVATIONS

Depth Flags

0 - accepted value
1 - error in recorded depth (same or less than previous depth)
2 - density inversion
Observed Level Flags
0 - accepted value
1 - range outlier (outside of broad range check)
2 - inversion check
3 - gradient check
4 - zero anomaly
5 - combined gradient and inversion checks
6 - failed range and inversion checks
7 - failed range and gradient checks
8 - failed range and zero anomaly checks
9 - failed range and combined gradient and inversion checks

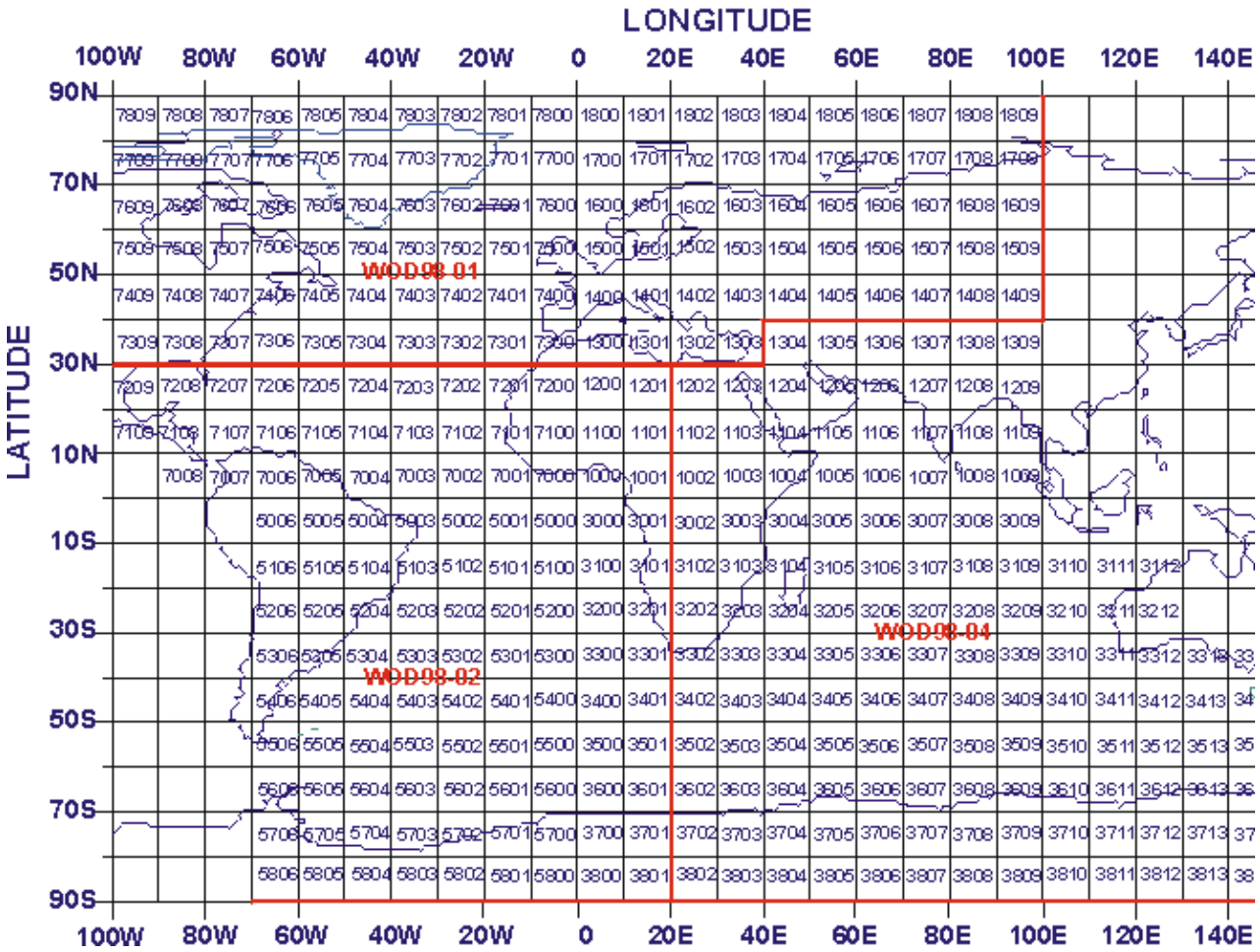
Standard Level Flags

0 - accepted value
1 - bullseye marker
2 - density inversion
3 - failed annual standard deviation check
4 - failed seasonal standard deviation check
5 - failed monthly standard deviation check
6 - failed annual and seasonal standard deviation check
7 - failed annual and monthly standard deviation check

8 - failed seasonal and monthly standard deviation check
9 - failed annual, seasonal and monthly standard deviation check

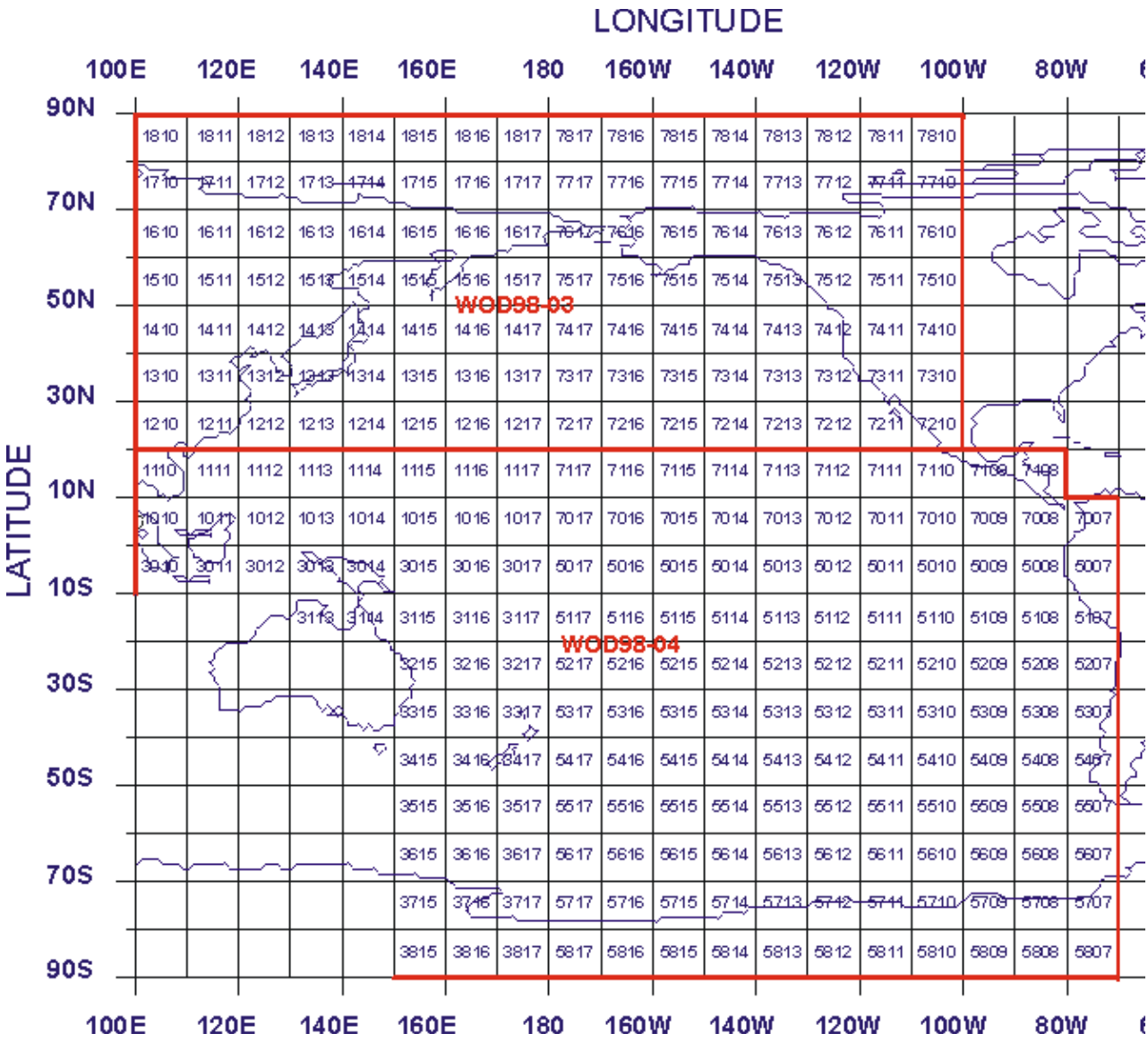
APPENDIX 10A.

WMO SQUARES FOR THE ATLANTIC AND INDIAN OCEANS



APPENDIX 10B.

WMO SQUARES FOR THE PACIFIC OCEAN



APPENDIX 11A.
INVENTORY OF SECONDARY HEADERS

SECONDARY HEADERS	BD	NBD	HCT	NHC	MBT	NMB	XBT	NXB	BIO

Accession number	790238	723620	96052	98879	932979	1129756	730921	909350	21421
Project	161504	75085	31333	42521	84814	59006	480396	222970	8949
Platform	580596	636845	42439	98189	673719	1051454	584390	880097	10508
Institute	269866	427080	46766	98031	340097	1071991	92584	868484	21377
Cast Number	8903	-	10493	-			-	-	-
Originator's Station Number	367992	429611	90373	93268	474105	645038	422950	442253	11117
Weather Station	-	-	-	-	31850	89787	63	52	-
Bottom Depth	431027	516574	47437	59986	296496	38086	163204	104132	4212
Cast Duration	11966	8667	5909	-	-	-	-	-	-
Cast Direction	-	369	385	392	-	-	-	-	-
High Resolution Pair	12393	274	13732	1060	-	-	-	-	-
Water Color	42239	52063	5	-	8	-	-	-	10
Water Transparency	61053	99181	5	-	8	-	-	-	10
Wave Direction	57600	137803	4	-	5195	-	18103	-	4
Wave Height	37709	85644	695	-	47113	-	15249	-	-
Sea State	49408	197859	-	18403	5210	-	12320	-	1
Wind Force	35539	134971	-	-	5441	-	279	-	1
Wave Period	19863	46486	611	-	15032	-	3031	-	1
Wind Direction	139223	421315	882	22839	81197	-	79709	-	630
Wind Speed	99728	269687	362	24664	75009	-	97654	-	10
Barometric Pressure	107695	195655	1180	19540	70234	-	16888	-	-
Dry Bulb Temperature	137867	381872	734	23606	109245	-	83448	-	10
Wet Bulb Temperature	43647	164498	234	21590	66280	-	10550	-	-
Weather Conditions	66691	268311	304	17630	25161	-	5742	-	621
Cloud Type	47528	129200	-	14506	2398	-	547	-	-
Cloud_Cover	77510	274232	313	15801	48042	-	2791	-	20
T-S Probe	48557	40540	96043	98879	932979	1129756	730921	909350	-
Calibration depth	-	-	-	-	-	-	13	405337	-
Calibration temperature	-	-	-	-	-	5990	2057	665587	-
BT recorder	-	-	-	-	-	-	41449	-	-
Bottom hit	-	-	-	-	-	-	22358	60942	-
Digitization method	-	-	-	-	-	4524	3953	728480	-
Digitization interval	-	-	-	-	-	214527	5102	783259	-
Data storage	-	-	-	-	-	4525	3953	722094	-
Depth correction	-	-	-	-	124204	214196	-	-	-
Temperature correction	-	-	-	-	1545145	464511	223	-	-
Reference Type	2442	-	96	-	411614	747171	23171	317	-
Visibility	14309	-	-	15700	6768	-	23	-	-
Absolute Humidity	19233	-	5	-	57	-	-	-	-
SECONDARY HEADERS	BD	NBD	HCT	NHC	MBT	NMB	XBT	NXB	BIO
Ref/Surf Temperature	20643	-	2	-	302593	734664	41532	1837	1
Surface Salinity	1	-	-	-	2556	-	-	-	1
Chlorophyll method	9345	-	3788	-	-	-	-	-	-
Nutrient method	5728	-	-	-	-	-	-	-	-
O_2 originator's unit	34959	-	12944	54	-	-	-	-	-

Nutrient originator's unit	258534	-	-	-	-	-	-	-	-
Chlorophyll originator's unit	387	-	-	-	-	-	-	-	-
Alkalinity originator's unit	1617	-	-	-	-	-	-	-	-
Filter type size	3077	-	-	-	-	-	-	-	-
Alkalinity method	1102	-	-	-	-	-	-	-	-
Conductivity standard	-	-	-	282	-	-	-	-	-
O_2 method	1247	-	5562	-	-	-	-	-	-
Salinity method	9319	-	11468	-	-	-	-	-	-
Temperature method	6178	-	8830	-	-	-	864	-	-
Radio signal	-	-	-	-	-	-	267618	-	-
XBT Wait	-	-	-	-	-	-	263	-	-
XBT Frequency	-	-	-	-	-	-	263	-	-

APPENDIX 11B.
INVENTORY OF BIOLOGICAL HEADERS

BIOLOGICAL HEADERS	BD	BIO
Water volume filtered	11879	6640
Sampling duration	41491	2530
Mesh size	56728	19515
Type of tow	58052	11191
Large removed volume	37708	
Large plankters removed	50023	1358
Gear code	60091	19888
Sampler volume	649	214
Net mouth area	58020	4036
Preservation	47215	3890
Weight method	1316	12
Large removed length	3140	
Count method	2551	1458
Tow speed average	10168	226
Sampling start	52827	1842
Flowmeter type	10515	
Flowmeter calibration	5978	
Counting Institute	229	844
Voucher Institute	246	
Wire angle start	1563	749
Depth determined	2251	749
Volume method	2049	1450

APPENDIX 11C.
INVENTORY OF TAXONOMIC HEADERS

TAXONOMIC HEADERS	BD	BIO
Taxa-Parameter/TSN's	435629	337126
Upper depth	433951	307208
Lower depth	426404	308785

Biomass value	63093	17502
Taxon lifestage	128939	17143
Taxon sex code	505	6639
Taxon present	9672	32335
Taxon trophic	2158	
Taxon realm	2885	
Taxon count	356617	287017
Taxon volume	2719	
Taxon wet weight	2426	
Taxon dry weight	71	
Taxon feature	28	454
Taxon modifier	28931	48819
Size minimum	5642	1175
Size maximum	1395	480
Units	425957	304791
Taxon radius		290
Taxon length		130

APPENDIX 12A.
TOTAL NUMBER OF KBYTES PER PROBE TYPE (prior to data compression)

PROBE (Instrument)	OBSERVED	STANDARD
Bottle	757838	582650
MBT	1024651	461925
XBT	2195806	442375
CTD	3505320	83767
Biology	20249	20249
TOTAL	*7503866*	*1590969*

APPENDIX 12B.
TOTAL NUMBER OF KBYTES BY REGION (prior to data compression)

PROBE	**OBSERVED**	**STANDARD**	**OBSERVED**	**STANDARD**
	North Pacific (20°N to 90°N)		**North Pacific (0°-20°N),South Pacific**	
Bottle	201968	171523	72492	60267
MBT	351298	161586	148690	64073
XBT	510576	144369	695503	97174
CTD	893685	27734	722268	11970
Biology	15766	15766	2606	2606
TOTAL	*1973313*	*520978*	*1641559*	*236090*

PROBE	North Indian		South Indian	
Bottle	19365	16123	33974	27892
MBT	18887	8933	28215	14377
XBT	85200	19142	172261	15487
CTD	50797	838	220847	3294
Biology	73	73	82	82
TOTAL	*174322*	*45109*	*455379*	*61132*
PROBE	**North Atlantic (30°N to 90°N)**		**North Atlantic (0°-30°N), South Atlantic**	
Bottle	326507	240972	110055	71084
MBT	358684	162830	133448	55575
XBT	328323	107935	444225	66828
CTD	848392	27460	798231	13165
Biology	1499	1499	228	228
TOTAL	*1863405*	*540696*	*1486187*	*206880*

APPENDIX 13.
SAMPLE OUTPUT FOR OBSERVED LEVEL DATA FROM WOD98-03\DATA\NPAC20-90\BDO7617
STATION 67064

38365670643133551934 8 744210374426193562-17227140 711012013014016017019002701811770950011012330224134401427143
1033272803321170222260332182033280 50

Output from ASCII file, profile# 1

CC	Latitde	Longitde	YYYY	MM	DD	Time	Station #	
31	355	61.930	-172.270	1934	8	7	10.37	67064 4

z	f 1	f 2	f 3	f 4	f 6	f 7	f 9	f
0.0	0 8.960 (3)	0 30.900 (4)	0 6.750 (3)	0 0.650 (2)	0 0.200 (2)	0 0.020 (2)	0 8.100 (3)	0
10.0	0 8.950 (3)	0 30.900 (4)	0 6.700 (3)	0 0.710 (2)	0 0.120 (2)	0 0.020 (2)	0 8.100 (3)	0
25.0	0 0.900 (2)	0 31.910 (4)	0 8.620 (3)	0 0.900 (2)	0 0.150 (2)	0 0.020 (2)	0 8.100 (3)	0
50.0	0 -1.230 (3)	0 32.410 (4)	0 7.280 (3)	0 1.170 (3)	0 0.260 (2)	0 1.820 (3)	0 8.050 (3)	0
ERR:	0	0	0	0	0	0	0	0

Secondary header # 1 9500110. (7)

Secondary header # 2		224. (3)
Secondary header # 3		1427. (4)
Secondary header # 4		393. (3)
Secondary header # 7		76. (2)
Secondary header # 10		60. (2)
Secondary header # 54		58. (2)
Secondary header # 55		29. (2)
Biological header # 2		18.000 (4)
Biological header # 3		76.000 (2)
Biological header # 4		2.000 (1)
Biological header # 7		103.000 (3)
Biological header # 9		0.050 (2)
Biological header # 13		11.000 (2)
Taxa-set 1 :	Taxonomic Code [1]#	85272(5)
Code # 2		0.000 (1)
Code # 3		25.000 (3)
Code # 10		6.000 (1)
Code # 20		68.000 (2)
Taxa-set 2 :	Taxonomic Code [1]#	79118(5)
Code # 2		0.000 (1)
Code # 3		25.000 (3)
Code # 5		5.000 (1)
Code # 10		227.000 (3)
Code # 20		68.000 (2)
Taxa-set 3 :	Taxonomic Code [1]#	69459(5)
Code # 2		0.000 (1)
Code # 3		25.000 (3)
Code # 5		5.000 (1)
Code # 10		113.000 (3)
Code # 20		68.000 (2)
Taxa-set 4 :	Taxonomic Code [1]#	159668(6)
Code # 2		0.000 (1)
Code # 3		25.000 (3)
Code # 10		16.000 (2)
Code # 17		1.000 (1)
Code # 20		68.000 (2)
Taxa-set 5 :	Taxonomic Code [1]#	88803(5)
Code # 2		0.000 (1)
Code # 3		25.000 (3)
Code # 10		16.000 (2)
Code # 20		68.000 (2)
Taxa-set 6 :	Taxonomic Code [1]#	88803(5)
Code # 2		0.000 (1)
Code # 3		25.000 (3)
Code # 5		2.000 (1)
Code # 10		535.000 (3)
Code # 20		68.000 (2)

Taxa-set 7 :	Taxonomic Code [1]#	88803(5)
Code # 2		0.000 (1)
Code # 3		25.000 (3)
Code # 5		43.000 (2)
Code # 10		32.000 (2)
Code # 20		68.000 (2)
Taxa-set 8 :	Taxonomic Code [1]#	85371(5)
Code # 2		0.000 (1)
Code # 3		25.000 (3)
Code # 5		2.000 (1)
Code # 10		16.000 (2)
Code # 20		68.000 (2)

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I. INTRODUCTION

Data received by the National Oceanographic Data Center's Ocean Climate Laboratory (NODC/OCL), through the Global Ocean Data Archeology and Rescue (GODAR) project, the Global Ocean Database project, the Global Temperature and Salinity Pilot Project (GTSPP), the US-NODC data archives, or other sources, are put through a set of quality control procedures to insure that 1) the data are converted to the OCL format correctly, 2) the data format provided with the data submitted is correct and the data itself has not been corrupted in transmission, 3) only one copy of data at each station is retained in the OCL format, and 4) the data, as initially collected

and processed, are of good quality.

This document expands on the quality control procedures briefly outlined in the *World Ocean Database 1998* (WOD98) documentation and in Conkright *et al.* (1994) and Boyer and Levitus (1994). These procedures were used to flag the observed and standard level data.

II. QUALITY CONTROL OF OBSERVED LEVEL DATA

1. Format conversion

When data are received at the OCL, the first step is to convert the data into the OCL format, using the format description provided by the data submittor. Some of the checks during format conversion may include unit conversion, calculation of the number of significant figures, identification of time used (GMT or local), and consistency in the originator's format. Stations are spot checked and compared with the original data for correctness.

2. Check position/date/time

Data are checked for incorrect/missing latitudes, longitudes, and dates. Suspect values are compared with the original data to make sure problems are not due to a conversion error. If the incorrect datum is found in the original data, the data submittor is notified of the error and a correction is requested.

3. Assignment of cruise numbers

Once station positions and dates are checked, unique OCL cruise numbers are assigned for all **PROJECT** data. If there is no identification of a cruise in the submitted data, or the division is not truly by cruise (*e.g.,* divided by platform per year), cruise numbers are assigned using either the platform or primary investigator, if provided. When no cruise information was available from the data or the data originator, a cruise was defined as a specific platform or primary investigator for all stations for which there is no break of more than twenty days. The twenty days between stations is a guideline, as some data sets necessitate a smaller break period, and others a longer period. Some data, which have nonspecific platforms (*e.g.,* airplane or ice camp), cannot be broken up this way. If no platform or primary investigator information is provided, a cruise number of "zero" is assigned to denote no cruise information. In addition, some cruises from the NODC data archives were split using the twenty day criteria since one cruise, in this archive, could span several years. This procedure was only followed with cruises which overlapped with the data.

4. Speed check

Following assignment of cruise numbers, the entire cruise is mapped out and the speed between stations is calculated. If the speed between adjoining stations is unrealistic, the date/time may be in error, the position may be wrong, or the station may not belong to this cruise. In many cases stations are attributed to the wrong platform. These problems, when encountered, were noted and the submittor contacted to decide on a course of action. Due to lack of time and resources, not every single cruise was checked and therefore some groupings of stations do not represent a cruise as defined here.

5. Duplicate checks

Upon completion of these preliminary quality control checks, the OCL performs extensive self-duplicate checks (internal to the new data set), and duplicate checks against the existing OCL database. Checks involve identifying stations with:
exact position/date/time

- position/date/time within some small offset
- same originator's stations within a cruise
- same profile data
- same taxonomic data

Below are the general types of duplicates which occur:

Identical profiles - two profiles which contain the same variables with identical values at each depth. Frequently, positions or times may be slightly different (depending on the accuracy to which latitude/longitude/time were provided in the original data submissions). Sometimes large differences in time, up to a one day offset, may also result when time is provided in GMT in one data set and not the other.

Identical stations - two stations from the same position, date and time, but with different variables or different values. When values are different, the stations may contain identical profiles that were handled differently by an intermediate data center or investigator (*e.g.,* using different storage criteria with XBT's or CTD's, or interpolating the observed data to standard levels). When variables are different between two stations which are otherwise identical, this may be due to cases in which data were submitted separately. Therefore data from the stations are combined (see *Special Case: merging profiles* below).

Overlapping Cruises - two cruises with the same platform that overlap in their starting and ending dates. In most cases, the overlapping cruises are duplicated and have already been detected by the previous two checks. In others cases, the difference in positions is so great that the standard position check does not detect the duplicated stations (*e.g.*, a missing "+/-" for latitude could allow a cruise to be duplicated in the northern and southern hemisphere with huge differences in position).

When duplicates are found, the "better" station is retained within the database, and the other station is removed. In general, the "better" station has more depth levels, additional variables, or data are stored at a higher precision. Preference is given to the original observed level data over interpolated data. Finally, OCL tries to give data obtained directly from the originator preference over data that has passed through many users, which has possibly lost precision or other information along the way.

Special Case: merging profiles

In some cases, different variables from the same oceanographic station will be submitted to the OCL at different times or from different sources. The most common example of this is when biological data (*e.g.,* pigments, plankton measurements) are submitted for already existing US-NODC ocean station data. Through the efforts of the GODAR project and the OCL Global Ocean Database project, many stations containing chlorophyll, nutrient, and plankton data have been reacquired, from the source institutes and/or digitized, and combined with existing data.

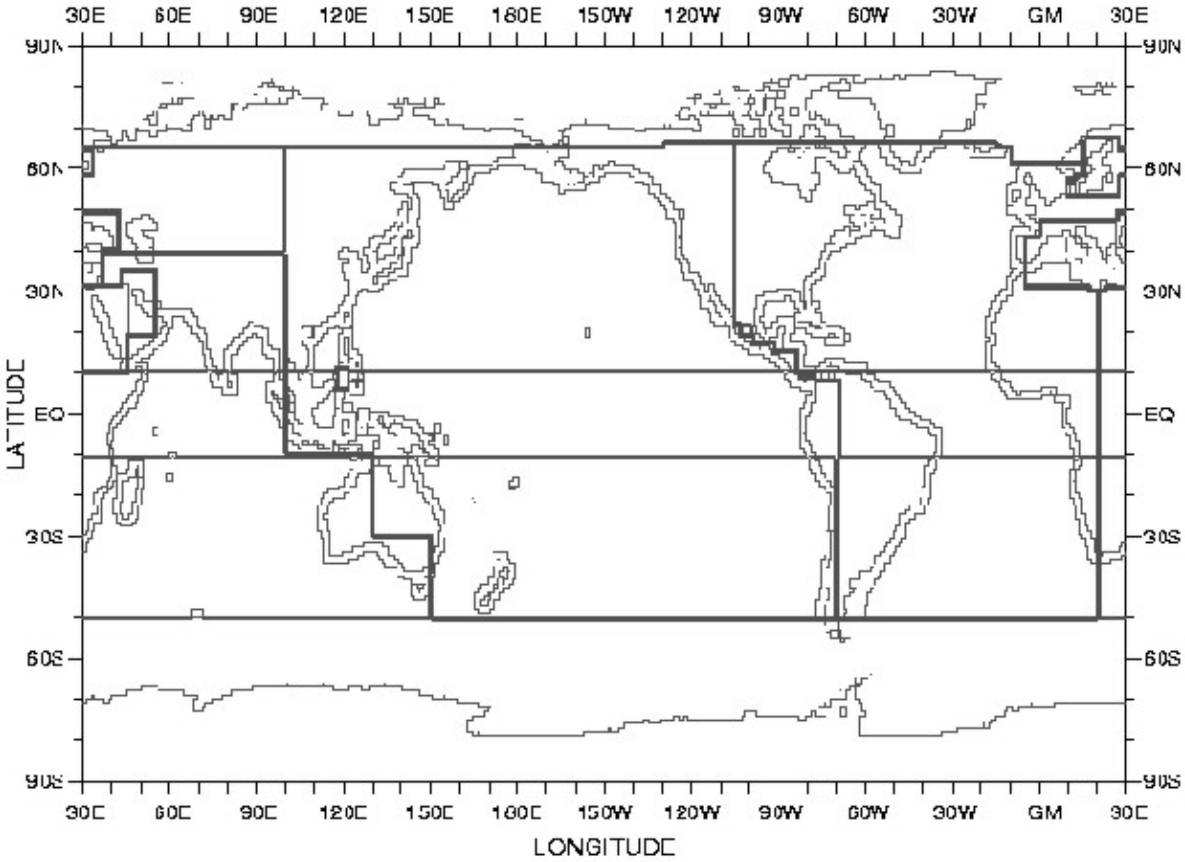
Information such as date, position, time, platform, and originator's station or cruise identifier is used to match up incoming stations with existing stations. Frequently, the match-up is obvious (*e.g.,* the same ship is in the exact position on the same day, and the depth levels of the existing data correspond exactly to the incoming data). When the match-up is less obvious, effort is made to determine whether this match is appropriate or not by reviewing the documentation or comparing cruise tracks.

When an appropriate match is made, the stations are merged into one station which contains the combination of the previous two stations. The resulting station will have all of the data and metadata of the previous two stations. When a match is uncertain, but platform, position and dates are very close, the stations are left separate and assigned the same OCL cruise number so the data will at least remain grouped, by cruise.

6. Depth inversion and depth duplication checks

Depth inversions and duplication of depths were found to occur in some profiles. A depth inversion occurs when an observation has a shallower depth than the observation directly preceding it. A depth duplication is a reading which has the same depth as the reading before it. In either case the second observation was always flagged, rather than trying to judge the data. Appendix 1 lists the flags assigned to the data. If, after an inversion or duplication, the next two depth observations were still shallower than the first reading, this observation and all subsequent observations were flagged. This usually occurred when two or more profiles have been entered together into a digital file with no separating header information.

7. Range Checks on observed level data



Range checks are used to screen the data for extreme values. Coarse ranges were set for the annual (*i.e.,* all-seasons/all-years) data, as a function of depth and basin (basins are shown in Figure 1) for each variable. Using frequency distributions, statistical analysis, literature values and atlases (*e.g,.* GEOSECS (Bainbridge, 1977; Craig *et al.*, 1981, Spencer *et al.,* 1982), Southern Ocean Atlas (Gordon *et al.*, 1982), Wyrtki (1988)), these ranges were applied to the observed level data for each variable. Table 1 lists the variables in the WOD98, the standard NODC/OCL units, and the Appendices containing the ranges set for these variables.

Table 1. Quality Controlled Variables in WOD98

CODE	VARIABLE	UNIT/SCALE	Range Appendix
1	Temperature (*in situ)*	C	2A
2	Salinity	PSS and o/$_{oo}$	2B
3	Oxygen	ml/l	2C
4	Phosphate	µM	2D
6	Silicate	µM	2E
7	Nitrite	µM	2F
8	Nitrate	µM	2G
9	pH	unitless	2H
11	Chlorophyll	µg/l	2I
17	Alkalinity	meq/l	2J

8. Excessive gradient checks

For each variable in Table 1, a check was made for "excessive decreases and increases in a value over a depth", or excessive gradients. A gradient was defined as

$$(1) \qquad \text{gradient} = \frac{V_2 - V_1}{Z_2 - Z_1}$$

where
v_1 = the value of the variable at the current depth level
v_2 = the value of the variable at the next depth level
z_1 = the depth (meters) of the current depth level
z_2 = the depth (meters) of the next depth level
Two types of gradients were checked, and marked accordingly:

- Excessive Gradients - a negative gradient, *i.e.* an excessive decrease in the value over depth. The criteria used to define "excessive", as a function of variable, are listed in Table2. Any value which exceeded this "maximum gradient value" (MGV) was marked with a gradient flag.
- Excessive Inversions - a positive gradient, ie. an excessive increase in value over depth. These criteria are presented in Table 2. Data which exceeded the "maximum inversion value" (MIV), were marked with an inversion flag.

MIV/MGV's were determined from literature and/or by objectively reviewing the trends of the variable within the data. To better accommodate the differences in gradient ranges between surface and deeper water (*e.g.,* due to physical or biological influence), a different set of MIV/MGV's were used for depths above and below 400 meters. When dealing with high resolution instruments (*e.g.,* HCTD, XBT), a minimum depth difference of 3.0 meters was used when calculating the gradients (in equation (1).

In addition, a check was used to distinguish *zero as a value* versus *zero as a missing-value- indicator*, particularly in the historical nutrient data. The zero sensitivity check will flag a zero value if a gradient decreases to zero at a rate greater than the MGV * ZSI (zero sensitivity indicator). For example, if ZSI is 2.00, than a gradient must be twice as large as the MGV for that depth range, and have a value of "0.00", to be flagged.

Table 2. Maximum gradient and inversion factors used for WOD98

VARIABLE	MIV (<400m)	MGV (<400m)	MIV (>400m)	MGV (>400m)	ZSI
Temperature	0.300	0.700	0.300	0.700	5.00
Salinity	9.000*	9.000*	0.050	0.050	5.00
Oxygen	1.000	1.000	0.750	0.750	2.00
Phosphate	1.000	1.000	0.500	0.500	2.50
Silicate	5.000	5.000	3.500	3.500	3.00
Nitrite	0.100	0.100	0.050	0.050	2.50
Nitrate	1.000	1.000	0.500	0.500	2.50
pH	0.400	0.400	0.200	0.200	2.00
Chlorophyll	1.000	1.000	0.250	0.250	2.00
Alkalinity	0.100	0.100	0.050	0.050	2.00

* Salinity MGV/MIV ranges (<400m) were purposely set high to be nearly irrelevant for these checks.

9. Observed level density checks

Density checks were run on the observed level data to locate density inversions. This check was not used to flag or eliminate data from subsequent quality control, but was used to get an estimate of data quality prior to interpolation to standard levels. The check is the same as described in Section 11., *Standard level density check*, except the values are divided by the depth difference between adjacent levels unless the difference is less than 3 meters, in which case a difference of 3 meters is used.

10. Vertical interpolation method

Prior to the next step in the quality control, the data are interpolated from observed levels to standard levels (listed in Table 1). Any data flagged as range outliers, excessive gradients, inversions, or depth errors were not interpolated to standard levels. For XBT data types, a drop rate correction (Hanawa *et al.*, 1994) was applied to any T4, T6, and T7 instrument measurements prior to standard level interpolation. When instrument model was not provided with XBT data, profiles with all measurements shallower than 840 meters were assumed to need this correction (profiles with measurements deeper than this were assumed to be taken with a T5 instrument, which does not have a systematic error in its drop rate equation).

The interpolation scheme used is a modification from that described by Reiniger and Ross (1968) and noted by UNESCO (1991) as being in common usage. Their scheme uses four observed values surrounding the standard level in question, the two closest shallower values and the two closest deeper values. The closest shallower and deep values ("inside" values) and the two "outside" values (farthest shallow and deep values) must be within the depth difference criteria shown in Table 3. The first set of depths in this table is the maximum distance between the closest or "inside" observed reading depth. The second set of depths applies to the maximum distances to the two observed levels further from the standard level in question. This interpolation scheme has the advantage over three point Lagrangian interpolation of being less susceptible to extremes when a large gradient is encountered since two separate three-point Lagrangian interpolations are averaged and then fit to a reference curve.

If all the above criteria are met, the standard depth value is set by the Reiniger and Ross (1968) interpolation. If there are not enough surrounding values within acceptable distances, three point Lagrangian interpolation is performed on the value above and two values below the level in question or on the two values above and one value below.

Modifications to the Reiniger and Ross (1968) method are the following:

a. If the Reiniger and Ross interpolated value does not fall between the observed values directly above and below it, linear interpolation is substituted.

b. If any value is recorded within 5 meters of the surface, this value is directly used as the surface value.

Some observed level data were not used in the interpolation process because they were too far from a standard level (and therefore not used), or there were other closer observations available. Direct substitution and the Reiniger and Ross interpolation account for most of the standard level values.

III. QUALITY CONTROL OF STANDARD LEVEL DATA

11. Standard level density check

A standard level density check was used to eliminate spurious inversions due to interpolation (Levitus *et al.* 1994). Each profile was checked for static stability using Hesselberg and Sverdrup's (1914) definition. The computation is a local one in the sense that adiabatic displacements between adjacent temperature-salinity measurements in the vertical are considered rather than displacements to the sea surface. The procedure for stability (E) computation follows that used by Lynn and Reid (1968):

$$E = \lim_{\rho_0 - 0} \frac{1}{\rho_0} \frac{\delta\rho}{\delta z} \qquad (2)$$

where "ro" =1.02 g/cm^3 and "z" is depth in meters. As noted by Lynn and Reid the term is "the individual gradient defined by vertical displacement of a water parcel". For discrete samples, the density difference ("delta") between two samples is taken after the deeper sample is adiabatically displaced to the standard level of the shallower depth. is then simply the displaced sample's density minus the

shallower sample's density. Densities were calculated using the IGOSS standard density equation (1993) on interpolated temperature and salinity data. An inversion was defined as anywhere the was less than zero. For observations with a deeper sample depth of 30 meters or less, an inversion of 3×10^{-5} g/cm^3 was considered an indication of problem with the data. The temperature and salinity at both of these depths were flagged. For observations with a deeper sample depth between 50 and 400 meters an inversion of 2×10^{-5} g/cm^3 was considered excessive. For depths greater than 400 meters any inversion greater than 10^{-6} g/cm^3 was considered excessive. If two or more such density inversion were found in one profile, all temperature and salinity values were flagged as unusable for this profile.

Table 3. Acceptable distances for "inside" and "outside" values used in the Reiniger-Ross scheme for interpolating observed level data to standard levels

Standard Levels	Standard Depths	Acceptable distances for inside values	Acceptable distances for outside values
1	0	5	200
2	10	50	200
3	20	50	200
4	30	50	200
5	50	50	200
6	75	50	200
7	100	50	200
8	125	50	200
9	150	50	200
10	200	50	200
11	250	100	200
12	300	100	200
13	400	100	200
14	500	100	400
15	600	100	400
16	700	100	400
17	800	100	400
18	900	200	400
19	1000	200	400
20	1100	200	400
21	1200	200	400
22	1300	200	1000
23	1400	200	1000
24	1500	200	1000
25	1750	200	1000
26	2000	1000	1000
27	2500	1000	1000
28	3000	1000	1000
29	3500	1000	1000
30	4000	1000	1000
31	4500	1000	1000
32	5000	1000	1000
33+	5500+	1000	1000

12. Statistical analysis of data at standard depth levels

Once observed level data were interpolated to standard levels, statistical checks were performed to flag data which exceeded the standard deviation criteria. All standard level data were first averaged by five-degree-squares to produce the number of observations, mean, and standard deviation for each square. Each five degree square box was designated coastal, near coastal, or open ocean, depending on the number of one-degree by one-degree latitude-longitude grid boxes in the five-degree box which were land areas.

Profiles were flagged if:

a. a five-degree square containing a land point exceeded 5 standard deviations in the upper 50 m;

b. near-coastal regions with values exceeding 4 standard deviations in the upper 50 m;

c. values exceeding three standard deviations for all other data except when a profile was at or below the average depth level for the one-degree box in which it was contained, or any of the adjacent one degree boxes, then 4 standard deviations were used.

The reason for varying the number of standard deviations allowed is the high variability in shallow coastal areas due to river runoff and other factors. Also, high variability within a five-degree box near the ocean bottom can occur if the five-degree square box contains portions of two basins: *i.e.* the mid-Atlantic ridge separating east and west Atlantic waters. This check was only performed if there were five or more observations at this depth in the grid box. If more than two observations in a profile exceeded the selected criteria, the profile was flagged and not included in further analysis. The standard deviation check was applied twice to the data and then new five-degree square statistics were computed to produce a new "clean" data set.

13. Objective analysis

Following the statistical check, data were averaged by one-degree squares for input to the objective analysis. The objective analysis is described by Levitus and Boyer (1994) and Conkright *et al.* (1994). After the initial objective analyses were computed for each standard level, there were still erroneous values which resulted in rapid value changes within an area appearing as a "bullseyes" or an unrealistic feature. These features occur because of the difficulty in identifying non-representative values in data sparse areas. "Bullseyes" and other suspicious features are investigated and are flagged by identifying the profile or individual data points which created each unrealistic feature. In some cases, entire cruises were flagged. These flags were applied to both the observed and standard level data.

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APPENDIX 1. DEFINITION OF QUALITY CONTROL FLAGS

(1) FLAGS FOR ENTIRE STATION (AS A FUNCTION OF VARIABLE)
0 - accepted station
1 - failed annual standard deviation check
2 - two or more density inversions (Levitus, 1982 criteria)
3 - flagged cruise
4 - failed seasonal standard deviation check
5 - failed monthly standard deviation check
6 - failed annual and seasonal standard deviation check
7 - bullseye from standard level data or failed annual and monthly standard deviation check
8 - failed seasonal and monthly standard deviation check
9 - failed annual, seasonal and monthly standard deviation check

(2) FLAGS ON INDIVIDUAL OBSERVATIONS

(a) Depth Flags
0 - accepted value
1 - error in recorded depth (same or less than previous depth)
2 - density inversion

(b) Observed Level Flags
0 - accepted value
1 - range outlier (outside of broad range check)
2 - failed inversion check
3 - failed gradient check
4 - zero anomaly
5 - failed combined gradient and inversion checks
6 - failed range and inversion checks
7 - failed range and gradient checks
8 - failed range and zero anomaly checks
9 - failed range and combined gradient and inversion checks

(c) Standard Level Flags
0 - accepted value
1 - bullseye marker
2 - density inversion
3 - failed annual standard deviation check
4 - failed seasonal standard deviation check
5 - failed monthly standard deviation check
6 - failed annual and seasonal standard deviation check
7 - failed annual and monthly standard deviation check
8 - failed seasonal and monthly standard deviation check
9 - failed annual, seasonal and monthly standard deviation check

Appendix 2A: WOD98 Ranges by Basin as a Function of Depth

WOD98 Temperature (C^o) Ranges by Basin as a Function of Depth

	North		Coastal		Equatorial		Coastal		South		Coastal		North		Coastal		Equatorial		Coastal	
Depth	Atlantic		N. Atlantic		Atlantic		Eq. Atlantic		Atlantic		S. Atlantic		Pacific		N. Pacific		Pacific		Eq. Pacific	
(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-3.00	35.00	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00
10	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-3.00	35.00	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00
20	-3.00	32.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-3.00	35.00	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00
30	-3.00	32.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-3.00	35.00	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00
50	-3.00	32.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-3.00	35.00	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00
75	-2.00	30.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	32.00	-3.00	35.00	-3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00
100	-2.00	30.00	-3.00	30.00	5.00	30.00	5.00	30.00	0.00	32.00	-3.00	30.00	-3.00	30.00	-3.00	30.00	5.00	30.00	5.00	30.00

125	-2.00	28.00	-3.00	30.00	5.00	30.00	5.00	30.00	-1.50	30.00	-3.00	30.00	-3.00	30.00	-3.00	30.00	3.00	30.00	3.00	30.0
150	-2.00	28.00	-3.00	30.00	5.00	30.00	5.00	30.00	-1.50	30.00	-3.00	30.00	-3.00	30.00	-3.00	30.00	3.00	30.00	3.00	30.0
200	-2.00	28.00	-3.00	30.00	5.00	30.00	5.00	30.00	-1.50	30.00	-3.00	30.00	-3.00	30.00	-3.00	30.00	3.00	30.00	3.00	30.0
250	-1.70	28.00	-3.00	28.00	5.00	28.00	0.00	28.00	-1.50	28.00	-3.00	28.00	-3.00	28.00	-3.00	28.00	3.00	28.00	3.00	28.0
300	-1.70	28.00	-3.00	28.00	3.00	28.00	0.00	28.00	-1.50	28.00	-3.00	28.00	-3.00	28.00	-3.00	28.00	3.00	28.00	3.00	28.0
400	-1.50	20.00	-3.00	28.00	3.00	28.00	0.00	28.00	-1.50	28.00	-3.00	28.00	-3.00	28.00	-3.00	28.00	3.00	28.00	3.00	28.0
500	-1.50	20.00	-3.00	28.00	3.00	28.00	0.00	28.00	-1.50	28.00	-3.00	28.00	-3.00	28.00	-3.00	28.00	0.00	28.00	0.00	28.0
600	-1.50	20.00	-3.00	20.00	3.00	20.00	0.00	20.00	-1.50	20.00	-3.00	20.00	-3.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.0
700	-1.50	20.00	-3.00	20.00	3.00	20.00	0.00	20.00	-1.50	20.00	-3.00	20.00	-3.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.0
800	-1.50	20.00	-3.00	20.00	-0.50	20.00	0.00	20.00	-1.50	20.00	-3.00	20.00	-3.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.0
900	-1.50	20.00	-3.00	20.00	-0.50	20.00	0.00	20.00	-1.50	20.00	-3.00	20.00	-3.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.0
1000	-1.50	18.00	-3.00	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-3.00	18.00	-3.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.0
1100	-1.50	18.00	-3.00	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-3.00	18.00	-3.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.0
1200	-1.50	18.00	-3.00	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-3.00	18.00	-3.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.0
1300	-1.50	18.00	-3.00	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-3.00	18.00	-3.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.0
1400	-1.50	18.00	-3.00	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-3.00	18.00	-3.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.0
1500	-1.50	18.00	-3.00	18.00	-0.50	18.00	0.00	18.00	-1.50	18.00	-3.00	18.00	-3.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.0
1750	-1.50	13.00	-3.00	13.00	-0.50	13.00	0.00	13.00	-1.50	13.00	-3.00	13.00	-3.00	13.00	-3.00	13.00	0.00	13.00	0.00	13.0
2000	-1.50	13.00	-3.00	13.00	-0.50	13.00	0.00	13.00	-1.50	13.00	-3.00	13.00	-3.00	13.00	-3.00	13.00	0.00	13.00	0.00	13.0
2500	-1.50	13.00	-3.00	13.00	-0.50	13.00	-1.00	13.00	-1.50	13.00	-3.00	13.00	-3.00	13.00	-3.00	13.00	0.00	13.00	0.00	13.0
3000	-1.50	7.00	-3.00	7.00	-0.50	7.00	-1.00	7.00	-1.50	7.00	-3.00	7.00	-3.00	7.00	-3.00	7.00	0.00	7.00	0.00	7.0
3500	-1.50	7.00	-3.00	7.00	-0.50	7.00	-1.00	7.00	-1.50	7.00	-3.00	7.00	-3.00	7.00	-3.00	7.00	0.00	7.00	0.00	7.0
4000	-1.50	7.00	-1.50	7.00	-0.50	7.00	-1.00	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.0
4500	-1.50	7.00	-1.50	7.00	-0.50	7.00	-1.00	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.0
5000	-1.50	7.00	-1.50	7.00	-0.50	7.00	-1.00	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.0
5500+	-1.50	5.00	-1.50	3.00	-0.50	3.00	-1.00	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.0

Appendix 2A (cont.):
WOD98 Temperature (°C) Ranges by Basin as a Function of Depth

	South		**Coastal**		**North**		**Coastal**		**Equatorial**		**Coastal**		**South**		**Coastal**		**Southern**		**Arctic**	
Depth	**Pacific**		**S. Pacific**		**Indian**		**N. Indian**		**Indian**		**Eq. Indian**		**Indian**		**S. Indian**		**Ocean**		**Ocean**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	-2.00	32.00	-3.00	35.00	3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-3.00	35.00	-3.00	15.00	-3.00	20.0
10	-2.00	32.00	-3.00	35.00	3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-3.00	35.00	-3.00	15.00	-3.00	20.0
20	-2.00	32.00	-3.00	35.00	3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-3.00	35.00	-3.00	15.00	-3.00	20.0
30	-2.00	32.00	-3.00	35.00	3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-3.00	35.00	-3.00	15.00	-3.00	14.0
50	-2.00	32.00	-3.00	35.00	3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-3.00	35.00	-3.00	15.00	-3.00	14.0
75	-2.00	32.00	-3.00	35.00	3.00	35.00	-3.00	35.00	5.00	35.00	5.00	35.00	0.00	35.00	-3.00	35.00	-3.00	15.00	-3.00	14.0
100	-2.00	30.00	-3.00	30.00	3.00	30.00	-3.00	30.00	5.00	30.00	5.00	30.00	0.00	30.00	-3.00	30.00	-3.00	15.00	-3.00	14.0
125	-2.00	30.00	-3.00	30.00	3.00	30.00	-3.00	30.00	3.00	30.00	3.00	30.00	0.00	30.00	-3.00	30.00	-3.00	15.00	-3.00	14.0
150	-2.00	30.00	-3.00	30.00	3.00	30.00	-3.00	30.00	3.00	30.00	3.00	30.00	0.00	30.00	-3.00	30.00	-3.00	15.00	-3.00	10.0
200	-2.00	30.00	-3.00	30.00	3.00	30.00	-3.00	30.00	3.00	30.00	3.00	30.00	0.00	30.00	-3.00	30.00	-3.00	15.00	-3.00	10.0
250	-2.00	28.00	-3.00	28.00	3.00	28.00	-3.00	28.00	3.00	28.00	3.00	28.00	0.00	28.00	-3.00	28.00	-3.00	15.00	-3.00	10.0
300	-2.00	28.00	-3.00	28.00	3.00	28.00	-3.00	28.00	3.00	28.00	3.00	28.00	0.00	28.00	-3.00	28.00	-3.00	15.00	-3.00	10.0
400	-2.00	28.00	-3.00	28.00	3.00	28.00	-3.00	28.00	3.00	28.00	3.00	28.00	0.00	28.00	-3.00	28.00	-3.00	15.00	-3.00	10.0
500	-2.00	28.00	-3.00	28.00	3.00	28.00	-3.00	28.00	0.00	28.00	0.00	28.00	0.00	28.00	-3.00	28.00	-3.00	15.00	-3.00	10.0
600	-2.00	20.00	-3.00	20.00	0.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.00	0.00	20.00	-3.00	20.00	-3.00	10.00	-3.00	9.0
700	-2.00	20.00	-3.00	20.00	0.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.00	0.00	20.00	-3.00	20.00	-3.00	10.00	-3.00	9.0
800	-2.00	20.00	-3.00	20.00	0.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.00	0.00	20.00	-3.00	20.00	-3.00	10.00	-3.00	9.0
900	-2.00	20.00	-3.00	20.00	0.00	20.00	-3.00	20.00	0.00	20.00	0.00	20.00	0.00	20.00	-3.00	20.00	-3.00	10.00	-3.00	9.0

1000	-2.00	18.00	-3.00	18.00	0.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-3.00	18.00	-3.00	10.00	-3.00	8.0
1100	-2.00	18.00	-3.00	18.00	0.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-3.00	18.00	-3.00	10.00	-3.00	8.0
1200	-2.00	18.00	-3.00	18.00	0.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-3.00	18.00	-3.00	7.00	-3.00	8.0
1300	-2.00	18.00	-3.00	18.00	0.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-3.00	18.00	-3.00	7.00	-3.00	8.0
1400	-2.00	18.00	-3.00	18.00	0.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-3.00	18.00	-3.00	7.00	-3.00	8.0
1500	-2.00	18.00	-3.00	18.00	0.00	18.00	-3.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	-3.00	18.00	-3.00	7.00	-3.00	8.0
1750	-2.00	13.00	-3.00	13.00	0.00	13.00	-3.00	13.00	0.00	13.00	0.00	13.00	0.00	13.00	-3.00	13.00	-3.00	7.00	-3.00	8.0
2000	-2.00	13.00	-3.00	13.00	0.00	13.00	-3.00	13.00	0.00	13.00	0.00	13.00	0.00	13.00	-3.00	13.00	-3.00	7.00	-3.00	8.0
2500	-2.00	13.00	-3.00	13.00	0.00	13.00	-3.00	13.00	0.00	13.00	0.00	13.00	0.00	13.00	-3.00	13.00	-3.00	3.00	-3.00	8.0
3000	-2.00	7.00	-3.00	7.00	0.00	7.00	-3.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	-3.00	7.00	-3.00	3.00	-3.00	7.0
3500	-2.00	7.00	-3.00	7.00	0.00	7.00	-3.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	-3.00	7.00	-3.00	3.00	-3.00	7.0
4000	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	3.00	-1.50	7.0
4500	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	3.00	-1.50	7.0
5000	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	7.00	-1.50	3.00	-1.50	7.0
5500+	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.00	-1.50	3.0

Appendix 2A (cont.):
WOD98 Temperature (°C) Ranges by Basin as a Function of Depth

Depth	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea	
(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	0.00	34.00	0.00	27.00	-2.00	25.00	-3.00	35.00	14.00	35.00	0.00	35.00
10	0.00	34.00	0.00	27.00	-2.00	25.00	-3.00	35.00	14.00	35.00	0.00	35.00
20	0.00	34.00	0.00	27.00	-2.00	25.00	-3.00	35.00	14.00	34.00	0.00	35.00
30	3.00	30.00	0.00	27.00	-2.00	25.00	-3.00	35.00	14.00	34.00	0.00	35.00
50	3.00	30.00	3.00	30.00	-2.00	25.00	-3.00	35.00	13.00	32.00	0.00	35.00
75	3.00	28.00	3.00	30.00	-2.00	25.00	-3.00	35.00	13.00	30.00	0.00	35.00
100	3.00	26.00	3.00	30.00	-2.00	25.00	-3.00	32.00	13.00	30.00	0.00	30.00
125	3.00	26.00	3.00	30.00	-2.00	25.00	-3.00	32.00	13.00	30.00	0.00	30.00
150	3.00	26.00	5.00	30.00	-2.00	25.00	-3.00	32.00	13.00	30.00	0.00	30.00
200	3.00	22.00	5.00	30.00	-2.00	16.00	-3.00	32.00	13.00	28.00	0.00	30.00
250	3.00	22.00	5.00	25.00	-2.00	16.00	-3.00	32.00	13.00	28.00	0.00	28.00
300	3.00	22.00	5.00	25.00	-2.00	16.00	-3.00	32.00	10.00	28.00	0.00	28.00
400	3.00	20.00	5.00	20.00	-2.00	16.00	-3.00	32.00	10.00	28.00	0.00	28.00
500	3.00	20.00	5.00	20.00	-2.00	16.00	-3.00	32.00	10.00	28.00	0.00	28.00
600	3.00	20.00	5.00	17.00	-2.00	16.00	-3.00	32.00	10.00	26.00	0.00	20.00
700	3.00	20.00	5.00	17.00	-2.00	16.00	-3.00	32.00	10.00	26.00	0.00	20.00
800	3.00	20.00	5.00	17.00	-2.00	16.00	-3.00	32.00	10.00	26.00	0.00	20.00
900	3.00	20.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	26.00	0.00	20.00
1000	3.00	20.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	23.00	0.00	18.00
1100	3.00	20.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	23.00	0.00	18.00
1200	3.00	18.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	23.00	0.00	18.00
1300	3.00	18.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	23.00	0.00	18.00
1400	3.00	18.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	23.00	0.00	18.00
1500	3.00	18.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	23.00	0.00	18.00
1750	3.00	16.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	34.00	0.00	13.00
2000	3.00	16.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	34.00	0.00	13.00
2500	3.00	16.00	5.00	16.00	-2.00	16.00	-3.00	32.00	10.00	34.00	0.00	13.00
3000	3.00	16.00	5.00	16.00	-2.00	16.00	-3.00	13.00	10.00	34.00	0.00	12.00
3500	3.00	16.00	5.00	16.00	-2.00	16.00	-3.00	13.00	10.00	20.00	0.00	12.00
4000	3.00	16.00	5.00	16.00	-2.00	16.00	-1.50	7.00	10.00	20.00	-1.50	12.00
4500	3.00	16.00	5.00	16.00	-2.00	16.00	-1.50	7.00	10.00	20.00	-1.50	12.00

5000	3.00	16.00	5.00	16.00	-2.00	16.00	-1.50	7.00	10.00	20.00	-1.50	12.00
5500+	3.00	16.00	5.00	16.00	-2.00	16.00	-1.50	7.00	10.00	20.00	-1.50	12.00

WOD98 Salinity (PSS) Ranges by Basin as a Function of Depth

	North		Coastal		Equatorial		Coastal		South		Coastal		North		Coastal		Equatorial		Coas	
Depth	**Atlantic**		**N. Atlantic**		**Atlantic**		**Eq. Atlantic**		**Atlantic**		**S. Atlantic**		**Pacific**		**N. Pacific**		**Pacific**		**Eq. Pa**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**I**
0	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	4
10	27.00	38.20	0.00	40.00	20.00	37.60	0.00	40.00	28.00	38.50	0.00	40.00	25.00	37.00	0.00	40.00	28.60	37.00	0.00	4
20	28.30	38.20	0.00	40.00	28.00	37.40	0.00	40.00	28.00	38.00	0.00	40.00	30.00	36.50	0.00	40.00	29.00	37.00	0.00	4
30	28.50	38.20	0.00	40.00	31.00	37.40	0.00	40.00	30.60	38.00	0.00	40.00	30.00	36.50	0.00	40.00	29.60	37.00	0.00	4
50	28.90	38.00	20.00	40.00	31.40	37.40	20.00	40.00	31.00	38.00	20.00	40.00	31.00	36.00	20.00	40.00	30.20	37.00	20.00	4
75	28.90	38.00	20.00	40.00	31.80	37.40	20.00	40.00	31.20	38.00	20.00	40.00	31.00	36.00	20.00	40.00	31.00	37.00	20.00	4
100	30.30	38.00	20.00	40.00	31.80	37.40	20.00	40.00	31.40	38.00	20.00	40.00	31.50	36.00	26.00	40.00	31.50	37.00	30.00	4
125	30.80	38.00	20.00	40.00	31.80	37.40	20.00	40.00	31.40	37.80	20.00	40.00	31.50	36.00	26.00	40.00	31.50	36.80	30.00	4
150	30.80	37.60	20.00	40.00	31.80	37.20	20.00	40.00	31.40	37.40	20.00	40.00	32.00	35.80	26.00	40.00	31.50	36.80	30.00	4
200	31.20	37.40	20.00	40.00	31.80	37.00	30.00	40.00	31.40	36.60	30.00	40.00	32.00	35.80	26.00	40.00	31.50	36.70	30.00	4
250	32.20	37.10	30.00	40.00	32.00	37.00	30.00	40.00	31.40	36.20	30.00	40.00	32.00	35.80	26.00	40.00	31.80	36.30	30.00	4
300	33.00	36.80	30.00	40.00	32.20	36.80	30.00	40.00	31.60	36.00	30.00	40.00	32.00	35.80	30.00	40.00	31.80	36.30	30.00	4
400	33.00	36.70	33.00	40.00	32.40	36.60	33.00	40.00	32.00	35.80	33.00	40.00	32.20	35.50	30.00	40.00	31.80	36.20	33.00	4
500	33.00	36.60	33.00	40.00	33.70	36.50	33.00	40.00	34.00	35.50	33.00	40.00	32.40	35.25	30.50	40.00	32.75	36.10	33.00	4
600	33.00	36.60	33.00	40.00	33.70	36.00	33.00	40.00	34.10	35.10	33.00	40.00	32.60	35.25	30.50	40.00	33.00	36.00	33.00	4
700	33.00	36.60	33.00	40.00	33.60	35.80	33.00	40.00	34.10	35.10	33.00	40.00	32.60	35.25	32.00	40.00	33.00	35.90	33.00	4
800	33.00	36.60	33.00	40.00	33.60	35.60	33.00	40.00	34.10	35.00	33.00	40.00	33.20	35.25	33.00	40.00	33.75	35.80	33.00	4
900	33.00	36.60	33.00	40.00	33.60	35.60	33.00	40.00	34.10	34.90	33.00	40.00	33.60	35.25	33.00	40.00	33.80	35.50	33.00	4
1000	33.00	36.60	33.00	40.00	33.60	35.40	33.00	40.00	34.20	34.90	33.00	40.00	33.70	35.15	33.00	40.00	34.20	35.30	33.00	4
1100	33.00	36.60	33.00	38.00	33.60	35.40	33.00	38.00	34.20	34.90	33.00	38.00	33.70	35.15	33.00	38.00	34.20	35.30	33.00	3
1200	33.00	36.60	33.00	38.00	33.60	35.40	33.00	38.00	34.20	34.90	33.00	38.00	33.70	35.15	33.00	38.00	34.20	35.30	33.00	3
1300	33.00	36.60	33.00	38.00	33.60	35.40	33.00	38.00	34.30	34.90	33.00	38.00	33.70	35.15	33.00	38.00	34.20	35.30	33.00	3
1400	33.00	36.60	33.00	38.00	33.60	35.40	33.00	38.00	34.30	35.00	33.00	38.00	33.70	35.15	33.00	38.00	34.20	35.20	33.00	3
1500	33.00	36.60	33.00	38.00	33.80	35.40	33.00	38.00	34.40	35.00	33.00	38.00	33.80	35.00	33.00	38.00	34.40	35.20	33.00	3
1750	33.00	36.60	33.00	38.00	34.60	35.20	33.00	38.00	34.50	35.00	33.00	38.00	33.80	35.00	33.00	38.00	34.40	35.20	33.00	3
2000	33.00	36.00	33.00	38.00	34.70	35.15	33.00	38.00	34.60	35.00	33.00	38.00	34.00	35.00	33.00	38.00	34.40	35.10	33.00	3
2500	34.70	35.50	33.00	35.50	34.80	35.10	33.00	35.50	34.60	35.00	33.00	35.50	34.00	35.00	33.00	35.50	34.40	35.10	33.00	3
3000	34.80	35.40	33.00	35.50	34.80	35.10	33.00	35.50	34.66	35.00	33.00	35.50	34.00	35.00	33.00	35.50	34.20	35.10	33.00	3
3500	34.80	35.40	33.00	35.50	34.70	35.10	33.00	35.50	34.64	35.00	33.00	35.50	34.00	35.00	33.00	35.50	34.00	35.10	33.00	3
4000	34.80	35.40	33.00	35.50	34.50	35.10	33.00	35.50	34.62	35.00	33.00	35.50	34.00	35.00	33.00	35.50	34.00	35.50	33.00	3
4500	34.80	35.40	33.00	35.50	34.50	35.10	33.00	35.50	34.62	35.00	33.00	35.50	34.00	35.00	33.00	35.50	34.00	35.50	33.00	3
5000	34.80	35.40	33.00	35.50	34.50	35.10	33.00	35.50	34.62	35.00	33.00	35.50	34.00	35.00	33.00	35.50	34.00	35.50	33.00	3
5500+	34.80	35.40	34.30	35.50	34.50	35.10	34.30	35.50	34.62	35.00	34.30	35.50	34.00	35.00	34.30	35.50	34.00	35.50	34.30	3

Appendix 2B (cont.):
WOD98 Salinity (PSS) Ranges by Basin as a Function of Depth

	South		Coastal		North		Coastal		Equatorial		Coastal		South		Coastal		Southern		Arct	
Depth	**Pacific**		**S. Pacific**		**Indian**		**N. Indian**		**Indian**		**Eq. Indian**		**Indian**		**S. Indian**		**Ocean**		**Oce**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**I**
0	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00	0.00	4

10	28.00	37.00	0.00	40.00	28.00	38.00	0.00	40.00	26.00	38.00	0.00	40.00	30.00	36.40	0.00	40.00	26.00	36.75	0.00	4
20	28.00	37.00	0.00	40.00	29.80	38.00	0.00	40.00	31.00	37.40	0.00	40.00	31.40	36.40	0.00	40.00	28.00	36.75	0.00	4
30	29.00	37.00	0.00	40.00	30.20	38.00	0.00	40.00	31.20	37.00	0.00	40.00	31.60	36.40	0.00	40.00	29.00	36.50	0.00	4
50	30.00	36.70	20.00	40.00	31.20	38.00	20.00	40.00	31.60	36.80	20.00	40.00	31.90	36.30	20.00	40.00	30.00	36.50	0.00	4
75	31.00	36.70	20.00	40.00	32.20	38.00	20.00	40.00	31.60	36.80	20.00	40.00	32.00	36.30	20.00	40.00	30.50	36.50	0.00	4
100	31.00	36.70	30.00	40.00	32.40	37.00	30.00	40.00	31.80	36.60	20.00	40.00	32.00	36.20	30.00	40.00	30.50	36.50	26.00	3
125	31.00	36.70	30.00	40.00	32.40	37.00	30.00	40.00	31.80	36.50	20.00	40.00	32.00	36.20	30.00	40.00	30.50	36.50	26.00	3
150	31.00	36.70	30.00	40.00	32.60	37.00	30.00	40.00	31.80	36.40	20.00	40.00	32.00	36.10	30.00	40.00	31.00	36.50	26.00	3
200	31.20	36.00	30.00	40.00	33.40	37.00	30.00	40.00	31.80	36.40	30.00	40.00	32.00	36.00	30.00	40.00	31.00	36.25	26.00	3
250	31.50	36.00	30.00	40.00	33.60	37.00	30.00	40.00	32.00	36.30	30.00	40.00	32.20	35.80	30.00	40.00	31.00	36.00	26.00	3
300	32.00	36.00	30.00	40.00	33.70	37.00	30.00	40.00	32.00	36.20	30.00	40.00	32.20	35.60	30.00	40.00	31.00	36.00	30.00	3
400	32.00	36.00	33.00	40.00	34.00	36.50	33.00	40.00	32.40	36.20	33.00	40.00	32.40	35.40	33.00	40.00	31.50	35.75	33.00	3
500	34.20	35.50	33.00	40.00	34.60	36.50	33.00	40.00	34.30	36.00	33.00	40.00	34.10	35.30	33.00	40.00	32.00	35.50	33.00	3
600	34.20	35.25	33.00	40.00	34.85	36.30	33.00	40.00	34.40	36.00	33.00	40.00	34.15	35.20	33.00	40.00	33.00	35.50	33.00	3
700	34.20	35.00	33.00	40.00	34.85	36.30	33.00	40.00	34.40	35.75	33.00	40.00	34.20	35.00	33.00	40.00	33.80	35.25	33.00	3
800	34.20	35.00	33.00	40.00	34.85	36.20	33.00	40.00	34.45	35.75	33.00	40.00	34.20	35.00	33.00	40.00	33.80	35.00	33.00	3
900	34.20	35.00	33.00	40.00	34.85	36.00	33.00	40.00	34.45	35.75	33.00	40.00	34.20	34.90	33.00	40.00	34.00	35.00	33.00	3
1000	34.20	35.00	33.00	40.00	34.85	36.00	33.00	40.00	34.50	35.75	33.00	40.00	34.25	34.90	33.00	40.00	34.00	35.00	33.00	3
1100	34.30	35.00	33.00	38.00	34.80	35.90	33.00	38.00	34.50	35.75	33.00	38.00	34.25	34.90	33.00	38.00	34.00	35.00	33.00	3
1200	34.30	34.70	33.00	38.00	34.80	35.80	33.00	38.00	34.50	35.75	33.00	38.00	34.25	34.90	33.00	38.00	34.00	35.00	33.00	3
1300	34.30	34.70	33.00	38.00	34.80	35.60	33.00	38.00	34.55	35.60	33.00	38.00	34.30	34.90	33.00	38.00	34.00	34.90	33.00	3
1400	34.40	34.70	33.00	38.00	34.80	35.60	33.00	38.00	34.55	35.30	33.00	38.00	34.30	34.90	33.00	38.00	34.30	34.90	33.00	3
1500	34.40	34.80	33.00	38.00	34.75	35.60	33.00	38.00	34.55	35.20	33.00	38.00	34.35	34.90	33.00	38.00	34.30	34.90	33.00	3
1750	34.40	34.80	33.00	38.00	34.75	35.50	33.00	38.00	34.57	35.10	33.00	38.00	34.45	34.90	33.00	38.00	34.40	34.90	33.00	3
2000	34.40	34.80	33.00	38.00	34.70	35.40	33.00	38.00	34.60	35.00	33.00	38.00	34.55	34.90	33.00	38.00	34.40	34.90	33.00	3
2500	34.50	34.80	33.00	35.50	34.65	35.40	33.00	35.50	34.60	35.00	33.00	35.50	34.60	34.90	33.00	35.50	34.40	34.90	33.00	3
3000	34.50	34.80	33.00	35.50	34.65	35.40	33.00	35.50	34.60	35.00	33.00	35.50	34.60	34.90	33.00	35.50	34.40	34.90	33.00	3
3500	34.60	34.80	33.00	35.50	34.60	35.40	33.00	35.50	34.60	35.00	33.00	35.50	34.60	34.90	33.00	35.50	34.40	34.90	33.00	3
4000	34.60	34.80	33.00	35.50	34.60	35.40	33.00	35.50	34.60	35.00	33.00	35.50	34.60	34.90	33.00	35.50	34.40	34.90	33.00	3
4500	34.60	34.80	33.00	35.50	34.60	35.40	33.00	35.50	34.60	35.00	33.00	35.50	34.60	34.90	33.00	35.50	34.40	34.90	33.00	3
5000	34.60	34.80	33.00	35.50	34.60	35.40	33.00	35.50	34.60	35.00	33.00	35.50	34.60	34.90	33.00	35.50	34.40	34.90	33.00	3
5500+	34.60	34.80	34.30	35.50	34.60	35.40	34.30	35.50	34.60	35.00	34.30	35.50	34.60	34.90	34.30	35.50	34.40	34.90	34.30	3

Appendix 2B (cont.):
WOD98 Salinity (PSS) Ranges by Basin as a Function of Depth

Depth	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.00	40.00	0.00	25.00	0.00	35.00	0.00	42.00	0.00	44.00	0.00	40.00
10	0.00	40.00	0.00	25.00	0.00	35.00	0.00	42.00	0.00	44.00	0.00	40.00
20	0.00	40.00	0.00	25.00	0.00	35.00	0.00	42.00	0.00	44.00	0.00	40.00
30	0.00	40.00	0.00	25.00	0.00	35.00	0.00	42.00	0.00	44.00	0.00	40.00
50	12.00	40.00	10.00	40.00	0.00	35.00	20.00	42.00	20.00	43.00	20.00	40.00
75	12.00	40.00	10.00	40.00	0.00	35.00	20.00	42.00	20.00	43.00	20.00	40.00
100	31.00	40.00	12.00	40.00	0.00	35.00	30.00	42.00	30.00	43.00	30.00	40.00
125	31.00	40.00	12.00	40.00	0.00	35.00	30.00	42.00	30.00	43.00	30.00	40.00
150	31.00	40.00	12.00	40.00	0.00	35.00	30.00	42.00	30.00	43.00	30.00	40.00
200	31.00	40.00	12.00	40.00	1.00	25.00	30.00	42.00	30.00	43.00	30.00	40.00
250	31.00	40.00	12.00	40.00	1.00	25.00	30.00	42.00	30.00	43.00	30.00	40.00
300	31.00	40.00	12.00	35.00	1.00	25.00	30.00	42.00	30.00	43.00	30.00	40.00
400	31.00	40.00	12.00	33.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00

500	31.00	40.00	12.00	30.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00
600	33.00	40.00	12.00	30.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00
700	33.00	40.00	15.00	30.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00
800	33.00	40.00	15.00	28.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00
900	33.00	40.00	15.00	28.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00
1000	33.00	40.00	15.00	28.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	40.00
1100	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	38.00
1200	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	38.00
1300	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	38.00
1400	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	38.00
1500	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	43.00	33.00	38.00
1750	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	50.00	33.00	38.00
2000	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	50.00	33.00	38.00
2500	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	50.00	33.00	35.50
3000	33.00	40.00	18.00	25.00	1.00	25.00	33.00	42.00	33.00	50.00	33.00	35.50
3500	33.00	40.00	18.00	25.00	1.00	25.00	33.00	35.50	33.00	50.00	33.00	35.50
4000	33.00	40.00	18.00	25.00	1.00	25.00	33.00	35.50	33.00	50.00	33.00	35.50
4500	33.00	40.00	18.00	25.00	1.00	25.00	33.00	35.50	33.00	50.00	33.00	35.50
5000	33.00	40.00	18.00	25.00	1.00	25.00	33.00	35.50	33.00	50.00	33.00	35.50
5500+	34.30	40.00	18.00	25.00	1.00	25.00	34.30	35.50	34.30	50.00	34.30	35.50

WOD98 Oxygen (ml/l) Ranges by Basin as a Function of Depth

	North		**Coastal**		**Equatorial**		**Coastal**		**South**		**Coastal**		**North**		**Coastal**		**Equatorial**		**Coastal**	
Depth	**Atlantic**		**N. Atlantic**		**Atlantic**		**Eq. Atlantic**		**Atlantic**		**S. Atlantic**		**Pacific**		**N. Pacific**		**Pacific**		**Eq. Pacific**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.00	11.00	0.00	10.00	0.00	7.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	10.00	0.00	10.00	0.00	8.00	0.00	7.00
10	0.00	11.00	0.00	10.00	0.00	7.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	10.00	0.00	10.00	0.00	8.00	0.00	7.00
20	0.00	11.00	0.00	10.00	0.00	7.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	10.00	0.00	10.00	0.00	8.00	0.00	7.00
30	0.00	11.00	0.00	10.00	0.00	7.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	10.00	0.00	10.00	0.00	8.00	0.00	7.00
50	0.00	11.00	0.00	9.00	0.00	6.00	0.00	9.00	0.00	9.00	0.00	8.00	0.00	10.00	0.00	8.00	0.00	8.00	0.00	6.00
75	0.00	11.00	0.00	9.00	0.00	6.00	0.00	6.00	0.00	9.00	0.00	8.00	0.00	9.00	0.00	8.00	0.00	8.00	0.00	6.00
100	0.00	10.00	0.00	9.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	8.00	0.00	9.00	0.00	8.00	0.00	6.00	0.00	6.00
125	0.00	10.00	0.00	9.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	8.00	0.00	9.00	0.00	8.00	0.00	6.00	0.00	6.00
150	0.00	10.00	0.00	9.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	6.00	0.00	5.00
200	0.00	10.00	0.00	9.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	5.00	0.00	5.00
250	0.00	10.00	0.00	8.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	5.00	0.00	5.00
300	0.00	9.00	0.00	8.00	0.00	5.00	0.00	6.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	8.00	0.00	5.00	0.00	5.00
400	0.00	9.00	0.00	8.00	0.00	5.00	0.00	6.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	8.00	0.00	5.00	0.00	5.00
500	0.00	9.00	0.00	8.00	0.00	5.00	0.00	6.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	8.00	0.00	5.00	0.00	5.00
600	0.00	9.00	0.00	8.00	0.00	5.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	5.00	0.00	5.00
700	0.00	9.00	0.00	8.00	0.00	5.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
800	0.00	9.00	0.00	8.00	0.00	5.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
900	0.00	9.00	0.00	8.00	0.00	5.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1000	0.00	9.00	0.00	8.00	0.00	6.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1100	0.00	9.00	0.00	8.00	0.00	6.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1200	0.00	9.00	0.00	8.00	0.00	6.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1300	0.00	9.00	0.00	8.00	0.00	6.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1400	0.00	9.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1500	0.00	9.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
1750	0.00	9.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
2000	0.00	9.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00
2500	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	5.00

3000	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	4.00
3500	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	5.00	0.00	4.00
4000	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00
4500	0.00	8.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00
5000	0.00	8.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00
5500+	0.00	8.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	7.00	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00

Appendix 2C (cont.):
WOD98 Oxygen (ml/l) Ranges by Basin as a Function of Depth

	South		**Coastal**		**North**		**Coastal**		**Equatorial**		**Coastal**		**South**		**Coastal**		**Southern**		**Arctic**	
Depth	**Pacific**		**S. Pacific**		**Indian**		**N. Indian**		**Indian**		**Eq. Indian**		**Indian**		**S. Indian**		**Ocean**		**Ocean**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.00	8.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	9.00	0.00	10.00	0.00	11.00
10	0.00	8.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	9.00	0.00	10.00	0.00	11.00
20	0.00	8.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	9.00	0.00	10.00	0.00	11.00
30	0.00	8.00	0.00	8.00	0.00	7.00	0.00	7.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	9.00	0.00	10.00	0.00	11.00
50	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	9.00	0.00	10.00	0.00	11.00
75	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	10.00	0.00	6.00	0.00	8.00	0.00	9.00	0.00	9.00	0.00	10.00
100	0.00	8.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	7.00	0.00	5.00	0.00	8.00	0.00	9.00	0.00	9.00	0.00	10.00
125	0.00	8.00	0.00	7.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	5.00	0.00	8.00	0.00	9.00	0.00	9.00	0.00	10.00
150	0.00	8.00	0.00	7.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	5.00	0.00	8.00	0.00	9.00	0.00	9.00	0.00	10.00
200	0.00	7.00	0.00	7.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	8.00	0.00	9.00	0.00	9.00	0.00	10.00
250	0.00	7.00	0.00	7.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	8.00	0.00	7.00	0.00	9.00	0.00	10.00
300	0.00	7.00	0.00	7.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	7.00	0.00	8.00	0.00	10.00
400	0.00	7.00	0.00	7.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	7.00	0.00	8.00	0.00	10.00
500	0.00	7.00	0.00	7.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	7.00	0.00	8.00	0.00	10.00
600	0.00	7.00	0.00	7.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	6.00	0.00	8.00	0.00	9.00
700	0.00	7.00	0.00	6.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	7.00	0.00	6.00	0.00	8.00	0.00	9.00
800	0.00	7.00	0.00	6.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	3.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	9.00
900	0.00	7.00	0.00	6.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	3.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	9.00
1000	0.00	6.00	0.00	6.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	3.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	9.00
1100	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	3.00	0.00	6.00	0.00	6.00	0.00	8.00	0.00	9.00
1200	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	3.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00
1300	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00
1400	0.00	6.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00
1500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00
1750	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00
2000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00
2500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00
3000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00
3500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00
4000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00
4500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00
5000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00
5500+	0.00	5.00	0.00	5.00	0.00	5.00	0.00	4.00	0.00	5.00	0.00	5.00	0.00	6.00	0.00	6.00	0.00	7.00	0.00	9.00

Appendix 2C (cont.):
WOD98 Oxygen (ml/l) Ranges by Basin as a Function of Depth

Depth	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea	
(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	0.00	8.00	0.00	10.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	5.00
10	0.00	8.00	0.00	10.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	5.00
20	0.00	8.00	0.00	10.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	5.00
30	0.00	8.00	0.00	10.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	5.00
50	0.00	8.00	0.00	10.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	5.00
75	0.00	7.00	0.00	8.00	0.00	9.50	0.00	9.50	0.00	9.50	0.00	5.00
100	0.00	7.00	0.00	8.00	0.00	9.50	0.00	9.50	0.00	9.50	0.00	4.00
125	0.00	7.00	0.00	8.00	0.00	9.50	0.00	9.50	0.00	9.50	0.00	4.00
150	0.00	7.00	0.00	8.00	0.00	9.50	0.00	9.50	0.00	9.50	0.00	4.00
200	0.00	7.00	0.00	5.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	3.00
250	0.00	7.00	0.00	5.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	3.00
300	0.00	7.00	0.00	5.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	3.00
400	0.00	7.00	0.00	2.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	3.00
500	0.00	7.00	0.00	2.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	3.00
600	0.00	7.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	3.00
700	0.00	7.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	3.00
800	0.00	7.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	3.00
900	0.00	7.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	3.00
1000	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	3.00
1100	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	3.00
1200	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
1300	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
1400	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
1500	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
1750	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
2000	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
2500	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
3000	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
3500	0.00	6.00	0.00	2.00	0.00	7.10	0.00	7.10	0.00	7.10	0.00	2.00
4000	0.00	6.00	0.00	2.00	0.00	6.00	0.00	7.10	0.00	7.10	0.00	2.00
4500	0.00	6.00	0.00	2.00	0.00	6.00	0.00	6.00	0.00	6.00	0.00	2.00
5000	0.00	6.00	0.00	2.00	0.00	6.00	0.00	6.00	0.00	6.00	0.00	2.00
5500+	0.00	6.00	0.00	2.00	0.00	6.00	0.00	6.00	0.00	6.00	0.00	2.00

WOD98 Phosphate (µM) Ranges by Basin as a Function of Depth

	North		Coastal		Equatorial		Coastal		South		Coastal		North		Coastal		Equatorial		Coastal	
Depth	Atlantic		N. Atlantic		Atlantic		Eq. Atlantic		Atlantic		S. Atlantic		Pacific		N. Pacific		Pacific		Eq. Pacific	
(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	0.00	1.40	0.00	10.00	0.00	1.00	0.00	10.00	0.00	2.00	0.00	10.00	0.00	2.00	0.00	10.00	0.00	2.00	0.00	10.00
10	0.00	1.40	0.00	10.00	0.00	1.00	0.00	10.00	0.00	2.00	0.00	10.00	0.00	2.00	0.00	10.00	0.00	2.00	0.00	10.00
20	0.00	1.40	0.00	10.00	0.00	1.20	0.00	10.00	0.00	2.00	0.00	10.00	0.00	2.00	0.00	10.00	0.00	2.00	0.00	10.00
30	0.00	1.40	0.00	10.00	0.00	1.40	0.00	10.00	0.00	2.00	0.00	10.00	0.00	2.00	0.00	10.00	0.00	2.00	0.00	10.00
50	0.00	2.00	0.00	10.00	0.00	2.00	0.00	10.00	0.00	2.00	0.00	10.00	0.00	2.40	0.00	10.00	0.00	2.40	0.00	10.00
75	0.00	2.00	0.00	10.00	0.00	2.40	0.00	10.00	0.00	2.40	0.00	10.00	0.00	2.80	0.00	10.00	0.00	2.80	0.00	10.00
100	0.00	2.00	0.00	10.00	0.00	2.40	0.00	10.00	0.00	2.40	0.00	10.00	0.00	2.80	0.00	10.00	0.00	2.80	0.00	10.00
125	0.00	2.00	0.00	10.00	0.00	2.80	0.00	10.00	0.00	2.40	0.00	10.00	0.00	3.20	0.00	10.00	0.00	3.20	0.00	10.00
150	0.00	2.00	0.00	10.00	0.00	2.80	0.00	10.00	0.00	2.40	0.00	10.00	0.00	3.20	0.00	10.00	0.00	3.20	0.00	10.00
200	0.00	2.40	0.00	10.00	0.00	2.80	0.00	10.00	0.00	2.80	0.00	10.00	0.00	3.60	0.00	10.00	0.20	3.20	0.00	10.00

250	0.00	2.40	0.00	10.00	0.00	3.20	0.00	10.00	0.00	2.80	0.00	10.00	0.00	3.60	0.00	10.00	0.40	3.20	0.00	10.00
300	0.00	2.40	0.00	10.00	0.00	3.20	0.00	10.00	0.00	2.80	0.00	10.00	0.00	3.60	0.00	10.00	0.60	3.20	0.00	10.00
400	0.00	3.20	0.00	10.00	0.00	3.60	0.00	10.00	0.20	3.20	0.00	10.00	0.00	3.60	0.00	10.00	0.60	3.60	0.00	10.00
500	0.00	3.20	0.00	10.00	0.00	3.60	0.00	10.00	0.20	3.20	0.00	10.00	0.20	3.60	0.00	10.00	0.80	3.60	0.00	10.00
600	0.00	3.20	0.00	10.00	0.00	3.60	0.00	10.00	0.20	3.20	0.00	10.00	0.20	3.60	0.00	10.00	0.80	3.80	0.00	10.00
700	0.20	3.20	0.00	10.00	0.20	3.60	0.00	10.00	0.20	3.20	0.00	10.00	0.80	3.60	0.00	10.00	0.80	3.80	0.00	10.00
800	0.20	3.20	0.00	10.00	0.20	3.60	0.00	10.00	0.20	3.20	0.00	10.00	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00
900	0.20	3.60	0.00	10.00	0.30	3.60	0.00	10.00	0.20	3.20	0.00	10.00	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00
1000	0.20	3.60	0.00	10.00	0.30	3.60	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00
1100	0.20	3.60	0.00	10.00	0.30	3.60	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00
1200	0.20	3.60	0.00	10.00	0.30	3.60	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00
1300	0.20	3.60	0.00	10.00	0.30	3.60	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00
1400	0.20	3.60	0.00	10.00	0.60	3.20	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.60	0.00	10.00	0.80	3.80	0.00	10.00
1500	0.20	3.60	0.00	10.00	0.60	3.20	0.00	10.00	0.40	3.60	0.00	10.00	0.80	3.60	0.00	10.00	0.80	3.60	0.00	10.00
1750	0.20	3.60	0.00	10.00	0.60	3.20	0.00	10.00	0.40	3.60	0.00	10.00	0.80	3.60	0.00	10.00	0.80	3.60	0.00	10.00
2000	0.20	3.60	0.00	10.00	0.30	3.20	0.00	10.00	0.40	3.60	0.00	10.00	0.80	3.60	0.00	10.00	0.80	3.60	0.00	10.00
2500	0.20	3.40	0.00	10.00	0.30	3.20	0.00	10.00	0.40	3.60	0.00	10.00	0.80	3.60	0.00	10.00	0.80	3.60	0.00	10.00
3000	0.20	3.40	0.00	10.00	0.30	3.20	0.00	10.00	0.40	3.60	0.00	10.00	0.80	3.60	0.00	10.00	0.80	3.60	0.00	10.00
3500	0.20	3.40	0.00	10.00	0.30	3.20	0.00	10.00	0.60	3.20	0.00	10.00	0.80	3.20	0.00	10.00	0.80	3.20	0.00	10.00
4000	0.40	3.20	0.00	10.00	0.50	3.20	0.00	10.00	0.60	3.20	0.00	10.00	0.80	3.20	0.00	10.00	0.80	3.20	0.00	10.00
4500	0.40	3.20	0.00	10.00	0.60	2.80	0.00	10.00	0.60	3.20	0.00	10.00	0.80	3.20	0.00	10.00	0.80	3.20	0.00	10.00
5000	0.40	2.80	0.00	10.00	0.60	2.80	0.00	10.00	0.80	2.80	0.00	10.00	0.80	3.20	0.00	10.00	0.80	3.20	0.00	10.00
5500+	0.40	2.80	0.00	10.00	0.60	2.80	0.00	10.00	0.80	2.80	0.00	10.00	0.80	3.20	0.00	10.00	0.80	3.20	0.00	10.00

Appendix 2D (cont.):
WOD98 Phosphate (µM) Ranges by Basin as a Function of Depth

	South		**Coastal**		**North**		**Coastal**		**Equatorial**		**Coastal**		**South**		**Coastal**		**Southern**		**Arctic**	
Depth	**Pacific**		**S. Pacific**		**Indian**		**N. Indian**		**Indian**		**Eq. Indian**		**Indian**		**S. Indian**		**Ocean**		**Ocean**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.00	1.60	0.00	10.00	0.00	1.40	0.00	10.00	0.00	1.00	0.00	10.00	0.00	2.00	0.00	10.00	0.20	2.80	0.00	2.80
10	0.00	1.60	0.00	10.00	0.00	1.40	0.00	10.00	0.00	1.00	0.00	10.00	0.00	2.00	0.00	10.00	0.20	2.80	0.00	2.80
20	0.00	1.60	0.00	10.00	0.00	1.40	0.00	10.00	0.00	1.00	0.00	10.00	0.00	2.00	0.00	10.00	0.20	2.80	0.00	2.40
30	0.00	1.60	0.00	10.00	0.00	1.60	0.00	10.00	0.00	1.00	0.00	10.00	0.00	2.00	0.00	10.00	0.20	2.80	0.00	2.80
50	0.00	2.00	0.00	10.00	0.00	2.00	0.00	10.00	0.00	1.20	0.00	10.00	0.00	2.00	0.00	10.00	0.20	2.80	0.00	2.80
75	0.00	3.20	0.00	10.00	0.00	2.80	0.00	10.00	0.00	2.00	0.00	10.00	0.00	2.00	0.00	10.00	0.20	2.80	0.00	2.80
100	0.00	3.20	0.00	10.00	0.00	3.60	0.00	10.00	0.00	2.40	0.00	10.00	0.00	2.00	0.00	10.00	0.20	3.20	0.00	2.80
125	0.00	3.20	0.00	10.00	0.00	3.60	0.00	10.00	0.00	2.40	0.00	10.00	0.00	2.40	0.00	10.00	0.40	3.20	0.00	2.80
150	0.00	3.20	0.00	10.00	0.00	3.60	0.00	10.00	0.00	2.80	0.00	10.00	0.00	2.40	0.00	10.00	0.40	3.20	0.00	2.80
200	0.00	3.20	0.00	10.00	0.60	3.60	0.00	10.00	0.40	2.80	0.00	10.00	0.00	2.40	0.00	10.00	0.40	3.20	0.00	2.80
250	0.00	3.20	0.00	10.00	0.60	3.60	0.00	10.00	0.40	2.80	0.00	10.00	0.00	2.40	0.00	10.00	0.60	3.20	0.00	2.80
300	0.00	3.20	0.00	10.00	0.60	3.60	0.00	10.00	0.40	2.80	0.00	10.00	0.00	2.80	0.00	10.00	0.60	3.20	0.00	2.80
400	0.40	3.60	0.00	10.00	0.60	3.60	0.00	10.00	0.40	3.20	0.00	10.00	0.00	2.80	0.00	10.00	0.60	3.20	0.00	2.80
500	0.40	3.60	0.00	10.00	0.80	3.80	0.00	10.00	0.40	3.20	0.00	10.00	0.00	2.80	0.00	10.00	0.60	3.20	0.00	2.80
600	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00	0.40	3.60	0.00	10.00	0.00	3.20	0.00	10.00	0.60	3.20	0.00	3.20
700	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00	0.40	3.60	0.00	10.00	0.20	3.20	0.00	10.00	0.60	3.20	0.20	3.20
800	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00	0.40	3.80	0.00	10.00	0.40	3.20	0.00	10.00	0.60	3.20	0.40	3.80
900	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00	0.40	3.80	0.00	10.00	0.40	3.20	0.00	10.00	0.60	3.20	0.40	3.80
1000	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00	0.40	3.80	0.00	10.00	0.40	3.20	0.00	10.00	0.60	3.20	0.40	3.80
1100	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00	0.60	3.80	0.00	10.00	0.40	3.20	0.00	10.00	0.60	3.20	0.40	3.80
1200	0.80	3.60	0.00	10.00	0.80	3.80	0.00	10.00	0.60	3.80	0.00	10.00	0.40	3.20	0.00	10.00	0.60	3.20	0.40	3.80

1300	0.80	3.60	0.00	10.00	0.80	3.80	0.00	10.00	0.80	3.80	0.00	10.00	0.40	3.20	0.00	10.00	0.60	3.20	0.40	3.80
1400	0.80	3.60	0.00	10.00	0.80	3.80	0.00	10.00	0.80	3.60	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.20	0.40	3.80
1500	0.80	3.60	0.00	10.00	0.80	3.80	0.00	10.00	0.80	3.60	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.20	0.40	3.80
1750	0.80	3.60	0.00	10.00	0.80	3.80	0.00	10.00	0.80	3.60	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.20	0.40	3.80
2000	0.80	3.60	0.00	10.00	0.80	3.80	0.00	10.00	0.80	3.60	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.20	0.40	3.80
2500	0.80	3.60	0.00	10.00	0.60	3.80	0.00	10.00	0.80	3.60	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.20	0.40	3.80
3000	0.80	3.20	0.00	10.00	0.60	3.60	0.00	10.00	0.80	3.20	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.20	0.60	3.60
3500	0.80	3.20	0.00	10.00	0.60	3.60	0.00	10.00	0.80	3.20	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.20	0.60	3.60
4000	0.80	3.20	0.00	10.00	0.60	2.80	0.00	10.00	0.80	3.20	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.20	0.60	3.20
4500	0.80	3.20	0.00	10.00	0.60	2.80	0.00	10.00	0.80	3.20	0.00	10.00	0.40	3.20	0.00	10.00	0.80	3.20	0.60	2.80
5000	0.80	3.20	0.00	10.00	0.60	2.80	0.00	10.00	0.80	3.20	0.00	10.00	0.80	3.20	0.00	10.00	0.80	3.20	0.60	2.80
5500+	0.80	3.20	0.00	10.00	0.60	2.80	0.00	10.00	0.80	3.20	0.00	10.00	0.80	3.20	0.00	10.00	0.80	2.80	0.60	2.80

Appendix 2D (cont.):
WOD98 Phosphate (µM) Ranges by Basin as a Function of Depth

Depth	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
10	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
20	0.00	2.40	0.00	2.40	0.00	2.40	0.00	2.40	0.00	2.40	0.00	2.40
30	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
50	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
75	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
100	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
125	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
150	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
200	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
250	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
300	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
400	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
500	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80	0.00	2.80
600	0.00	3.20	0.00	3.20	0.00	3.20	0.00	3.20	0.00	3.20	0.00	3.20
700	0.20	3.20	0.20	3.20	0.20	3.20	0.20	3.20	0.20	3.20	0.20	3.20
800	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80
900	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80
1000	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80
1100	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80
1200	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80
1300	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80
1400	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80
1500	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80
1750	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80
2000	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80
2500	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80	0.40	3.80
3000	0.60	3.60	0.60	3.60	0.60	3.60	0.60	3.60	0.60	3.60	0.60	3.60
3500	0.60	3.60	0.60	3.60	0.60	3.60	0.60	3.60	0.60	3.60	0.60	3.60
4000	0.60	3.20	0.60	3.20	0.60	3.20	0.60	3.20	0.60	3.20	0.60	3.20
4500	0.60	2.80	0.60	2.80	0.60	2.80	0.60	2.80	0.60	2.80	0.60	2.80
5000	0.60	2.80	0.60	2.80	0.60	2.80	0.60	2.80	0.60	2.80	0.60	2.80
5500+	0.60	2.80	0.60	2.80	0.60	2.80	0.60	2.80	0.60	2.80	0.60	2.80

WOD98 Silicate (µM) Ranges by Basin as a Function of Depth

	North		Coastal		Equatorial		Coastal		South		Coastal		North		Coastal		Equatorial		Coastal	
Depth	Atlantic		N. Atlantic		Atlantic		Eq. Atlantic		Atlantic		S. Atlantic		Pacific		N. Pacific		Pacific		Eq. Pacific	
(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	0.0	50.0	0.0	250.0	0.0	40.0	0.0	250.0	0.0	30.0	0.0	250.0	0.0	60.0	0.0	250.0	0.0	80.0	0.0	60.0
10	0.0	50.0	0.0	250.0	0.0	40.0	0.0	250.0	0.0	30.0	0.0	250.0	0.0	60.0	0.0	250.0	0.0	80.0	0.0	60.0
20	0.0	50.0	0.0	250.0	0.0	40.0	0.0	250.0	0.0	30.0	0.0	250.0	0.0	60.0	0.0	250.0	0.0	80.0	0.0	60.0
30	0.0	50.0	0.0	250.0	0.0	40.0	0.0	250.0	0.0	30.0	0.0	250.0	0.0	60.0	0.0	250.0	0.0	80.0	0.0	60.0
50	0.0	60.0	0.0	250.0	0.0	50.0	0.0	250.0	0.0	30.0	0.0	250.0	0.0	60.0	0.0	250.0	0.0	80.0	0.0	60.0
75	0.0	60.0	0.0	250.0	0.0	50.0	0.0	250.0	0.0	30.0	0.0	250.0	0.0	80.0	0.0	250.0	0.0	80.0	0.0	60.0
100	0.0	60.0	0.0	250.0	0.0	50.0	0.0	250.0	0.0	40.0	0.0	250.0	0.0	80.0	0.0	250.0	0.0	80.0	0.0	60.0
125	0.0	60.0	0.0	250.0	0.0	60.0	0.0	250.0	0.0	40.0	0.0	250.0	0.0	80.0	0.0	250.0	0.0	80.0	0.0	60.0
150	0.0	60.0	0.0	250.0	0.0	60.0	0.0	250.0	0.0	40.0	0.0	250.0	0.0	80.0	0.0	250.0	0.0	80.0	0.0	60.0
200	0.0	80.0	0.0	250.0	0.0	60.0	0.0	250.0	0.0	40.0	0.0	250.0	2.0	80.0	0.0	250.0	2.0	80.0	0.0	60.0
250	0.0	80.0	0.0	250.0	2.0	60.0	0.0	250.0	2.0	40.0	0.0	250.0	2.0	80.0	0.0	250.0	2.0	80.0	0.0	60.0
300	0.0	80.0	0.0	250.0	2.0	80.0	0.0	250.0	2.0	40.0	0.0	250.0	2.0	80.0	0.0	250.0	2.0	80.0	0.0	60.0
400	0.0	100.0	0.0	250.0	2.0	80.0	0.0	250.0	2.0	40.0	0.0	250.0	2.0	100.0	0.0	250.0	2.0	80.0	0.0	60.0
500	2.0	100.0	0.0	250.0	2.0	80.0	0.0	250.0	2.0	80.0	0.0	250.0	5.0	140.0	0.0	250.0	5.0	100.0	20.0	60.0
600	2.0	100.0	0.0	250.0	2.0	80.0	0.0	250.0	2.0	80.0	0.0	250.0	5.0	140.0	0.0	250.0	5.0	120.0	20.0	120.0
700	2.0	120.0	0.0	250.0	2.0	80.0	0.0	250.0	2.0	80.0	0.0	250.0	10.0	140.0	0.0	250.0	5.0	120.0	20.0	120.0
800	2.0	120.0	0.0	250.0	2.0	80.0	0.0	250.0	2.0	80.0	0.0	250.0	10.0	140.0	0.0	250.0	5.0	120.0	20.0	120.0
900	2.0	120.0	0.0	250.0	2.0	80.0	0.0	250.0	5.0	120.0	0.0	250.0	10.0	160.0	0.0	250.0	5.0	140.0	20.0	120.0
1000	2.0	120.0	0.0	250.0	2.0	80.0	0.0	250.0	5.0	120.0	0.0	250.0	15.0	180.0	0.0	250.0	5.0	180.0	20.0	120.0
1100	2.0	120.0	0.0	250.0	2.0	80.0	0.0	250.0	5.0	120.0	0.0	250.0	15.0	180.0	0.0	250.0	10.0	180.0	20.0	150.0
1200	2.0	120.0	0.0	250.0	2.0	80.0	0.0	250.0	5.0	140.0	0.0	250.0	15.0	180.0	0.0	250.0	10.0	180.0	60.0	150.0
1300	2.0	120.0	0.0	250.0	2.0	80.0	0.0	250.0	5.0	140.0	0.0	250.0	15.0	180.0	0.0	250.0	10.0	180.0	60.0	150.0
1400	2.0	120.0	0.0	250.0	2.0	80.0	0.0	250.0	5.0	160.0	0.0	250.0	15.0	180.0	0.0	250.0	15.0	180.0	60.0	150.0
1500	2.0	120.0	0.0	250.0	2.0	80.0	0.0	250.0	5.0	160.0	0.0	250.0	15.0	200.0	0.0	250.0	15.0	180.0	60.0	150.0
1750	2.0	120.0	0.0	250.0	2.0	80.0	0.0	250.0	5.0	160.0	0.0	250.0	20.0	200.0	0.0	250.0	15.0	180.0	120.0	190.0
2000	5.0	130.0	0.0	250.0	5.0	80.0	0.0	250.0	5.0	160.0	0.0	250.0	20.0	200.0	0.0	250.0	15.0	180.0	120.0	190.0
2500	10.0	150.0	0.0	250.0	5.0	80.0	0.0	250.0	5.0	160.0	0.0	250.0	20.0	200.0	0.0	250.0	15.0	180.0	120.0	160.0
3000	10.0	150.0	0.0	250.0	5.0	80.0	0.0	250.0	5.0	160.0	0.0	250.0	20.0	200.0	0.0	250.0	15.0	180.0	150.0	160.0
3500	15.0	150.0	0.0	250.0	5.0	100.0	0.0	250.0	5.0	160.0	0.0	250.0	20.0	200.0	0.0	250.0	15.0	180.0	150.0	160.0
4000	15.0	150.0	0.0	250.0	10.0	100.0	0.0	250.0	10.0	160.0	0.0	250.0	20.0	200.0	0.0	250.0	15.0	180.0	150.0	160.0
4500	15.0	150.0	0.0	250.0	15.0	120.0	0.0	250.0	10.0	160.0	0.0	250.0	30.0	200.0	0.0	250.0	15.0	180.0	150.0	160.0
5000	15.0	150.0	0.0	250.0	30.0	160.0	0.0	250.0	10.0	160.0	0.0	250.0	30.0	200.0	0.0	250.0	20.0	180.0	150.0	160.0
5500+	15.0	150.0	0.0	250.0	30.0	160.0	0.0	250.0	10.0	160.0	0.0	250.0	30.0	200.0	0.0	250.0	20.0	180.0	150.0	160.0

Appendix 2E (cont.):
WOD98 Silicate (µM) Ranges by Basin as a Function of Depth

	South		Coastal		North		Coastal		Equatorial		Coastal		South		Coastal		Southern		Arctic	
Depth	Pacific		S. Pacific		Indian		N. Indian		Indian		Eq. Indian		Indian		S. Indian		Ocean		Ocean	
(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	0.0	80.0	0.0	40.0	0.0	30.0	0.0	40.0	0.0	50.0	0.0	40.0	0.0	80.0	0.0	40.0	0.0	120.0	0.0	100.0
10	0.0	80.0	0.0	40.0	0.0	30.0	0.0	40.0	0.0	50.0	0.0	40.0	0.0	80.0	0.0	40.0	0.0	120.0	0.0	100.0
20	0.0	80.0	0.0	40.0	0.0	30.0	0.0	40.0	0.0	50.0	0.0	40.0	0.0	80.0	0.0	40.0	0.0	120.0	0.0	100.0
30	0.0	80.0	0.0	40.0	0.0	30.0	0.0	40.0	0.0	50.0	0.0	40.0	0.0	80.0	0.0	40.0	0.0	120.0	0.0	100.0
50	0.0	80.0	0.0	40.0	0.0	30.0	0.0	40.0	0.0	50.0	0.0	40.0	0.0	80.0	0.0	40.0	0.0	120.0	0.0	100.0

75	0.0	80.0	0.0	40.0	0.0	30.0	0.0	40.0	0.0	50.0	0.0	40.0	0.0	80.0	0.0	40.0	0.0	120.0	0.0	100.0
100	0.0	80.0	0.0	40.0	0.0	60.0	0.0	40.0	0.0	50.0	0.0	40.0	0.0	80.0	0.0	40.0	0.0	120.0	0.0	100.0
125	0.0	80.0	0.0	40.0	0.0	60.0	0.0	40.0	0.0	50.0	0.0	40.0	0.0	80.0	0.0	40.0	0.0	120.0	0.0	100.0
150	0.0	80.0	0.0	40.0	0.0	60.0	0.0	40.0	2.0	60.0	0.0	40.0	0.0	80.0	0.0	40.0	5.0	140.0	0.0	100.0
200	0.0	80.0	0.0	40.0	5.0	80.0	0.0	40.0	2.0	60.0	0.0	40.0	0.0	80.0	0.0	40.0	5.0	140.0	0.0	100.0
250	1.0	100.0	0.0	40.0	10.0	80.0	0.0	40.0	2.0	60.0	0.0	40.0	2.0	80.0	0.0	40.0	5.0	140.0	0.0	100.0
300	1.0	100.0	0.0	40.0	10.0	80.0	0.0	40.0	2.0	60.0	0.0	40.0	2.0	80.0	0.0	40.0	5.0	140.0	2.0	120.0
400	1.0	100.0	0.0	40.0	10.0	80.0	0.0	40.0	2.0	60.0	0.0	40.0	2.0	80.0	0.0	40.0	5.0	140.0	2.0	120.0
500	1.0	120.0	10.0	40.0	10.0	80.0	10.0	40.0	5.0	80.0	10.0	40.0	2.0	80.0	10.0	40.0	5.0	160.0	2.0	120.0
600	1.0	120.0	10.0	40.0	10.0	80.0	10.0	40.0	5.0	80.0	10.0	40.0	2.0	100.0	10.0	40.0	10.0	160.0	2.0	120.0
700	1.0	120.0	10.0	40.0	10.0	80.0	10.0	40.0	10.0	80.0	10.0	40.0	2.0	100.0	10.0	40.0	10.0	160.0	2.0	120.0
800	1.0	120.0	10.0	40.0	10.0	80.0	10.0	40.0	10.0	80.0	10.0	40.0	2.0	100.0	10.0	40.0	15.0	160.0	5.0	80.0
900	2.0	120.0	10.0	40.0	15.0	120.0	10.0	40.0	15.0	120.0	10.0	40.0	5.0	120.0	10.0	40.0	25.0	160.0	5.0	80.0
1000	2.0	120.0	10.0	40.0	15.0	120.0	10.0	40.0	15.0	120.0	10.0	40.0	5.0	120.0	10.0	40.0	25.0	160.0	5.0	80.0
1100	2.0	120.0	10.0	80.0	20.0	120.0	10.0	80.0	15.0	120.0	10.0	80.0	5.0	120.0	10.0	40.0	25.0	160.0	5.0	80.0
1200	2.0	120.0	10.0	80.0	20.0	120.0	10.0	80.0	15.0	120.0	10.0	80.0	5.0	120.0	10.0	80.0	25.0	160.0	5.0	80.0
1300	5.0	160.0	10.0	80.0	20.0	120.0	10.0	80.0	15.0	120.0	10.0	80.0	10.0	120.0	10.0	80.0	25.0	160.0	5.0	80.0
1400	5.0	160.0	10.0	80.0	25.0	160.0	10.0	80.0	20.0	140.0	10.0	80.0	10.0	120.0	10.0	80.0	25.0	160.0	5.0	80.0
1500	10.0	160.0	10.0	80.0	25.0	160.0	10.0	80.0	20.0	140.0	10.0	80.0	15.0	140.0	10.0	80.0	30.0	160.0	5.0	80.0
1750	10.0	160.0	70.0	120.0	30.0	160.0	70.0	120.0	20.0	140.0	70.0	120.0	15.0	140.0	70.0	120.0	30.0	160.0	5.0	80.0
2000	15.0	160.0	70.0	120.0	30.0	160.0	70.0	120.0	30.0	160.0	70.0	120.0	20.0	160.0	70.0	120.0	30.0	160.0	5.0	80.0
2500	15.0	180.0	100.0	140.0	30.0	160.0	100.0	140.0	30.0	160.0	100.0	140.0	20.0	160.0	100.0	140.0	35.0	160.0	5.0	80.0
3000	15.0	180.0	100.0	140.0	30.0	180.0	100.0	140.0	30.0	160.0	100.0	140.0	20.0	160.0	100.0	140.0	35.0	160.0	5.0	80.0
3500	15.0	180.0	130.0	130.0	30.0	180.0	130.0	130.0	30.0	160.0	130.0	130.0	20.0	160.0	130.0	130.0	35.0	160.0	5.0	80.0
4000	15.0	180.0	130.0	130.0	30.0	180.0	130.0	130.0	30.0	160.0	130.0	130.0	20.0	160.0	130.0	130.0	35.0	160.0	5.0	80.0
4500	15.0	180.0	130.0	130.0	30.0	180.0	130.0	130.0	30.0	160.0	130.0	130.0	20.0	160.0	130.0	130.0	35.0	160.0	5.0	80.0
5000	15.0	180.0	130.0	130.0	30.0	180.0	130.0	130.0	30.0	160.0	130.0	130.0	20.0	160.0	130.0	130.0	35.0	160.0	5.0	80.0
5500+	15.0	180.0	130.0	130.0	30.0	180.0	130.0	130.0	30.0	160.0	130.0	130.0	20.0	160.0	130.0	130.0	35.0	160.0	5.0	80.0

Appendix 2E (cont.):
WOD98 Silicate (µM) Ranges by Basin as a Function of Depth

Depth	Mediterranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
10	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
20	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
30	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
50	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
75	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
100	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
125	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
150	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
200	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
250	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
300	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
400	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
500	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
600	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
700	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
800	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0

900	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
1000	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
1100	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
1200	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
1300	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
1400	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
1500	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
1750	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
2000	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
2500	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
3000	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
3500	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
4000	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
4500	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
5000	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0
5500+	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0	0.0	250.0

WOD98 Nitrite (µM) Ranges by Basin as a Function of Depth

	North		**Coastal**		**Equatorial**		**Coastal**		**South**		**Coastal**		**North**		**Coastal**		**Equatorial**		**Coastal**	
Depth	**Atlantic**		**N. Atlantic**		**Atlantic**		**Eq. Atlantic**		**Atlantic**		**S. Atlantic**		**Pacific**		**N. Pacific**		**Pacific**		**Eq. Pacific**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.00	12.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
10	0.00	12.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
20	0.00	12.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
30	0.00	12.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
50	0.00	12.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
75	0.00	12.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
100	0.00	12.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
125	0.00	10.00	0.00	15.00	0.00	10.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
150	0.00	10.00	0.00	15.00	0.00	10.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
200	0.00	10.00	0.00	15.00	0.00	10.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
250	0.00	10.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
300	0.00	10.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
400	0.00	10.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
500	0.00	10.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
600	0.00	10.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
700	0.00	10.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
800	0.00	8.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
900	0.00	8.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
1000	0.00	8.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
1100	0.00	5.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
1200	0.00	5.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	12.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
1300	0.00	5.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	10.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
1400	0.00	5.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	10.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
1500	0.00	4.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
1750	0.00	4.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	8.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
2000	0.00	4.00	0.00	15.00	0.00	6.00	0.00	15.00	0.00	2.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
2500	0.00	4.00	0.00	15.00	0.00	6.00	0.00	15.00	0.00	2.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
3000	0.00	3.00	0.00	15.00	0.00	6.00	0.00	15.00	0.00	2.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00
3500	0.00	3.00	0.00	15.00	0.00	5.00	0.00	15.00	0.00	2.00	0.00	15.00	0.00	14.00	0.00	15.00	0.00	14.00	0.00	15.00

4000	0.00	2.00	0.00	15.00	0.00	5.00	0.00	15.00	0.00	0.50	0.00	15.00	0.00	14.00	0.00	15.00	0.00	2.00	0.00	15.00
4500	0.00	2.00	0.00	15.00	0.00	2.00	0.00	15.00	0.00	0.50	0.00	15.00	0.00	14.00	0.00	15.00	0.00	2.00	0.00	15.00
5000	0.00	1.50	0.00	15.00	0.00	1.00	0.00	15.00	0.00	0.50	0.00	15.00	0.00	14.00	0.00	15.00	0.00	2.00	0.00	15.00
5500+	0.00	1.50	0.00	15.00	0.00	1.00	0.00	15.00	0.00	0.25	0.00	15.00	0.00	6.00	0.00	15.00	0.00	2.00	0.00	15.00

Appendix 2F (cont.):
WOD98 Nitrite (µM) Ranges by Basin as a Function of Depth

	South		Coastal		North		Coastal		Equatorial		Coastal		South		Coastal		Southern		Arctic	
Depth	**Pacific**		**S. Pacific**		**Indian**		**N. Indian**		**Indian**		**Eq. Indian**		**Indian**		**S. Indian**		**Ocean**		**Ocean**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.00	14.00	0.00	15.00	0.00	14.00	0.00	12.00	0.00	14.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	10.00	0.00	10.00
10	0.00	14.00	0.00	15.00	0.00	14.00	0.00	12.00	0.00	14.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	10.00	0.00	10.00
20	0.00	14.00	0.00	15.00	0.00	14.00	0.00	12.00	0.00	14.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	10.00	0.00	10.00
30	0.00	14.00	0.00	15.00	0.00	14.00	0.00	12.00	0.00	14.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	10.00	0.00	10.00
50	0.00	14.00	0.00	15.00	0.00	14.00	0.00	12.00	0.00	14.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	10.00	0.00	10.00
75	0.00	14.00	0.00	15.00	0.00	14.00	0.00	12.00	0.00	14.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	8.00	0.00	10.00
100	0.00	14.00	0.00	15.00	0.00	14.00	0.00	12.00	0.00	14.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	8.00	0.00	10.00
125	0.00	14.00	0.00	15.00	0.00	14.00	0.00	10.00	0.00	14.00	0.00	10.00	0.00	12.00	0.00	10.00	0.00	8.00	0.00	8.00
150	0.00	14.00	0.00	15.00	0.00	14.00	0.00	10.00	0.00	12.00	0.00	10.00	0.00	12.00	0.00	10.00	0.00	8.00	0.00	8.00
200	0.00	14.00	0.00	15.00	0.00	14.00	0.00	10.00	0.00	12.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	8.00	0.00	8.00
250	0.00	14.00	0.00	15.00	0.00	14.00	0.00	10.00	0.00	12.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	8.00	0.00	8.00
300	0.00	14.00	0.00	15.00	0.00	14.00	0.00	10.00	0.00	12.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	5.00	0.00	8.00
400	0.00	14.00	0.00	15.00	0.00	14.00	0.00	10.00	0.00	12.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	5.00	0.00	8.00
500	0.00	6.00	0.00	15.00	0.00	14.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	4.00	0.00	8.00
600	0.00	6.00	0.00	15.00	0.00	12.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	4.00	0.00	8.00
700	0.00	6.00	0.00	15.00	0.00	12.00	0.00	10.00	0.00	6.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	4.00	0.00	8.00
800	0.00	6.00	0.00	15.00	0.00	12.00	0.00	8.00	0.00	6.00	0.00	8.00	0.00	10.00	0.00	8.00	0.00	4.00	0.00	8.00
900	0.00	6.00	0.00	15.00	0.00	12.00	0.00	8.00	0.00	6.00	0.00	8.00	0.00	10.00	0.00	8.00	0.00	4.00	0.00	8.00
1000	0.00	6.00	0.00	15.00	0.00	12.00	0.00	8.00	0.00	6.00	0.00	8.00	0.00	10.00	0.00	8.00	0.00	4.00	0.00	8.00
1100	0.00	6.00	0.00	15.00	0.00	12.00	0.00	5.00	0.00	6.00	0.00	5.00	0.00	10.00	0.00	5.00	0.00	4.00	0.00	8.00
1200	0.00	6.00	0.00	15.00	0.00	12.00	0.00	5.00	0.00	6.00	0.00	5.00	0.00	10.00	0.00	5.00	0.00	4.00	0.00	8.00
1300	0.00	6.00	0.00	15.00	0.00	12.00	0.00	5.00	0.00	6.00	0.00	5.00	0.00	10.00	0.00	5.00	0.00	4.00	0.00	8.00
1400	0.00	6.00	0.00	15.00	0.00	12.00	0.00	5.00	0.00	6.00	0.00	5.00	0.00	10.00	0.00	5.00	0.00	4.00	0.00	8.00
1500	0.00	6.00	0.00	15.00	0.00	12.00	0.00	4.00	0.00	6.00	0.00	4.00	0.00	10.00	0.00	4.00	0.00	4.00	0.00	8.00
1750	0.00	3.00	0.00	15.00	0.00	12.00	0.00	4.00	0.00	6.00	0.00	4.00	0.00	10.00	0.00	4.00	0.00	4.00	0.00	8.00
2000	0.00	3.00	0.00	15.00	0.00	12.00	0.00	4.00	0.00	6.00	0.00	4.00	0.00	10.00	0.00	4.00	0.00	4.00	0.00	1.00
2500	0.00	3.00	0.00	15.00	0.00	6.00	0.00	4.00	0.00	3.00	0.00	4.00	0.00	10.00	0.00	4.00	0.00	4.00	0.00	1.00
3000	0.00	3.00	0.00	15.00	0.00	6.00	0.00	3.00	0.00	3.00	0.00	3.00	0.00	6.00	0.00	3.00	0.00	3.00	0.00	1.00
3500	0.00	3.00	0.00	15.00	0.00	1.00	0.00	3.00	0.00	3.00	0.00	3.00	0.00	6.00	0.00	3.00	0.00	3.00	0.00	1.00
4000	0.00	3.00	0.00	15.00	0.00	1.00	0.00	2.00	0.00	3.00	0.00	2.00	0.00	6.00	0.00	2.00	0.00	2.00	0.00	1.00
4500	0.00	3.00	0.00	15.00	0.00	1.00	0.00	2.00	0.00	3.00	0.00	2.00	0.00	2.00	0.00	2.00	0.00	2.00	0.00	1.00
5000	0.00	3.00	0.00	15.00	0.00	1.00	0.00	1.50	0.00	3.00	0.00	1.50	0.00	2.00	0.00	1.50	0.00	2.00	0.00	1.00
5500+	0.00	3.00	0.00	15.00	0.00	1.00	0.00	1.50	0.00	3.00	0.00	1.50	0.00	2.00	0.00	1.50	0.00	2.00	0.00	1.00

Appendix 2F (cont.):
WOD98 Nitrite (µM) Ranges by Basin as a Function of Depth

Depth	Mediterranean	Black Sea	Baltic Sea	Persian Gulf	Red Sea	Sulu Sea

(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00
10	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00
20	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00
30	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00
50	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00
75	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00
100	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00	0.00	12.00
125	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00
150	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00
200	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00
250	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00
300	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00
400	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00
500	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00
600	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00
700	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00	0.00	10.00
800	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00
900	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00
1000	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00	8.00
1100	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1200	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1300	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1400	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1500	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00
1750	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00
2000	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00
2500	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00
3000	0.00	3.00	0.00	3.00	0.00	3.00	0.00	3.00	0.00	3.00	0.00	3.00
3500	0.00	3.00	0.00	3.00	0.00	3.00	0.00	3.00	0.00	3.00	0.00	3.00
4000	0.00	2.00	0.00	2.00	0.00	2.00	0.00	2.00	0.00	2.00	0.00	2.00
4500	0.00	2.00	0.00	2.00	0.00	2.00	0.00	2.00	0.00	2.00	0.00	2.00
5000	0.00	1.50	0.00	1.50	0.00	1.50	0.00	1.50	0.00	1.50	0.00	1.50
5500+	0.00	1.50	0.00	1.50	0.00	1.50	0.00	1.50	0.00	1.50	0.00	1.50

WOD98 Nitrate (µM) Ranges by Basin as a Function of Depth

	North		Coastal		Equatorial		Coastal		South		Coastal		North		Coastal		Equatorial		Coastal	
Depth	Atlantic		N. Atlantic		Atlantic		Eq. Atlantic		Atlantic		S. Atlantic		Pacific		N. Pacific		Pacific		Eq. Pacific	
(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	0.00	18.00	0.00	500.00	0.00	18.00	0.00	30.00	0.00	22.00	0.00	60.00	0.00	26.00	0.00	50.00	0.00	22.00	0.00	100.0
10	0.00	18.00	0.00	500.00	0.00	18.00	0.00	30.00	0.00	26.00	0.00	60.00	0.00	26.00	0.00	50.00	0.00	22.00	0.00	100.0
20	0.00	18.00	0.00	500.00	0.00	18.00	0.00	30.00	0.00	26.00	0.00	60.00	0.00	26.00	0.00	50.00	0.00	22.00	0.00	100.0
30	0.00	18.00	0.00	500.00	0.00	18.00	0.00	30.00	0.00	30.00	0.00	60.00	0.00	30.00	0.00	50.00	0.00	26.00	0.00	100.0
50	0.00	26.00	0.00	500.00	0.00	26.00	0.00	30.00	0.00	30.00	0.00	60.00	0.00	30.00	0.00	50.00	0.00	34.00	0.00	100.0
75	0.00	30.00	0.00	500.00	0.00	30.00	0.00	30.00	0.00	34.00	0.00	60.00	0.00	34.00	0.00	50.00	0.00	34.00	0.00	100.0
100	0.00	30.00	0.00	500.00	0.00	30.00	0.00	30.00	0.00	34.00	0.00	60.00	0.00	34.00	0.00	50.00	0.00	34.00	0.00	100.0
125	0.00	30.00	0.00	500.00	0.00	30.00	0.00	40.00	0.00	34.00	0.00	60.00	0.00	42.00	0.00	50.00	0.00	34.00	0.00	100.0
150	0.00	30.00	0.00	500.00	0.00	30.00	0.00	40.00	0.00	34.00	0.00	60.00	0.00	42.00	0.00	50.00	0.00	38.00	0.00	100.0
200	0.00	30.00	0.00	500.00	0.00	30.00	0.00	40.00	0.00	38.00	0.00	60.00	0.00	46.00	0.00	50.00	0.00	38.00	0.00	100.0

250	0.00	34.00	0.00	500.00	0.00	34.00	0.00	45.00	0.00	38.00	0.00	60.00	0.00	46.00	0.00	75.00	0.00	42.00	0.00	100.0
300	0.00	34.00	0.00	500.00	0.00	34.00	0.00	45.00	0.00	38.00	0.00	60.00	0.00	46.00	0.00	75.00	0.00	42.00	0.00	100.0
400	0.00	42.00	0.00	500.00	0.00	42.00	0.00	45.00	2.00	42.00	0.00	60.00	2.00	46.00	0.00	75.00	2.00	42.00	0.00	100.0
500	0.00	42.00	0.00	500.00	0.00	42.00	0.00	45.00	2.00	46.00	0.00	60.00	2.00	46.00	0.00	75.00	2.00	46.00	0.00	100.0
600	0.00	42.00	0.00	500.00	0.00	42.00	0.00	45.00	2.00	46.00	0.00	60.00	2.00	50.00	0.00	75.00	2.00	46.00	0.00	100.0
700	6.00	46.00	0.00	500.00	0.00	46.00	0.00	45.00	2.00	46.00	0.00	60.00	2.00	50.00	0.00	75.00	2.00	50.00	0.00	75.0
800	6.00	46.00	0.00	500.00	0.00	46.00	0.00	45.00	2.00	46.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	56.00	0.00	75.0
900	6.00	46.00	0.00	500.00	0.00	46.00	0.00	45.00	2.00	46.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	56.00	0.00	75.0
1000	6.00	46.00	0.00	500.00	0.00	46.00	0.00	40.00	2.00	46.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	56.00	0.00	75.0
1100	6.00	46.00	0.00	500.00	0.00	46.00	0.00	40.00	2.00	46.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	56.00	0.00	75.0
1200	6.00	48.00	0.00	500.00	0.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	56.00	0.00	75.0
1300	6.00	48.00	0.00	500.00	0.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	50.00	0.00	75.0
1400	6.00	48.00	0.00	500.00	6.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	50.00	0.00	75.0
1500	6.00	48.00	0.00	500.00	6.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	50.00	0.00	75.0
1750	6.00	48.00	0.00	500.00	6.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	50.00	0.00	75.0
2000	6.00	48.00	0.00	500.00	6.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	50.00	0.00	75.0
2500	6.00	48.00	0.00	500.00	6.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	54.00	0.00	75.00	2.00	50.00	0.00	75.0
3000	6.00	48.00	0.00	500.00	6.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	50.00	0.00	75.00	2.00	46.00	0.00	75.0
3500	10.00	48.00	0.00	500.00	10.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	46.00	0.00	75.00	2.00	46.00	0.00	75.0
4000	10.00	48.00	0.00	500.00	10.00	48.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	46.00	0.00	75.00	2.00	46.00	0.00	75.0
4500	10.00	46.00	0.00	500.00	10.00	46.00	0.00	40.00	6.00	42.00	0.00	60.00	2.00	42.00	0.00	75.00	2.00	46.00	0.00	75.0
5000	10.00	44.00	0.00	500.00	10.00	44.00	0.00	40.00	10.00	42.00	0.00	60.00	10.00	42.00	0.00	75.00	2.00	46.00	0.00	75.0
5500+	14.00	42.00	0.00	500.00	14.00	42.00	0.00	40.00	14.00	34.00	0.00	60.00	14.00	42.00	0.00	75.00	2.00	46.00	0.00	75.0

Appendix 2G (cont.):
WOD98 Nitrate (µM) Ranges by Basin as a Function of Depth

	South		**Coastal**		**North**		**Coastal**		**Equatorial**		**Coastal**		**South**		**Coastal**		**Southern**		**Arctic**	
Depth	**Pacific**		**S. Pacific**		**Indian**		**N. Indian**		**Indian**		**Eq. Indian**		**Indian**		**S. Indian**		**Ocean**		**Ocean**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.00	18.00	0.00	40.00	0.00	14.00	0.00	30.00	0.00	4.00	0.00	35.00	0.00	18.00	0.00	50.00	0.00	46.00	0.00	18.00
10	0.00	18.00	0.00	40.00	0.00	18.00	0.00	30.00	0.00	6.00	0.00	35.00	0.00	18.00	0.00	50.00	0.00	46.00	0.00	18.00
20	0.00	18.00	0.00	40.00	0.00	18.00	0.00	30.00	0.00	6.00	0.00	35.00	0.00	18.00	0.00	50.00	0.00	46.00	0.00	18.00
30	0.00	22.00	0.00	40.00	0.00	18.00	0.00	30.00	0.00	14.00	0.00	35.00	0.00	18.00	0.00	50.00	0.00	46.00	0.00	18.00
50	0.00	26.00	0.00	40.00	0.00	30.00	0.00	30.00	0.00	18.00	0.00	35.00	0.00	18.00	0.00	50.00	0.00	46.00	0.00	18.00
75	0.00	30.00	0.00	40.00	0.00	30.00	0.00	40.00	0.00	26.00	0.00	35.00	0.00	22.00	0.00	50.00	0.00	46.00	0.00	18.00
100	0.00	30.00	0.00	40.00	0.00	30.00	0.00	40.00	0.00	30.00	0.00	45.00	0.00	22.00	0.00	50.00	0.00	46.00	0.00	22.00
125	0.00	30.00	0.00	40.00	0.00	42.00	0.00	40.00	0.00	34.00	0.00	45.00	0.00	26.00	0.00	50.00	0.00	46.00	0.00	22.00
150	0.00	30.00	0.00	40.00	0.00	42.00	0.00	40.00	0.00	34.00	0.00	45.00	0.00	30.00	0.00	50.00	0.00	46.00	0.00	22.00
200	0.00	38.00	0.00	40.00	0.00	42.00	0.00	40.00	0.00	38.00	0.00	45.00	0.00	30.00	0.00	50.00	0.00	46.00	0.00	26.00
250	0.00	38.00	0.00	40.00	2.00	42.00	0.00	40.00	2.00	38.00	0.00	50.00	0.00	30.00	0.00	50.00	0.00	46.00	0.00	26.00
300	0.00	38.00	0.00	60.00	2.00	50.00	0.00	40.00	2.00	46.00	0.00	50.00	0.00	30.00	0.00	50.00	0.00	46.00	0.00	26.00
400	4.00	42.00	0.00	60.00	2.00	50.00	0.00	40.00	2.00	46.00	0.00	50.00	0.00	34.00	0.00	50.00	4.00	46.00	0.00	28.00
500	6.00	46.00	0.00	60.00	2.00	50.00	0.00	40.00	2.00	46.00	0.00	50.00	0.00	34.00	0.00	50.00	6.00	46.00	0.00	28.00
600	6.00	50.00	0.00	60.00	2.00	50.00	0.00	40.00	2.00	46.00	0.00	50.00	0.00	38.00	0.00	50.00	6.00	46.00	0.00	32.00
700	6.00	50.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	6.00	46.00	0.00	32.00
800	10.00	50.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	46.00	0.00	42.00
900	10.00	50.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	46.00	0.00	42.00
1000	10.00	50.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	50.00	0.00	46.00
1100	10.00	50.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	50.00	0.00	46.00
1200	10.00	54.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	50.00	0.00	46.00

1300	10.00	54.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	50.00	0.00	50.00
1400	10.00	54.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	0.00	46.00	0.00	50.00	14.00	50.00	0.00	50.00
1500	10.00	54.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	50.00	0.00	50.00
1750	10.00	54.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	50.00	0.00	50.00
2000	10.00	54.00	0.00	60.00	2.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	50.00	0.00	54.00
2500	10.00	54.00	0.00	60.00	4.00	54.00	0.00	40.00	2.00	54.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	50.00	0.00	54.00
3000	10.00	54.00	0.00	60.00	4.00	54.00	0.00	40.00	2.00	46.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	50.00	0.00	54.00
3500	10.00	54.00	0.00	60.00	2.00	46.00	0.00	40.00	2.00	46.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	46.00	2.00	54.00
4000	10.00	54.00	0.00	60.00	4.00	46.00	0.00	40.00	2.00	46.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	46.00	2.00	46.00
4500	10.00	42.00	0.00	60.00	4.00	46.00	0.00	40.00	2.00	46.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	42.00	2.00	46.00
5000	10.00	38.00	0.00	60.00	4.00	46.00	0.00	40.00	2.00	46.00	0.00	50.00	2.00	46.00	0.00	50.00	14.00	42.00	2.00	46.00
5500+	14.00	38.00	0.00	60.00	10.00	46.00	0.00	40.00	2.00	46.00	0.00	50.00	10.00	46.00	0.00	50.00	18.00	42.00	2.00	46.00

Appendix 2G (cont.):
WOD98 Nitrate (µM) Ranges by Basin as a Function of Depth

Depth	**Mediterranean**		**Black Sea**		**Baltic Sea**		**Persian Gulf**		**Red Sea**		**Sulu Sea**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00
10	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00
20	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00
30	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00
50	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00
75	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00	0.00	18.00
100	0.00	22.00	0.00	22.00	0.00	22.00	0.00	22.00	0.00	22.00	0.00	22.00
125	0.00	22.00	0.00	22.00	0.00	22.00	0.00	22.00	0.00	22.00	0.00	22.00
150	0.00	22.00	0.00	22.00	0.00	22.00	0.00	22.00	0.00	22.00	0.00	22.00
200	0.00	26.00	0.00	26.00	0.00	26.00	0.00	26.00	0.00	26.00	0.00	26.00
250	0.00	26.00	0.00	26.00	0.00	26.00	0.00	26.00	0.00	26.00	0.00	26.00
300	0.00	26.00	0.00	26.00	0.00	26.00	0.00	26.00	0.00	26.00	0.00	26.00
400	0.00	28.00	0.00	28.00	0.00	28.00	0.00	28.00	0.00	28.00	0.00	28.00
500	0.00	28.00	0.00	28.00	0.00	28.00	0.00	28.00	0.00	28.00	0.00	28.00
600	0.00	32.00	0.00	32.00	0.00	32.00	0.00	32.00	0.00	32.00	0.00	32.00
700	0.00	32.00	0.00	32.00	0.00	32.00	0.00	32.00	0.00	32.00	0.00	32.00
800	0.00	42.00	0.00	42.00	0.00	42.00	0.00	42.00	0.00	42.00	0.00	42.00
900	0.00	42.00	0.00	42.00	0.00	42.00	0.00	42.00	0.00	42.00	0.00	42.00
1000	0.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00
1100	0.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00
1200	0.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00
1300	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00
1400	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00
1500	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00
1750	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00
2000	0.00	54.00	0.00	54.00	0.00	54.00	0.00	54.00	0.00	54.00	0.00	54.00
2500	0.00	54.00	0.00	54.00	0.00	54.00	0.00	54.00	0.00	54.00	0.00	54.00
3000	0.00	54.00	0.00	54.00	0.00	54.00	0.00	54.00	0.00	54.00	0.00	54.00
3500	2.00	54.00	2.00	54.00	2.00	54.00	0.00	54.00	0.00	54.00	0.00	54.00
4000	2.00	46.00	2.00	46.00	2.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00
4500	2.00	46.00	2.00	46.00	2.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00
5000	2.00	46.00	2.00	46.00	2.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00
5500+	2.00	46.00	2.00	46.00	2.00	46.00	0.00	46.00	0.00	46.00	0.00	46.00

WOD98 pH (unitless) Ranges by Basin as a Function of Depth

	North		Coastal		Equatorial		Coastal		South		Coastal		North		Coastal		Equatorial		Coastal	
Depth	Atlantic		N. Atlantic		Atlantic		Eq. Atlantic		Atlantic		S. Atlantic		Pacific		N. Pacific		Pacific		Eq. Pacific	
(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	7.30	8.70	6.30	9.20	7.10	8.80	6.20	8.70	6.90	8.80	7.10	8.80	6.30	9.00	7.00	8.90	7.00	8.70	6.00	8.80
10	7.30	8.70	6.60	9.00	7.10	8.80	6.20	8.70	7.00	8.80	7.10	8.80	7.10	9.00	7.00	8.80	7.00	8.70	6.00	8.90
20	7.30	8.70	6.80	9.00	7.10	8.80	6.60	8.70	7.10	8.80	7.10	8.80	7.10	9.00	7.00	8.80	7.00	8.70	6.00	9.00
30	7.30	8.70	6.80	9.00	7.10	8.80	6.60	8.70	7.10	8.80	7.10	8.80	7.10	9.00	7.00	8.80	7.00	8.70	6.00	9.00
50	7.30	8.70	6.80	9.00	7.10	8.80	7.20	8.70	7.10	8.80	7.10	8.80	7.10	9.00	7.00	8.80	7.00	8.70	6.00	9.00
75	7.30	8.70	7.00	9.00	7.10	8.80	7.40	8.70	7.10	8.80	7.10	8.80	7.10	9.00	7.00	8.80	7.00	8.70	6.00	9.00
100	7.30	8.70	7.00	8.80	7.10	8.80	7.40	8.70	7.10	8.80	7.10	8.80	7.10	9.00	7.00	8.80	7.00	8.60	6.00	9.00
125	7.30	8.70	7.00	8.80	7.10	8.80	7.40	8.70	7.10	8.80	7.10	8.80	7.10	9.00	7.00	8.80	7.00	8.60	7.00	8.70
150	7.30	8.70	7.00	8.80	7.10	8.80	7.40	8.70	7.10	8.80	7.20	8.80	7.10	9.00	7.00	8.60	7.00	8.50	7.00	8.70
200	7.30	8.70	7.00	8.80	7.10	8.80	7.50	8.70	7.10	8.60	7.30	8.80	7.10	8.90	7.00	8.60	7.00	8.50	7.00	8.70
250	7.30	8.70	7.00	8.80	7.10	8.80	7.50	8.70	7.10	8.60	7.40	8.80	7.10	8.90	7.00	8.50	7.00	8.40	7.00	8.70
300	7.30	8.70	7.00	8.80	7.10	8.80	7.50	8.70	7.10	8.60	7.40	8.80	7.10	8.90	7.00	8.50	7.00	8.40	7.00	8.70
400	7.30	8.70	7.10	8.80	7.10	8.80	7.50	8.70	7.10	8.60	7.40	8.80	7.10	8.90	7.00	8.50	7.00	8.40	7.00	8.50
500	7.30	8.70	7.10	8.80	7.10	8.80	7.50	8.70	7.10	8.60	7.40	8.60	7.10	8.90	7.00	8.50	7.00	8.40	7.00	8.50
600	7.30	8.70	7.10	8.80	7.10	8.80	7.50	8.70	7.10	8.60	7.40	8.60	7.10	8.90	7.00	8.50	7.00	8.30	7.00	8.50
700	7.30	8.70	7.20	8.80	7.10	8.80	7.50	8.70	7.10	8.60	7.40	8.60	7.10	8.90	7.00	8.50	7.00	8.30	7.00	8.40
800	7.30	8.70	7.20	8.80	7.10	8.80	7.60	8.70	7.10	8.60	7.40	8.60	7.10	8.90	7.10	8.50	7.00	8.30	7.00	8.40
900	7.30	8.70	7.20	8.80	7.10	8.80	7.60	8.70	7.10	8.60	7.40	8.50	7.10	8.90	7.20	8.50	7.00	8.30	7.00	8.40
1000	7.30	8.70	7.20	8.60	7.10	8.80	7.60	8.70	7.10	8.60	7.50	8.50	7.10	8.90	7.20	8.50	7.20	8.30	7.00	8.40
1100	7.30	8.70	7.20	8.60	7.20	8.80	7.60	8.70	7.10	8.60	7.50	8.40	7.10	8.90	7.20	8.40	7.20	8.30	7.10	8.40
1200	7.30	8.70	7.20	8.50	7.20	8.80	7.60	8.70	7.10	8.60	7.50	8.40	7.10	8.90	7.20	8.40	7.20	8.30	7.10	8.30
1300	7.30	8.70	7.70	8.50	7.20	8.80	7.60	8.70	7.10	8.50	7.50	8.40	7.10	8.90	7.20	8.20	7.20	8.30	7.10	8.30
1400	7.30	8.70	7.70	8.50	7.20	8.80	7.60	8.70	7.10	8.50	7.50	8.40	7.10	8.90	7.20	8.20	7.40	8.30	7.20	8.30
1500	7.30	8.70	7.70	8.50	7.20	8.80	7.60	8.70	7.10	8.50	7.50	8.40	7.10	8.90	7.20	8.20	7.40	8.30	7.20	8.30
1750	7.30	8.70	7.70	8.50	7.20	8.80	7.60	8.70	7.10	8.50	7.50	8.40	7.30	8.60	7.20	8.20	7.40	8.30	7.30	8.30
2000	7.30	8.70	7.70	8.50	7.20	8.80	7.60	8.70	7.40	8.50	7.50	8.40	7.30	8.60	7.40	8.20	7.40	8.30	7.40	8.30
2500	7.30	8.70	7.80	8.50	7.30	8.80	7.60	8.70	7.40	8.50	7.50	8.40	7.30	8.60	7.40	8.20	7.40	8.30	7.40	8.30
3000	7.40	8.70	7.80	8.40	7.60	8.80	7.60	8.70	7.40	8.50	7.50	8.40	7.30	8.60	7.40	8.20	7.40	8.30	7.40	8.30
3500	7.40	8.60	7.80	8.30	7.60	8.80	7.60	8.70	7.40	8.50	7.50	8.40	7.30	8.60	7.40	8.20	7.40	8.30	7.40	8.30
4000	7.50	8.50	7.80	8.30	7.60	8.50	7.60	8.70	7.40	8.50	7.50	8.40	7.30	8.60	7.40	8.20	7.40	8.30	7.40	8.30
4500	7.60	8.40	7.80	8.30	7.60	8.50	7.60	8.70	7.40	8.50	7.50	8.40	7.40	8.60	7.40	8.20	7.40	8.30	7.40	8.30
5000	7.60	8.40	7.80	8.30	7.60	8.50	7.60	8.70	7.40	8.50	7.50	8.40	7.50	8.60	7.40	8.20	7.40	8.30	7.40	8.30
5500+	7.60	8.40	7.80	8.30	7.60	8.50	7.60	8.70	7.40	8.50	7.50	8.40	7.50	8.60	7.40	8.20	7.40	8.30	7.40	8.30

Appendix 2H (cont.):
WOD98 pH (unitless) Ranges by Basin as a Function of Depth

	South		Coastal		North		Coastal		Equatorial		Coastal		South		Coastal		Southern		Arctic	
Depth	Pacific		S. Pacific		Indian		N. Indian		Indian		Eq. Indian		Indian		S. Indian		Ocean		Ocean	
(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	7.40	8.90	7.30	9.00	7.10	8.80	7.10	8.80	7.10	9.00	7.20	8.90	7.10	8.70	7.30	8.50	7.00	8.60	6.70	8.70
10	7.40	8.90	7.30	9.00	7.10	8.70	7.10	8.80	7.10	8.90	7.20	8.90	7.10	8.70	7.30	8.50	7.00	8.60	6.70	8.70
20	7.40	9.00	7.30	9.00	7.10	8.70	7.10	8.80	7.10	8.90	7.20	8.80	7.10	8.70	7.30	8.50	7.00	8.60	6.70	8.70

30	7.40	9.00	7.30	9.00	7.10	8.70	7.10	8.80	7.10	8.90	7.20	8.60	7.10	8.70	7.30	8.50	7.00	8.60	7.10	8.70
50	7.40	9.00	7.30	9.00	7.10	8.70	7.10	8.70	7.10	8.90	7.20	8.60	7.10	8.70	7.40	8.50	7.00	8.60	7.10	8.70
75	7.40	9.00	7.30	8.90	7.10	8.70	7.10	8.70	7.10	8.90	7.20	8.50	7.10	8.70	7.40	8.50	7.00	8.50	7.50	8.70
100	7.40	9.00	7.30	8.90	7.10	8.70	7.10	8.60	7.10	8.90	7.20	8.50	7.10	8.70	7.40	8.50	7.00	8.50	7.50	8.70
125	7.40	9.00	7.30	8.90	7.10	8.50	7.10	8.40	7.10	8.90	7.20	8.40	7.10	8.70	7.40	8.50	7.00	8.50	7.50	8.50
150	7.40	9.00	7.30	8.90	7.10	8.50	7.10	8.40	7.10	8.90	7.20	8.30	7.10	8.60	7.40	8.50	7.00	8.50	7.50	8.50
200	7.40	8.90	7.30	8.70	7.10	8.50	7.10	8.40	7.10	8.90	7.20	8.30	7.10	8.60	7.40	8.50	7.00	8.50	7.50	8.50
250	7.40	8.80	7.30	8.70	7.10	8.50	7.10	8.40	7.10	8.90	7.20	8.30	7.10	8.60	7.40	8.50	7.00	8.50	7.50	8.50
300	7.40	8.80	7.30	8.70	7.10	8.50	7.10	8.40	7.10	8.50	7.20	8.30	7.10	8.60	7.40	8.50	7.00	8.50	7.50	8.50
400	7.40	8.80	7.30	8.70	7.10	8.50	7.10	8.40	7.10	8.50	7.20	8.30	7.10	8.60	7.40	8.50	7.00	8.50	7.50	8.50
500	7.40	8.80	7.40	8.60	7.10	8.50	7.10	8.30	7.10	8.50	7.40	8.30	7.20	8.60	7.60	8.40	7.20	8.50	7.50	8.50
600	7.50	8.80	7.50	8.60	7.10	8.40	7.10	8.30	7.10	8.50	7.40	8.30	7.20	8.50	7.60	8.40	7.20	8.50	7.50	8.50
700	7.50	8.80	7.50	8.50	7.10	8.40	7.10	8.30	7.10	8.50	7.40	8.30	7.20	8.50	7.60	8.40	7.30	8.50	7.50	8.50
800	7.50	8.80	7.50	8.50	7.10	8.40	7.10	8.30	7.10	8.50	7.40	8.30	7.20	8.50	7.60	8.30	7.30	8.50	7.50	8.50
900	7.50	8.80	7.50	8.50	7.10	8.40	7.30	8.30	7.30	8.50	7.50	8.30	7.20	8.50	7.60	8.30	7.30	8.50	7.50	8.40
1000	7.50	8.80	7.50	8.40	7.10	8.40	7.30	8.30	7.30	8.50	7.50	8.30	7.20	8.40	7.60	8.30	7.30	8.50	7.50	8.40
1100	7.50	8.80	7.50	8.40	7.10	8.40	7.30	8.30	7.30	8.50	7.50	8.30	7.20	8.40	7.60	8.30	7.30	8.50	7.50	8.40
1200	7.50	8.80	7.50	8.30	7.10	8.40	7.40	8.30	7.30	8.50	7.50	8.30	7.20	8.40	7.60	8.30	7.30	8.50	7.50	8.40
1300	7.50	8.80	7.50	8.30	7.10	8.40	7.40	8.30	7.30	8.50	7.60	8.30	7.20	8.40	7.60	8.30	7.40	8.50	7.50	8.40
1400	7.50	8.80	7.50	8.30	7.10	8.40	7.40	8.30	7.30	8.50	7.60	8.30	7.20	8.40	7.60	8.30	7.40	8.50	7.50	8.40
1500	7.50	8.80	7.60	8.30	7.10	8.40	7.40	8.30	7.30	8.50	7.60	8.30	7.20	8.40	7.60	8.30	7.40	8.50	7.50	8.40
1750	7.50	8.50	7.60	8.30	7.10	8.30	7.40	8.30	7.50	8.30	7.60	8.30	7.20	8.40	7.60	8.30	7.50	8.50	7.50	8.40
2000	7.50	8.50	7.60	8.30	7.10	8.30	7.40	8.30	7.50	8.30	7.60	8.30	7.20	8.40	7.60	8.30	7.50	8.50	7.50	8.40
2500	7.60	8.50	7.60	8.30	7.60	8.30	7.60	8.30	7.50	8.30	7.60	8.30	7.60	8.40	7.60	8.30	7.60	8.50	7.60	8.40
3000	7.60	8.50	7.60	8.30	7.60	8.30	7.60	8.30	7.50	8.30	7.60	8.30	7.60	8.40	7.60	8.30	7.60	8.50	7.60	8.40
3500	7.60	8.50	7.60	8.30	7.60	8.30	7.60	8.30	7.50	8.30	7.60	8.30	7.60	8.40	7.60	8.30	7.60	8.50	7.60	8.40
4000	7.60	8.50	7.60	8.30	7.60	8.30	7.60	8.30	7.50	8.30	7.60	8.30	7.60	8.40	7.60	8.30	7.60	8.40	7.60	8.30
4500	7.60	8.50	7.60	8.30	7.60	8.30	7.60	8.30	7.50	8.30	7.60	8.30	7.60	8.40	7.60	8.30	7.60	8.40	7.60	8.30
5000	7.60	8.50	7.60	8.30	7.60	8.30	7.60	8.30	7.50	8.30	7.60	8.30	7.60	8.40	7.60	8.30	7.60	8.40	7.60	8.30
5500+	7.60	8.50	7.60	8.30	7.60	8.30	7.60	8.30	7.50	8.30	7.60	8.30	7.60	8.40	7.60	8.30	7.60	8.30	7.60	8.30

Appendix 2H (cont.):
WOD98 pH (unitless) Ranges by Basin as a Function of Depth

Depth	**Mediteranean**		**Black Sea**		**Baltic Sea**		**Persian Gulf**		**Red Sea**		**Sulu Sea**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	7.40	8.70	7.00	9.00	6.70	9.20	6.00	9.30	7.40	8.50	7.60	8.40
10	7.40	8.70	7.00	8.90	6.70	9.20	6.00	9.30	7.40	8.50	7.60	8.40
20	7.40	8.70	7.00	8.90	6.70	9.20	6.00	9.30	7.40	8.50	7.60	8.40
30	7.40	8.70	7.10	8.90	6.70	9.20	6.00	9.30	7.40	8.50	7.60	8.40
50	7.40	8.70	7.10	8.80	6.70	9.20	6.00	9.30	7.40	8.50	7.60	8.40
75	7.40	8.70	7.10	8.50	6.70	9.00	6.00	9.30	7.40	8.50	7.60	8.40
100	7.40	8.70	7.10	8.50	6.70	8.60	6.00	9.30	7.40	8.50	7.60	8.40
125	7.40	8.60	7.10	8.40	6.70	8.60	6.00	8.60	7.40	8.50	7.60	8.40
150	7.40	8.60	7.10	8.40	6.70	8.60	6.00	8.60	7.40	8.40	7.60	8.40
200	7.40	8.60	7.10	8.30	6.70	8.40	6.00	8.60	7.40	8.40	7.60	8.40
250	7.40	8.60	7.20	8.30	6.70	8.40	6.70	8.20	7.40	8.40	7.60	8.40
300	7.40	8.60	7.20	8.30	6.70	8.40	6.70	8.20	7.40	8.40	7.60	8.40
400	7.40	8.60	7.20	8.30	6.70	8.40	6.70	8.20	7.40	8.40	7.60	8.40
500	7.40	8.60	7.20	8.30	7.50	8.40	6.70	8.20	7.40	8.40	7.60	8.40
600	7.40	8.60	7.20	8.30	7.50	8.40	7.50	8.40	7.40	8.40	7.60	8.40

700	7.40	8.50	7.20	8.30	7.50	8.40	7.50	8.40	7.40	8.40	7.60	8.40
800	7.40	8.50	7.20	8.30	7.50	8.40	7.50	8.40	7.40	8.40	7.60	8.40
900	7.40	8.50	7.20	8.30	7.50	8.40	7.50	8.40	7.40	8.40	7.60	8.40
1000	7.40	8.50	7.20	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
1100	7.40	8.50	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
1200	7.40	8.50	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
1300	7.40	8.50	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
1400	7.40	8.50	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
1500	7.40	8.50	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
1750	7.40	8.40	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.40
2000	7.40	8.40	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.60	8.20
2500	7.40	8.40	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20
3000	7.40	8.30	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20
3500	7.40	8.30	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20
4000	7.40	8.30	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20
4500	7.40	8.30	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20
5000	7.40	8.30	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20
5500+	7.40	8.30	7.40	8.30	7.50	8.40	7.50	8.40	7.60	8.40	7.70	8.20

WOD98 Chlorophyll (µg/l) Ranges by Basin as a Function of Depth

	North		**Coastal**		**Equatorial**		**Coastal**		**South**		**Coastal**		**North**		**Coastal**		**Equatorial**		**Coastal**	
Depth	**Atlantic**		**N. Atlantic**		**Atlantic**		**Eq. Atlantic**		**Atlantic**		**S. Atlantic**		**Pacific**		**N. Pacific**		**Pacific**		**Eq. Pacific**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.00	3.00	0.00	30.00	0.00	1.50	0.00	2.00	0.00	1.00	0.00	50.00	0.00	1.50	0.00	50.00	0.00	1.00	0.00	20.00
10	0.00	3.00	0.00	30.00	0.00	1.00	0.00	2.00	0.00	1.00	0.00	50.00	0.00	1.50	0.00	50.00	0.00	1.00	0.00	20.00
20	0.00	3.00	0.00	20.00	0.00	1.00	0.00	2.00	0.00	1.00	0.00	50.00	0.00	1.50	0.00	50.00	0.00	1.00	0.00	20.00
30	0.00	2.50	0.00	15.00	0.00	1.00	0.00	2.00	0.00	0.80	0.00	50.00	0.00	1.50	0.00	50.00	0.00	1.00	0.00	20.00
50	0.00	2.00	0.00	10.00	0.00	1.00	0.00	2.00	0.00	0.80	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.75	0.00	20.00
75	0.00	1.50	0.00	10.00	0.00	0.80	0.00	2.00	0.00	0.50	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.60	0.00	5.00
100	0.00	1.00	0.00	10.00	0.00	0.60	0.00	2.00	0.00	0.50	0.00	50.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	5.00
125	0.00	0.50	0.00	10.00	0.00	0.40	0.00	2.00	0.00	0.50	0.00	50.00	0.00	0.75	0.00	50.00	0.00	0.40	0.00	5.00
150	0.00	0.50	0.00	10.00	0.00	0.20	0.00	2.00	0.00	0.40	0.00	50.00	0.00	0.75	0.00	50.00	0.00	0.40	0.00	5.00
200	0.00	0.50	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.50	0.00	50.00	0.00	0.40	0.00	5.00
250	0.00	0.50	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.50	0.00	50.00	0.00	0.10	0.00	3.00
300	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.10	0.00	3.00
400	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.10	0.00	3.00
500	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.05	0.00	3.00
600	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.05	0.00	3.00
700	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.05	0.00	3.00
800	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	3.00
900	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	3.00
1000	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	3.00
1100	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	3.00
1200	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	3.00
1300	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	3.00
1400	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	3.00
1500	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	3.00
1750	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	3.00
2000	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	3.00
2500	0.00	0.40	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	3.00

3000	0.00	0.30	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	3.00
3500	0.00	0.30	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	3.00
4000	0.00	0.30	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	3.00
4500	0.00	0.05	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	3.00
5000	0.00	0.05	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	3.00
5500+	0.00	0.05	0.00	10.00	0.00	0.05	0.00	2.00	0.00	0.10	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.05	0.00	3.00

Appendix 2I (cont.):
WOD98 Chlorophyll (µg/l) Ranges by Basin as a Function of Depth

	South		Coastal		North		Coastal		Equatorial		Coastal		South		Coastal		Southern		Arctic	
Depth	**Pacific**		**S. Pacific**		**Indian**		**N. Indian**		**Indian**		**Eq. Indian**		**Indian**		**S. Indian**		**Ocean**		**Ocean**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	0.00	0.80	0.00	50.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00	0.00	4.50	0.00	8.00
10	0.00	0.50	0.00	50.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00	0.00	4.50	0.00	8.00
20	0.00	0.50	0.00	50.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00	0.00	4.50	0.00	10.00
30	0.00	0.50	0.00	50.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00	0.00	4.50	0.00	12.00
50	0.00	0.50	0.00	50.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00	0.00	4.50	0.00	12.00
75	0.00	0.50	0.00	50.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	50.00	0.00	0.50	0.00	50.00	0.00	0.00	0.00	5.00
100	0.00	0.50	0.00	50.00	0.00	0.50	0.00	0.50	0.00	0.75	0.00	50.00	0.00	0.50	0.00	50.00	0.00	0.50	0.00	4.00
125	0.00	0.40	0.00	50.00	0.00	0.50	0.00	0.50	0.00	0.50	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.50	0.00	4.00
150	0.00	0.30	0.00	50.00	0.00	0.40	0.00	0.40	0.00	0.30	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.50	0.00	4.00
200	0.00	0.20	0.00	50.00	0.00	0.40	0.00	0.40	0.00	0.20	0.00	50.00	0.00	0.40	0.00	50.00	0.00	0.50	0.00	4.00
250	0.00	0.10	0.00	50.00	0.00	0.40	0.00	0.40	0.00	0.10	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.50	0.00	4.00
300	0.00	0.10	0.00	50.00	0.00	0.40	0.00	0.40	0.00	0.05	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.50	0.00	4.00
400	0.00	0.10	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.50	0.00	4.00
500	0.00	0.10	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.20	0.00	50.00	0.00	0.50	0.00	4.00
600	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
700	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
800	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
900	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1000	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1100	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1200	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1300	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1400	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1500	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
1750	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
2000	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
2500	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
3000	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
3500	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
4000	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
4500	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
5000	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00
5500+	0.00	0.05	0.00	50.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	50.00	0.00	0.05	0.00	50.00	0.00	0.50	0.00	4.00

Appendix 2I (cont.):
WOD98 Chlorophyll (µg/l) Ranges by Basin as a Function of Depth

Depth	Mediteranean		Black Sea		Baltic Sea		Persian Gulf		Red Sea		Sulu Sea	
(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
10	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
20	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
30	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
50	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
75	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
100	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
125	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
150	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
200	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
250	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
300	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
400	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
600	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
700	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
800	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
900	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1100	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1200	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1300	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1400	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
1750	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
2000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
2500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
3000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
3500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
4000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
4500	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
5000	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00
5500+	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00	0.00	5.00

WOD98 Alkalinity (meq/l) Ranges by Basin as a Function of Depth

	North		Coastal		Equatorial		Coastal		South		Coastal		North		Coastal		Equatorial		Coastal	
Depth	Atlantic		N. Atlantic		Atlantic		Eq. Atlantic		Atlantic		S. Atlantic		Pacific		N. Pacific		Pacific		Eq. Pacific	
(m)	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
0	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	1.70	2.80	0.40	2.80	2.00	2.80	2.00	2.80
10	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	1.70	2.80	0.40	2.80	2.00	2.80	2.00	2.80
20	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	1.70	2.80	0.40	2.80	2.00	2.80	2.00	2.80
30	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	1.70	2.80	0.40	2.80	2.00	2.80	2.00	2.80
50	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	1.70	2.80	0.40	2.80	2.00	2.80	2.00	2.80
75	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	1.70	2.80	0.40	2.80	2.00	2.80	2.00	2.80
100	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	1.70	2.80	0.40	2.80	2.00	2.80	2.00	2.80
125	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	1.70	2.80	0.40	2.80	2.00	2.80	2.00	2.80
150	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	2.00	2.80	0.40	2.80	1.70	2.80	0.40	2.80	2.00	2.80	2.00	2.80

200	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
250	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
300	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
400	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
600	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
700	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
800	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
900	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1100	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1200	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1300	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1400	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1750	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
2000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
2500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.70	2.80	2.00	2.80	2.00	2.80	2.00	2.80
3000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
3500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
4000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
4500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
5000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
5500+	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80

Appendix 2J (cont.):
WOD98 Alkalinity (meq/l) Ranges by Basin as a Function of Depth

	South		**Coastal**		**North**		**Coastal**		**Equatorial**		**Coastal**		**South**		**Coastal**		**Southern**		**Arctic**	
Depth	**Pacific**		**S. Pacific**		**Indian**		**N. Indian**		**Indian**		**Eq. Indian**		**Indian**		**S. Indian**		**Ocean**		**Ocean**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	0.40	2.80
10	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	0.40	2.80
20	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	0.40	2.80
30	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	0.40	2.80
50	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	0.40	2.80
75	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.50	2.80
100	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.50	2.80
125	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.50	2.80
150	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.50	2.80
200	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.50	2.80
250	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.50	2.80
300	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	1.50	2.80
400	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
600	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
700	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
800	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
900	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1100	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80

1200	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1300	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1400	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
1750	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
2000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
2500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
3000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
3500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
4000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
4500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
5000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
5500+	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80

Appendix 2J (cont.):
WOD98 Alkalinity (meq/l) Ranges by Basin as a Function of Depth

Depth	**Mediteranean**		**Black Sea**		**Baltic Sea**		**Persian Gulf**		**Red Sea**		**Sulu Sea**	
(m)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
0	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
10	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
20	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
30	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
50	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
75	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
100	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
125	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
150	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
200	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
250	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
300	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
400	2.00	2.80	0.40	2.80	0.40	2.80	0.40	2.80	2.00	2.80	0.40	2.80
500	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
600	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
700	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
800	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
900	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
1000	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
1100	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
1200	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
1300	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
1400	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
1500	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
1750	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
2000	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
2500	2.00	2.80	1.70	2.80	1.70	2.80	1.70	2.80	2.00	2.80	1.70	2.80
3000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
3500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
4000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
4500	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80
5000	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80

5500+	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80	2.00	2.80