ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM SURFACE WATERS FIELD OPERATIONS MANUAL FOR LAKES

The information in this Adobe Acrobat Reader PDF file is one of several PDF files extracted from this report. The PDF files from the report are:

lake_ove.pdf	Overview of EMAP Surface Waters Lake Sampling, daily operations, lake verification and index site location, and general lake assessment (Sections 1, 2, 3, 4, 9)
lake_hab.pdf	Protocols for temperature, dissolved oxygen, shoreline physical habitat (Section 5)
lake_fis.pdf	Protocols for fish sampling (Section 6)
lake_wat.pdf	Protocols for Secchi transparency, water sample collection, chlorophyll a, zooplankton, sediment diatom (Section 7)
lake_ben.pdf	Protocols for benthic invertebrate sampling (Section 8)
lake_avi.pdf	Protocols for avian assemblages (Appendix A)
lake_vis.pdf	Lake-Visit Checklists for all Field Measurements (Appendix B)
field_for.pdf	Field Data Forms for all Field Measurements (Appendix C)

The Table of Contents, acknowledgments, notice page, listing of figures, listing of tables, and listing of acronyms for the document appear at the end of each pdf file.

In all cases, the source for this information for citation purposes is:

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ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM SURFACE WATERS FIELD OPERATIONS MANUAL FOR LAKES

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ABSTRACT

The methods and instructions for field operations presented in this manual for lake surveys were developed and tested through 4 years of pilot and demonstration projects from 1991 through 1994. These projects were conducted under the sponsorship of the U.S. Environmental Protection Agency and its collaborators through the Environmental Monitoring and Assessment Program (EMAP). This program focuses on evaluating ecological conditions on regional and national scales. This document describes procedures for collecting data, samples, and information about biotic assemblages, environmental measures, or attributes of indicators of lake ecosystem condition. The procedures presented in this manual were developed based on standard or accepted methods, modified as necessary to adapt them to EMAP sampling requirements. In addition to methodology, additional information on data management and other logistical aspects is integrated into the procedures and overall operational scenario. Procedures are described for collecting chlorophyl *a*, water, sedimentary diatoms, and zooplankton data in conjunction with the development of standard methods to obtain acceptable index samples for macrobenthos, fish assemblage, fish tissue contaminants, riparian birds, and physical habitat structure. The manual describes field implementation of these methods and the logistical foundation constructed during field projects. The manual includes flow charts with overall summaries of specific field activities required to visit a lake site and collect data for these indicators. Tables give step-by-step protocol instructions. These figures and tables can be extracted and bound separately to make a convenient quick field reference for field teams. The manual also includes example field data forms for recording measurements and observations made in the field and sample tracking information. Checklists of all supplies and equipment needed for each field task are included to help ensure that these materials are available when required.

APPENDIX C

FIELD DATA FORMS

Field data forms are presented in the general order of their use at each lake:

1. Lake Verification Form
2. Lake Profile Form
3. Physical Habitat Characterization Form--Lakes
4. Physical Habitat Characterization Comment Form
5. Physical Habitat Sketch Map Form
6. Fish Tally Form--Lakes
7. Fish Tally Continuation Form--Lakes
8. Fish Length Form--Lakes
9. Fish Tissue Sample Tracking Form--Lakes
10. Sample Collection Form--Lakes
11. Benthos Sample Location and Collection Form--Lakes
12. Lake Assessment Form

LAKE VERIFICATION FORM

LAKE NAME: **DATE OF VISIT:** / / **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **MODE OF ACCESS:** VEHICLE HIKE-IN AIRCRAFT

TEAM ID (CIRCLE): 1 2 3 4 5 6 7 8 9 10 OTHER: _____

ARROW INDICATES NORTH **MARK SITE:** L = LAUNCH X = INDEX

LAKE VERIFICATION INFORMATION

LAKE SHAPE COMPARES TO MAP? ☐ YES ☐ NO

LAKE VERIFIED BY (✓ all that apply) : ☐ GPS ☐ LOCAL CONTACT ☐ SIGNS ☐ ROADS ☐ TOPO. MAP

☐ Other (Describe Here): ☐ NOT VERIFIED (Explain in Comments)

COORDINATES	LATITUDE (dd mm ss) North	LONGITUDE (ddd mm ss) West	TYPE OF GPS FIX	SIGNAL QUALITY	GEOMETRIC QUALITY	Are GPS Coordinates w/i ±1 min. of map?
Map:	__ __ " __ __ ' __ __"	__ __ __ " __ __ ' __ __ "				
Launch Site:	__ __ " __ __ ' __ __"	__ __ __ " __ __ ' __ __ "	☐ 2D ☐ 3D	_____	_____	☐ YES ☐ NO
Index Site:	__ __ " __ __ ' __ __"	__ __ __ " __ __ ' __ __ "	☐ 2D ☐ 3D	_____	_____	☐ YES ☐ NO

LAKE SAMPLED? ☐ YES ☐ NO

REASON NOT SAMPLED (EXPLAIN BELOW): ☐ NOT VISITED ☐ NON-TARGET ☐ INACCESSIBLE ☐ OTHER

Explanation:

CHECK HERE IF EXPLANATION IS CONTINUED ON BACK. ☐

DESCRIBE LAUNCH SITE, LAKE DIRECTIONS, AND ADD COMMENTS ON BACK

REVIEWED BY (INITIAL):_____

LAKE ID: ___ ___ ___ ___ ___ L LAKE VERIFICATION FORM (continued) VISIT #: 1 2

DIRECTIONS TO LAKE & LAUNCH SITE

LAUNCH SITE DESCRIPTION

GENERAL COMMENTS

EXPLANATION FOR NOT SAMPLING THE LAKE (continued from front)

REVIEWED BY (INITIAL):_____

LAKE PROFILE FORM

LAKE NAME: DATE OF PROFILE: / / VISIT #: 1 2

LAKE ID: ___ ___ ___ ___ ___ L SITE ID (circle): INDEX OTHER: _____

TEAM ID (circle): 1 2 3 4 5 6 7 8 9 10 OTHER: ___

PRECIPITATION (circle): NONE LIGHT HEAVY

SURFACE CONDITIONS (circle): FLAT RIPPLES CHOPPY WHITECAPS

ODOR? ☐ NO ☐ YES	Description:
SCUM? ☐ NO ☐ YES	Description:

INDEX SITE DEPTH: ___ ___ ___ . ___ M CHECK (✓) IF SONAR NOT USED: ☐

FLAG: COMMENTS:

DISSOLVED OXYGEN & TEMPERATURE PROFILE

(Depth of Measurement[a] [m]: Surface, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 20, 25, 30, 35, 40, 45, and 50 m), Also include readings at 1 m above bottom.

DEPTH (m) xx.x	O_2 (mg/L) xx.x	TEMP. (°C) xx.x	FLAG	META-LIMNION (T, B)[b]	DEPTH (m) xx.x	O_2 (mg/L) xx.x	TEMP. (°C) xx.x	FLAG	META-LIMNION (T,B)[a]
SURFACE									
SURFACE (Dup.)									

IS THE DUPLICATE O_2 READING WITHIN ±0.5 MG/L OF THE INITIAL SURFACE READING? ☐ YES ☐ NO

CHECK HERE IF ADDITIONAL PROFILE MEASUREMENTS ARE RECORDED ON THE REVERSE SIDE: _____

[a] If the site depth is ≤ 3 m, take readings at the surface, every 0.5 m, and 1 m above the bottom.

[b] METALIMNION = The region of the profile where the temperature changes at a rate of 1 °C or greater per meter of depth. Indicate the depth of the top of the metalimnion with a "T," and the bottom of the metalimnion (when the rate of change becomes less than 1 °C per meter) with a "B." After the metalimnion is encountered, take readings every 1 m until bottom of the metalimnion is reached. Record the depth of the top of the metalimnion on the Benthos Sample Location and Collection Form.

FLAG CODES: K = NO MEASUREMENT OR OBSERVATION MADE; U = SUSPECT MEASUREMENT OR OBSERVATION; Q = UNACCEPTABLE QC CHECK ASSOCIATED WITH MEASUREMENT; F1, F2, ETC. = MISCELLANEOUS FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS IN COMMENTS SECTION ON BACK OF FORM.

REVIEWED BY (INITIAL):_____

LAKE ID: ___ ___ ___ ___ ___ L	LAKE PROFILE FORM (continued)	VISIT #: 1 2

OXYGEN METER CALIBRATION INFORMATION

SALINITY KNOB AT "0-FRESH": ☐ MEMBRANE CHECK ☐ ELECTRONIC ZERO ☐ RED LINE: ☐

CALIBRATION CHAMBER TEMPERATURE: °C	SATURATED O_2 @ CHAMBER TEMP.: MG/L
LAKE ELEVATION (FROM TOPO. MAP OR ALTIMETER): FT	ELEVATION CORRECTION FACTOR: ×

THE CALIBRATION VALUE IS OBTAINED BY MULTIPLYING THE SATURATED O_2 CONCENTRATION TIMES AN ELEVATION CORRECTION FACTOR (BOTH VALUES ARE OBTAINED FROM TABLES PRESENT ON THE BACK OF THE METER, OR PROVIDED IN THE MANUFACTURER'S OPERATIONS MANUAL). ADJUST THE METER READING TO THE CALIBRATION VALUE.

CALIBRATION VALUE: MG/L

FLAG	COMMENTS

DISSOLVED OXYGEN & TEMPERATURE PROFILE (continued)

For depths >15 m, continue recording at 5-m intervals)

DEPTH (m) xx.x	O_2 (mg/L) xx.x	TEMP. (°C) xx.x	FLAG	META-LIMNION (T, B)[a]	DEPTH (m) xx.x	O_2 (mg/L) xx.x	TEMP. (°C) xx.x	FLAG	META-LIMNION (T,B)[b]

DEPTH & FLAG	COMMENTS

REVIEWED BY (INITIAL): _____

PHYSICAL HABITAT CHARACTERIZATION FORM-LAKES

LAKE NAME: **DATE OF VISIT:** / / **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **TEAM ID (circle):** 1 2 3 4 5 6 7 8 9 10 OTHER: ___

	NEW STATION ID (if needed):										
RIPARIAN ZONE	STATION ID:	A	B	C	D	E	F	G	H	I	J
VEGETATION TYPE N=NONE, D= DECID., C=CONIF., M=MIXED	CANOPY LAYER (> 5 M)										
	UNDERSTORY (0.5 TO 5 M)										
AREAL COVERAGE CATEGORIES 0 = ABSENT 1 = SPARSE (<10%) 2 = MODERATE (10 TO 40%) 3 = HEAVY (40 TO 75%) 4 = VERY HEAVY (> 75%)											
CANOPY LAYER (> 5 M HEIGHT)	TREES ≥ 0.3 M DBH										
	TREES < 0.3 M DBH										
UNDERSTORY (HEIGHT=0.5 TO 5 M)	WOODY SHRUBS & SAPLINGS										
	TALL HERBS, FORBS, & GRASSES										
GROUND COVER (< 0.5 M HEIGHT)	WOODY SHRUBS & SEEDLINGS										
	HERBS, FORBS, & GRASSES										
	STANDING WATER OR INUNDATED VEGETATION										
	BARREN OR BUILDINGS										
SHORELINE SUBSTRATE ZONE	BEDROCK (> 4000 MM; BIGGER THAN A CAR)										
	BOULDERS (250 - 4000 MM; BASKETBALL - CAR SIZE)										
	COBBLE/GRAVEL (2 - 250 MM; LADYBUG - BASKETBALL SIZE)										
	LOOSE SAND (0.06 TO 2 MM; GRITTY BETWEEN FINGERS)										
	OTHER FINE SOIL/SEDIMENT (< 0.06 MM; NOT GRITTY)										
	VEGETATED										
	OTHER (EXPLAIN IN COMMENTS)										
BANK FEATURES (WITHIN PLOT)	ANGLE: V = NEAR VERTICAL/UNDERCUT, S = 30-75°, G =<30°										
	VERTICAL DISTANCE (M) FROM WATERLINE TO HIGH-WATER MARK										
	HORIZONTAL DISTANCE (M) FROM WATERLINE TO HIGH-WATER MARK										
HUMAN INFLUENCE	0 = ABSENT CHECK (✓) = PRESENT WITHIN PLOT B = OBSERVED ADJACENT TO OR BEHIND PLOT										
	BUILDINGS										
	COMMERCIAL										
	PARK FACILITIES										
	DOCKS/BOATS										
	WALLS, DIKES, OR REVETMENTS										
	LITTER, TRASH DUMP, OR LANDFILL										
	ROADS OR RAILROAD										
	ROW CROPS										
	PASTURE OR HAYFIELD										
	ORCHARD										
	LAWN										
	OTHER (EXPLAIN IN COMMENTS)										

FLAG CODES: K = MEASUREMENT OR OBSERVATION NOT OBTAINED; U = SUSPECT MEASUREMENT OR OBSERVATION;
F1, F2, ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS ON SEPARATE COMMENTS FORM.

REVIEWED BY (INITIAL): _____

LAKE ID: __ __ __ __ __ L **PHYSICAL HABITAT CHARACTERIZATION FORM (continued)** VISIT #: 1 2

NEW STATION ID (if needed):										
LITTORAL ZONE STATION ID:	A	B	C	D	E	F	G	H	I	J
STATION DEPTH (M) AT 10 M OFFSHORE										
SURFACE FILM TYPE (S=SCUM, A=ALGAL MAT, P=OILY, N=NONE/OTHER)										
BOTTOM SUBSTRATE: AREAL COVERAGE: 0=ABSENT 1=SPARSE (<10%) 2=MODERATE (10 TO 40%) 3=HEAVY (40 TO 75%) 4=VERY HEAVY (>75%)										
BEDROCK (>4000 MM; LARGER THAN A CAR)										
BOULDERS (250 - 4000 MM; BASKETBALL - CAR SIZE)										
COBBLE (64 - 250 MM; TENNIS BALL - BASKETBALL SIZE)										
GRAVEL (2 TO 64 MM; LADYBUG TO TENNIS BALL SIZE)										
SAND (0.06 TO 2 MM; GRITTY BETWEEN FINGERS)										
SILT. CLAY, OR MUCK (< 0.06 MM; NOT GRITTY)										
WOODY DEBRIS										
COLOR (BL=BLACK, GY=GRAY, BR=BROWN, RD=RED, N=NONE OR OTHER)										
ODOR (S=H_2S, A=ANOXIC, P=OIL, C=CHEMICAL, N=NONE)										
MACROPHYTES AREAL COVERAGE: 0=ABSENT 1=SPARSE (<10%) 2=MODERATE (10 TO 40%) 3=HEAVY (40 TO 75%) 4=VERY HEAVY(>75%)										
SUBMERGENT										
EMERGENT										
FLOATING										
TOTAL WEED COVER										
DO MACROPHYTES EXTEND LAKEWARD? (Y OR N)?										
FISH COVER 0=ABSENT 1=PRESENT BUT SPARSE 2=PRESENT IN MODERATE TO VERY HEAVY DENSITY										
AQUATIC WEEDS										
SNAGS > 0.3 M DIAMETER										
BRUSH OR WOODY DEBRIS < 0.3 M DIAMETER										
INUNDATED LIVE TREES > 0.3 M DIAMETER										
OVERHANGING VEGETATION < 1 M ABOVE SURFACE										
ROCK LEDGES OR SHARP DROPOFFS										
BOULDERS										
HUMAN STRUCTURES (E.G., DOCKS, LANDINGS, PILINGS, RIPRAP, ETC.)										
LITTORAL FISH HABITAT CLASSIFICATION										
DISTURBANCE (H=HUMAN N=NATURAL M=MIXED)										
COVER CLASS (C=COVER, O=OPEN, M=MIXED)										
COVER TYPE (A=ARTIFICIAL F=FILL V=VEG. W=WOODY B=BOULDERS M=MIXED N=NONE)										
SUBSTRATE (M=MUD/MUCK, S=SAND/GRAVEL, C=COBBLE/BOULDER, B=BEDROCK)										
GEAR (G=GILL NET, T=TRAP NET, S=SEINE, 0=NONE)										
GEAR LOCATION (DIST. & DIR. TO NEAREST REPRES. MACROHABITAT)										

FLAG CODES: **K** = MEASUREMENT OR OBSERVATION NOT OBTAINED; **U** = SUSPECT MEASUREMENT OR OBSERVATION;
F1, F2, ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS ON SEPARATE PHYSICAL CHARACTERIZATION HABITAT COMMENTS FORM.

REVIEWED BY (INITIAL): _____

PHYSICAL HABITAT CHARACTERIZATION COMMENT FORM

Page ____ of ____

LAKE ID: ___ ___ ___ ___ ___ L

VISIT #: 1 2

TEAM ID (circle): 1 2 3 4 5 6 7 8 9 10 OTHER: _____

STATION ID	SECTION OF FORM	MEASUREMENT OR VARIABLE	FLAG	COMMENT OR FLAG EXPLANATION

FLAG CODES: K = NO MEASUREMENT OR OBSERVATION ATTEMPTED; U = SUSPECT MEASUREMENT OR OBSERVATION;
F1, F2, ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW.

CHECK HERE IF INFORMATION IS RECORDED ON OTHER SIDE OF FORM _____

REVIEWED BY (INITIAL): _____

LAKE ID: ____ ____ ____ ____ ____ L

PHYSICAL HABITAT CHARACTERIZATION
COMMENTS FORM (continued)

VISIT #: 1 2

STATION ID	SECTION OF FORM	MEASUREMENT OR VARIABLE	FLAG	COMMENT OR FLAG EXPLANATION

CHECK HERE IF AN ADDITIONAL COMMENTS FORM IS USED _____

FLAG CODES: K = NO MEASUREMENT OR OBSERVATION ATTEMPTED; U = SUSPECT MEASUREMENT OR OBSERVATION;
F1, F2, ETC.= MISC. FLAGS ASSIGNED BY EACH FIELD CREW.

REVIEWED BY (INITIAL): _____

PHYSICAL HABITAT SKETCH MAP FORM-LAKES

LAKE NAME: **VISIT #: 1 2**

LAKE ID: ___ ___ ___ ___ ___ **L** | **START TIME:** ___ ___ : ___ ___ **END TIME:** ___ ___ : ___ ___

TEAM ID (circle): 1 2 3 4 5 6 7 8 9 10 OTHER: _____

Sketch and label riparian, in-lake, shoreline, and littoral fish habitats around the lake, using codes below. To identify littoral fish habitats on the map, compose a four-character code as: (Disturbance) (Cover class) (Cover type) (Substrate type). EXAMPLE: NCVS for Natural, Cover, Vegetated, Sand/Gravel.

RIPARIAN AND IN-LAKE CODES: WET = Wetland; BCH = Beach; RSD = Residences; PRK = Park; FST = Forest; ALT = Altered shoreline; DCK = Dock(s); MNA = Marina; CRP = Cropland; PTR = Pasture; LFL = Landfill/Dump; IND = Industry; MNG = Mining; LGG = Logging; FLM = Floating macrophytes; SBM = Submerged macrophytes; EMM = Emergent macrophytes; SHL = Shoal or Rocks.
LITTORAL FISH HABITAT CODES: (DISTURBANCE): Human, Natural, Mixed. (COVER CLASS): Cover, Open, Mixed. (COVER TYPE): Artificial structure, Fill, Vegetated, Woody, Boulders, Mixed, None. (SUBSTRATE TYPE): Mud/Muck, Sand/Gravel, Cobble/Boulders, Bedrock.

MAP OF FISH SAMPLING SITES ON BACK **REVIEWED BY (INITIAL):**_____

LAKE ID: ___ ___ ___ ___ ___ L PHYSICAL HABITAT SKETCH MAP FORM (continued) VISIT #: 1 2

USE THIS MAP TO LOCATE LITTORAL MACROHABITAT TYPES AND FISH SAMPLING SITES

RECORD FISH SAMPLING STATIONS AND GEAR TYPE
(G = GILL NET, T = TRAP NET, M = MINNOW TRAP, B = BEACH SEINE, S = SHORT SEINE. EXAMPLE: F1G, F2T, ETC.).
IF A SITE IS SELECTED FOR ADDITIONAL STANDARD PROTOCOL OR JUDGEMENT SAMPLING, ADD AN "X" OR "J" TO THE STATION AND GEAR TYPE CODES.
EXAMPLE: F10GX, F4BJ, ETC.

MACROHABITAT CLASSIFICATION AND EXTENT SUMMARY

MACROHAB. CLASS (XXXX)	%EXTENT(S) AND TOTAL	STATIONS	COMMENTS
	= %		
	= %		
	= %		
	= %		
	= %		
	= %		
	TOTAL = %		

REVIEWED BY (INITIAL):_____

FISH TALLY FORM-LAKES

Page ____ of ___

LAKE NAME: VISIT #: 1 2

LAKE ID: ___ ___ ___ ___ ___ L TEAM ID (circle): 1 2 3 4 5 6 7 8 9 10 OTHER:_____

NEAREST P-HAB STATION (A - J, X): ____ DIST. & DIR. FROM STATION: SITE ID: F ___ ___ ___ ___

SAMPLING EFFORT INFORMATION

START CREW INITIALS: _____ , _____, _____	END CREW INITIALS: _____ , _____, _____
START DATE: ___ ___ / ___ ___ / ___ ___	END DATE: ___ ___ / ___ ___ / ___ ___
START TIME: ___ ___ : ___ ___	END TIME: ___ ___ : ___ ___

LITTORAL HABITAT CLASSIFICATION

MACROHAB. CLASS (FROM SKETCH MAP FORM): ___ ___ ___ ___	MICROHAB. CLASS (FOR FISHING SITE): ___ ___ ___ ___

PELAGIC HABITAT CLASSIFICATION (circle one)

ISOTHERMAL EPILIMNION METALIMNION HYPOLIMNION

SAMPLING GEAR INFORMATION (circle one)

GILL NET	TRAP NET	MINNOW TRAP	BEACH SEINE	SHORT SEINE	OTHER (SPECIFY):
TYPE OF GILL NET SET (CIRCLE):			TOTAL AREA SEINED : _____ M^2		
LITTORAL MIDWATER/ SURFACE BOTTOM			TOTAL NUMBER OF SEINE HAULS = _____		

FISHING DEPTHS: MINIMUM: ___ ___ . ___ M MAXIMUM: ___ ___ . ___ M

COMMENTS:

CHECK HERE IF NO FISH WERE COLLECTED: _____

JAR ID (Barcode): ___ ___ ___ ___ ___ ___ TAG ID: ___ ___

Common Name:						SPECIES CODE: ___ ___ ___ ___ ___ ___		FLAG:
Adult			Juvenile			YOY		
TOTAL	MUSEUM	# MEASURED FOR LENGTH:	TOTAL	MUSEUM	# MEASURED FOR LENGTH:	TOTAL	MUSEUM	# MEASURED FOR LENGTH:

Common Name:						SPECIES CODE: ___ ___ ___ ___ ___ ___		FLAG:
Adult			Juvenile			YOY		
TOTAL	MUSEUM	# MEASURED FOR LENGTH:	TOTAL	MUSEUM	# MEASURED FOR LENGTH:	TOTAL	MUSEUM	# MEASURED FOR LENGTH:

REVIEWED BY (INITIAL): _____

LAKE ID: __ __ __ __ __ L **FISH TALLY FORM (continued)** SITE ID: F_________ VISIT #: 1 2

Common Name:				**SPECIES CODE:** ___ ___ ___ ___ ___ ___			**FLAG:**	
Adult			**Juvenile**			**YOY**		
TOTAL	**MUSEUM**	**# MEASURED FOR LENGTH:**	**TOTAL**	**MUSEUM**	**# MEASURED FOR LENGTH:**	**TOTAL**	**MUSEUM**	**# MEASURED FOR LENGTH:**
Common Name:				**SPECIES CODE:** ___ ___ ___ ___ ___ ___			**FLAG:**	
Adult			**Juvenile**			**YOY**		
TOTAL	**MUSEUM**	**# MEASURED FOR LENGTH:**	**TOTAL**	**MUSEUM**	**# MEASURED FOR LENGTH:**	**TOTAL**	**MUSEUM**	**# MEASURED FOR LENGTH:**
Common Name:				**SPECIES CODE:** ___ ___ ___ ___ ___ ___			**FLAG:**	
Adult			**Juvenile**			**YOY**		
TOTAL	**MUSEUM**	**# MEASURED FOR LENGTH:**	**TOTAL**	**MUSEUM**	**# MEASURED FOR LENGTH:**	**TOTAL**	**MUSEUM**	**# MEASURED FOR LENGTH:**

IF > 5 SPECIES ARE COLLECTED, CHECK HERE AND USE A TALLY CONTINUATION FORM _____

IS THERE EVIDENCE OF STOCKING (circle)?	**YES NO**

SPECIES CODE	ANOMALY/ STOCKING CODE	# OF FISH	FLAG	SPECIES CODE	ANOMALY/ STOCKING CODE	# OF FISH	FLAG

ANOMALY/STOCKING CODES: D = Deformities; E = Eroded fins; L = Lesions or ulcers; T = Tumors; F= Fungus; X = Multiple D,E,L,T anomalies; B = Blind in one or both eyes; K = Emaciated; M = Excessive mucus; P = Heavy Infestation of external parasites; Z = Other (explain in comments); S = Stocking.

FLAG	COMMENTS

FLAG CODES: **K**=NO MEASUREMENT OR OBSERVATION MADE; **U**= SUSPECT MEASUREMENT OR OBSERVATION; **F1, F2, ETC.**= MISC. FLAGS ASSIGNED BY FIELD CREW. EXPLAIN ALL FLAGS IN COMMENTS SECTION. ATTACH SEPARATE COMMENTS SHEET IF NECESSARY.

REVIEWED BY (INITIAL): _______

FISH TALLY CONTINUATION FORM-LAKES

Page ____ of ___

LAKE ID: ___ ___ ___ ___ ___ L

SITE ID: F__ __ __ __

VISIT #: 1 2

JAR ID (Barcode): ___ ___ ___ ___ ___ ___

TAG ID: ___ ___

Common Name:				**Species Code:** ___ ___ ___ ___ ___ ___			**Flag:**	
Adult			**Juvenile**			**YOY**		
Total	**Museum**	**# Measured for Length:**	**Total**	**Museum**	**# Measured for Length:**	**Total**	**Museum**	**# Measured for Length:**
Common Name:				**Species Code:** ___ ___ ___ ___ ___ ___			**Flag:**	
Adult			**Juvenile**			**YOY**		
Total	**Museum**	**# Measured for Length:**	**Total**	**Museum**	**# Measured for Length:**	**Total**	**Museum**	**# Measured for Length:**
Common Name:				**Species Code:** ___ ___ ___ ___ ___ ___			**Flag:**	
Adult			**Juvenile**			**YOY**		
Total	**Museum**	**# Measured for Length:**	**Total**	**Museum**	**# Measured for Length:**	**Total**	**Museum**	**# Measured for Length:**
Common Name:				**Species Code:** ___ ___ ___ ___ ___ ___			**Flag:**	
Adult			**Juvenile**			**YOY**		
Total	**Museum**	**# Measured for Length:**	**Total**	**Museum**	**# Measured for Length:**	**Total**	**Museum**	**# Measured for Length:**
Common Name:				**Species Code:** ___ ___ ___ ___ ___ ___			**Flag:**	
Adult			**Juvenile**			**YOY**		
Total	**Museum**	**# Measured for Length:**	**Total**	**Museum**	**# Measured for Length:**	**Total**	**Museum**	**# Measured for Length:**
Common Name:				**Species Code:** ___ ___ ___ ___ ___ ___			**Flag:**	
Adult			**Juvenile**			**YOY**		
Total	**Museum**	**# Measured for Length:**	**Total**	**Museum**	**# Measured for Length:**	**Total**	**Museum**	**# Measured for Length:**

CHECK HERE IF INFORMATION IS RECORDED ON OTHER SIDE OF FORM: _____

Reviewed by (initial): ______

LAKE ID: __ __ __ __ __ L   FISH TALLY CONTINUATION FORM (continued)   SITE ID: F__________   VISIT #: 1 2

Common Name:				Species Code: ___ ___ ___ ___ ___ ___			Flag:	
Adult			Juvenile			YOY		
Total	Museum	# Measured for Length:	Total	Museum	# Measured for Length:	Total	Museum	# Measured for Length:

Common Name:				Species Code: ___ ___ ___ ___ ___ ___			Flag:	
Adult			Juvenile			YOY		
Total	Museum	# Measured for Length:	Total	Museum	# Measured for Length:	Total	Museum	# Measured for Length:

Common Name:				Species Code: ___ ___ ___ ___ ___ ___			Flag:	
Adult			Juvenile			YOY		
Total	Museum	# Measured for Length:	Total	Museum	# Measured for Length:	Total	Museum	# Measured for Length:

CHECK HERE IF AN ADDITIONAL CONTINUATION FORM IS REQUIRED: _____

Species Code	Anomaly/ Stocking Code	# of Fish	Flag	Species Code	Anomaly/ Stocking Code	# of Fish	Flag

ANOMALY/STOCKING CODES: D = Deformities; E = Eroded fins; L = Lesions or ulcers; T = Tumors; F = Fungus; X = Multiple D,E,L,T anomalies; B = Blind in one or both eyes; K = Emaciated; M = Excessive mucus; P = Heavy infestation of external parasites; Z = Other (explain in comments); S = Stocking.

FLAG	COMMENTS

FLAG CODES: K = NO MEASUREMENT OR OBSERVATION MADE; **U =** SUSPECT MEASUREMENT OR OBSERVATION; **Q =** UNACCEPTABLE **QC** CHECK ASSOCIATED WITH MEASUREMENT; **F1, F2,** ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS IN COMMENTS SECTION.

REVIEWED BY (INITIAL): ______

FISH LENGTH FORM-LAKES **PAGE _____ of _____**

LAKE NAME: **VISIT #: 1 2**

LAKE ID: ___ ___ ___ ___ ___ L **TEAM ID (circle): 1 2 3 4 5 6 7 8 9 10 OTHER: _____**

SITE ID	SPECIES CODE	COMMON NAME	TOTAL LENGTH (mm)	AGE CLASS (A, J, Y)*	OUT (✓)	FLAG	COMMENTS

CHECK HERE IF ADDITIONAL DATA ARE RECORDED ON REVERSE SIDE: _____

***A = ADULT; J = JUVENILE; AND Y = YOUNG OF YEAR**

FLAG CODES: K = NO MEASUREMENT COLLECTED; U = SUSPECT MEASUREMENT; F1. F2, ETC. = MISC. FLAGS ASSIGNED BY FIELD CREW. EXPLAIN ALL FLAGS IN COMMENTS SECTION.

REVIEWED BY (INITIAL):_____

LAKE ID: ___ ___ ___ ___ ___ L FISH LENGTH FORM (continued) VISIT #: 1 2

SITE ID	SPECIES CODE	COMMON NAME	TOTAL LENGTH (mm)	AGE CLASS (A, J, Y)*	OUT (✓)	FLAG	COMMENTS

CHECK HERE IF AN ADDITIONAL FISH LENGTH FORM IS USED FOR THIS LAKE: _____

* A = ADULT; J = JUVENILE; AND Y = YOUNG OF YEAR.

FLAG CODES: K = NO MEASUREMENT COLLECTED; U = SUSPECT MEASUREMENT; F1. F2, ETC. = MISC. FLAGS ASSIGNED BY FIELD CREW. EXPLAIN ALL FLAGS IN COMMENTS SECTION.

REVIEWED BY (INITIAL):_____

FISH TISSUE SAMPLE TRACKING FORM-LAKES

LAKE NAME: **DATE PREPARED:** / / **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **TEAM ID (circle):** 1 2 3 4 5 6 7 8 9 10 OTHER:_____

	SPECIES CODE	COMMON NAME	TOTAL LENGTH (MM)	WEIGHT (KG)	FLAG	SAMPLE ID (BARCODE)
1	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
2	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
3	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
4	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
5	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
6	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
7	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
8	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
9	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
10	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
11	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
12	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
13	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
14	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
15	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
16	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
17	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
18	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
19	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___
20	___ ___ ___ ___ ___ ___					___ ___ ___ ___ ___ ___

OF STATIONS FROM WHICH FISH TISSUE CANDIDATE SPECIMENS WERE COLLECTED: _____

TOTAL # OF STATIONS SAMPLED: _____

LINE #	FLAG	COMMENT OR FLAG EXPLANATION

CHECK HERE IF MORE DATA ARE RECORDED ON OTHER SIDE: _____

FLAG CODES: K = NO SAMPLE COLLECTED; **U** = SUSPECT SAMPLE; **F1. F2,** ETC. = MISC. FLAGS ASSIGNED BY FIELD CREW. EXPLAIN ALL FLAGS IN COMMENTS SECTION.

REVIEWED BY (INITIAL):_____

LAKE ID: __ __ __ __ __ L

FISH TISSUE SAMPLE TRACKING FORM

(continued)

DATE PREPARED: / /

VISIT #: 1 2

	SPECIES CODE	COMMON NAME	TOTAL LENGTH (MM)	WEIGHT (KG)	FLAG	SAMPLE ID (BARCODE)
1	__ __ __ __ __ __					__ __ __ __ __ __
2	__ __ __ __ __ __					__ __ __ __ __ __
3	__ __ __ __ __ __					__ __ __ __ __ __
4	__ __ __ __ __ __					__ __ __ __ __ __
5	__ __ __ __ __ __					__ __ __ __ __ __
6	__ __ __ __ __ __					__ __ __ __ __ __
7	__ __ __ __ __ __					__ __ __ __ __ __
8	__ __ __ __ __ __					__ __ __ __ __ __
9	__ __ __ __ __ __					__ __ __ __ __ __
10	__ __ __ __ __ __					__ __ __ __ __ __
11	__ __ __ __ __ __					__ __ __ __ __ __
12	__ __ __ __ __ __					__ __ __ __ __ __
13	__ __ __ __ __ __					__ __ __ __ __ __
14	__ __ __ __ __ __					__ __ __ __ __ __
15	__ __ __ __ __ __					__ __ __ __ __ __
16	__ __ __ __ __ __					__ __ __ __ __ __
17	__ __ __ __ __ __					__ __ __ __ __ __
18	__ __ __ __ __ __					__ __ __ __ __ __
19	__ __ __ __ __ __					__ __ __ __ __ __
20	__ __ __ __ __ __					__ __ __ __ __ __

LINE #	FLAG	COMMENT OR FLAG EXPLANATION

FLAG CODES: K = NO SAMPLE COLLECTED; U = SUSPECT SAMPLE; F1. F2, ETC. = MISC. FLAGS ASSIGNED BY FIELD CREW. EXPLAIN ALL FLAGS IN COMMENTS SECTION.

REVIEWED BY (INIITIAL):_____

SAMPLE COLLECTION FORM-LAKES

LAKE NAME: **DATE OF COLLECTION:** / / **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **SITE ID (circle):** INDEX OTHER: _____

TEAM ID (circle): 1 2 3 4 5 6 7 8 9 10 **OTHER:** ___

SECCHI DISK TRANSPARENCY

DEPTH DISK DISSAPPEARS	DEPTH DISK REAPPEARS	CLEAR TO BOTTOM (X)	COMMENTS
___ ___ . ___ ___ M	___ ___ . ___ ___ M		

WATER CHEMISTRY (4-L CUBITAINER AND 4 SYRINGES)

SAMPLE ID # (Barcode)	SAMPLE TYPE	DEPTH COLLECTED	FLAG	COMMENTS
__ __ __ __ __ __	R1	M		
__ __ __ __ __ __		M		

CHLOROPHYLL (TARGET VOLUME = 500 mL)

SAMPLE ID # (Barcode)	SAMPLE TYPE	DEPTH COLLECTED	SAMPLE VOLUME	FLAG	COMMENTS
__ __ __ __ __ __	R1	M	mL		
__ __ __ __ __ __		M	mL		

ZOOPLANKTON (FILL TO MARK ON BOTTLE = 80 mL)

MESH SIZE	SAMPLE ID # (Barcode)	SAMPLE TYPE	LENGTH OF TOW	CONTAINERS NO. PRESERVED (✓)		FLAG	COMMENTS
COARSE	__ __ __ __ __ __	R1	M				
FINE	__ __ __ __ __ __	R1	M				
	__ __ __ __ __ __		M				
	__ __ __ __ __ __		M				

SEDIMENT CORE SAMPLES (TARGET CORE LENGTH = 35 TO 40 CM)

Collected at (circle): INDEX OTHER **If OTHER, record direction and distance from INDEX site:**

SAMPLE CLASS	SAMPLE ID # (Barcode)	SAMPLE TYPE	LENGTH OF CORE	INTERVAL From	To	FLAG	COMMENTS
TOP	__ __ __ __ __ __	R1	CM	CM	CM		
BOTTOM	__ __ __ __ __ __	R1	CM	CM	CM		
	__ __ __ __ __ __		CM	CM	CM		
	__ __ __ __ __ __		CM	CM	CM		

FLAG CODES: K = NO MEASUREMENT OR SAMPLE COLLECTED; U = SUSPECT MEASUREMENT OR SAMPLE;
F1. F2, ETC. = MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS IN COMMENTS SECTION.

REVIEWED BY (INITIAL):_____

BENTHOS SAMPLE LOCATION AND COLLECTION FORM-LAKES

LAKE NAME: **DATE OF COLLECTION:** / / **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **TEAM ID (circle):** 1 2 3 4 5 6 7 8 9 10 OTHER: ___

OUTLINE MAP OF LAKE (WITH PHYSICAL HABITAT STATIONS IDENTIFIED)

INDICATE LOCATIONS WHERE BENTHIC CORE SAMPLES ARE COLLECTED WITH THE LETTER OF THE NEAREST PHYSICAL HABITAT SITE (A - J).

ARROW INDICATES NORTH.	RECORD THE SHALLOWER OF THE FOLLOWING DEPTHS (FROM LAKE PROFILE FORM) A) THE DEPTH OF TOP OF METALIMNION OR B) THE DEEPEST DEPTH AT WHICH DISSOLVED OXYGEN ≥ 5 MG/L TARGET DEPTH _____ M

COMMENTS:

REVIEWED BY (INITIAL): _____

BENTHOS SAMPLE LOCATION AND COLLECTION FORM (CONTINUED)

VISIT #: 1 2

LAKE ID: ___ ___ ___ ___ ___ L

DATE OF COLLECTION: / /

RECORD SAMPLING START TIME: :

RECORD PROCESSING COMPLETION TIME: :

SAMPLE ID # (Barcode)	STATION ID	DEPTH COLLECTED	SUBSTRATE TYPE[a]	FLAG[b]	COMMENTS
___ ___ ___ ___ ___ ___	A	M			
___ ___ ___ ___ ___ ___	B	M			
___ ___ ___ ___ ___ ___	C	M			
___ ___ ___ ___ ___ ___	D	M			
___ ___ ___ ___ ___ ___	E	M			
___ ___ ___ ___ ___ ___	F	M			
___ ___ ___ ___ ___ ___	G	M			
___ ___ ___ ___ ___ ___	H	M			
___ ___ ___ ___ ___ ___	I	M			
___ ___ ___ ___ ___ ___	J	M			
___ ___ ___ ___ ___ ___		M			
___ ___ ___ ___ ___ ___		M			
___ ___ ___ ___ ___ ___		M			
___ ___ ___ ___ ___ ___		M			
___ ___ ___ ___ ___ ___		M			

[a]SUBSTRATE TYPE CODES: G = GRAVEL; S = SAND; C = SILT CLAY, OR MUCK; W = WOODY DEBRIS; O = OTHER (DESCRIBE IN COMMENTS)

[b]FLAG CODES: K = NO SAMPLE COLLECTED; U = SUSPECT SAMPLE; F1. F2, ETC.= MISC. FLAGS ASSIGNED BY EACH FIELD CREW. EXPLAIN ALL FLAGS IN COMMENTS SECTION.

ZEBRA MUSSEL OBSERVATION AND COLLECTION

STATION	OBSERVED (Y/N)	COLLECTED (Y/N)	COMMENTS
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
LAUNCH			
OTHER			

REVIEWED BY (INITIAL):_____

LAKE ASSESSMENT FORM

LAKE NAME: **DATE OF VISIT:** / / **VISIT #:** 1 2

LAKE ID: ___ ___ ___ ___ ___ L **TEAM ID (circle):** 1 2 3 4 5 6 7 8 9 10 OTHER:___

LAKE SITE ACTIVITIES AND DISTURBANCES OBSERVED (INTENSITY: BLANK = NOT OBSERVED, L = LOW, M = MODERATE, H = HEAVY)

RESIDENTIAL	RECREATIONAL	AGRICULTURAL	INDUSTRIAL	LAKE MANAGEMENT
___ RESIDENCES	___ PARKS, CAMPGROUNDS, BEACHES	___ CROPLAND	___ INDUSTRIAL PLANTS	___ MACROPHYTE CONTROL
___ MAINTAINED LAWNS	___ PRIMITIVE PARKS, CAMPING, BEACHES	___ PASTURE	___ MINES/QUARRIES	___ LIMING
___ CONSTRUCTION	___ RESORTS	___ LIVESTOCK	___ POWER LINES	___ DRINKING WATER TREATMENT
___ PIPES, DRAINS	___ MARINAS		___ POWER PLANTS	___ ANGLING PRESSURE
___ TREATMENT PLANT	___ TRASH/LITTER		___ LOGGING	
___ LANDFILL, DUMPING	___ SURFACE FILMS, SCUMS, OR SLICKS		___ EVIDENCE OF FIRE	
			___ ODORS	

GENERAL LAKE INFORMATION

HYDROLOGIC LAKE TYPE	G RESERVOIR	G DRAINAGE (OUTLETS PRESENT)	G SEEPAGE (NO OUTLETS OBSERVED)	
OUTLET DAMS	G NONE	G ARTIFICIAL	G NATURAL	
LOW ELEVATION FLIGHT HAZARDS	G YES	G NO		
MOTOR BOAT DENSITY	G HIGH	G LOW	G RESTRICTED	G BANNED
GENERAL AESTHETICS	G PLEASANT	G SOMEWHAT PLEASANT	G UNPLEASANT	
SWIMMABILITY	G GOOD	G FAIR	G NOT SWIMMABLE	
LAKE LEVEL CHANGES	G ZERO	G ELEVATION CHANGE = _____ M		

SHORELINE CHARACTERISTICS (% of shoreline)

FOREST/SHRUB	G RARE (<5%)	G SPARSE (5 TO 25%)	G MODERATE (25 TO 75%)	G EXTENSIVE (> 75%)
AGRICULTURE	G RARE (< 5%)	G SPARSE (5 TO 25%)	G MODERATE (25 TO 75%)	G EXTENSIVE (> 75%)
OPEN GRASS	G RARE (< 5%)	G SPARSE (5 TO 25%)	G MODERATE (25 TO 75%)	G EXTENSIVE (>75%)
WETLAND	G RARE (< 5%)	G SPARSE (5 TO 25%)	G MODERATE (25 TO 75%)	G EXTENSIVE (>75%)
BARREN (BEACH)	G RARE (< 5%)	G SPARSE (5 TO 25%)	G MODERATE (25 TO 75%)	G EXTENSIVE (>75%)
DEVELOPED	G RARE (< 5%)	G SPARSE (5 TO 25%)	G MODERATE (25 TO 75%)	G EXTENSIVE (>75%)
SHORELINE MODS. (DOCKS, RIPRAP)	G RARE (< 5%)	G SPARSE (5 TO 25%)	G MODERATE (25 TO 75%)	G EXTENSIVE (>75%)

QUALITATIVE MACROPHYTE SURVEY

MACROPHYTE DENSITY	G ABSENT	G SPARSE	G MODERATE	G DENSE
EMERGENT/FLOATING COVERAGE (% LAKE AREA)	G 0 TO 25%	G 25 TO 50%	G 50 TO 75%	G > 75%
SUBMERGENT COVERAGE (% LAKE AREA)	G 0 TO 25%	G 25 TO 50%	G 50 TO 75%	G > 75%

DESCRIPTION:

(Continued on reverse side)

REVIEWED BY (INITIAL):_____

LAKE ID: ___ ___ ___ ___ ___ L LAKE ASSESSMENT FORM (continued) VISIT #: 1 2

QUALITATIVE ASSESSMENT OF ENVIRONMENTAL VALUES

TROPHIC STATE G OLIGOTROPHIC G MESOTROPHIC G EUTROPHIC G HYPEREUTROPHIC

VISUAL ASSESSMENT:

ALGAL ABUNDANCE & TYPE:

NUTRIENT STATUS:

OTHER:

FISHABILITY: G EXCELLENT G GOOD G FAIR G POOR

CONDITIONS:

LOCAL CONTACTS:

OBSERVATIONS:

OVERALL BIOTIC INTEGRITY G EXCELLENT G IMPACTED G SEVERELY IMPACTED

GENERAL ASSESSMENT:

WILDLIFE OBSERVED:

WATERBODY CHARACTER (CIRCLE ONE)

PRISTINE	5	4	3	2	1	DEVELOPED
APPEALING	5	4	3	2	1	UNAPPEALING

COMMENTS:

REVIEWED BY (INITIAL):_____

NOTICE

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TABLES (Continued)

ACKNOWLEDGMENTS

In any undertaking with a scope as broad as that of EMAP-Surface Waters, many individuals contribute in important ways not reflected by authorship on documents such as this. This is especially true of the contents of this manual which are the product of tests and lessons learned over a period of 5 years of field work. Rather than attempt to list all of these contributors, and risk omitting some, we will identify the organizations whose staff members participated in the development of the material presented in this manual:

- EMAP-Surface Waters and associated laboratory staff in Corvallis, Las Vegas, and Cincinnati, including EPA and on-site contractor personnel (ManTech Environmental Technology, Inc., Lockheed Environmental Systems & Technologies Company, and Technology Applications, Inc.).

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ACRONYMS AND ABBREVIATIONS

BPJ	Best Professional Judgment
DLGs	Digital Line Graphs
DO	dissolved oxygen
EMAP	Environmental Monitoring and Assessment Program
EPA	U.S. Environmental Protection Agency
GPS	Global Positioning System
GQ	geometric quality
ID	identification
ORD	Office of Research and Development
OSHA	Occupational Safety and Health Administration
P-Hab	physical habitat
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
SQ	signal quality
STARS	Sample Tracking and Reporting System
T	Top
TIME	Temporally Integrated Monitoring of Ecosystems
USGS	United States Geological Survey
YOY	young of year
YSI	Yellow Springs Instrument system

Measurement Units

ha	hectare
m	meter
ppm	parts per million