APPENDIX G.

CONVERSIONS, MEASUREMENTS, AND ABBREVIATIONS

Length

To convert	Multiply by
Centimeters to inches	0.3937
to feet	0.03281
Feet to meters	0.304801
to centimeters	30.4801
Inches to meters	0.0254
to centimeters	2.54
to millimeters	25.4
Kilometers to miles	0.6214
to feet	3,280.83
Meters to yards	1.0936
to feet	3.2808
to inches	39.37
Miles to kilometers	1.6094
to meters	1,609.35
Millimeters to inches	0.03937
Yards to centimeters	91.4402
to meters	0.9144

Area

To convert	Multiply by
Acres to hectares	0.405
to square feet	43,560.00
to square kilometers	0.004047
to square meters	4,047.00
to square miles	0.00156
Hectares to acres	2.469
to square feet	107,639.1
to square kilometers	0.01
to square meters	10,000.00
to square miles	0.003858
Square centimeters to square inches	0.155

Area (cont'd)

To convert	Multiply by
Square feet to acres	0.0000229
to hectares	0.0000093
to square centimeters	929.034
to square meters	0.0929
Square inches to square millimeters	645.16
to square centimeters	6.4516
to square meters	0.000645
Square kilometers to acres	247.104
to square miles	0.3861
Square kilometers to hectares	100.00
Square meters to acres	0.000247
to hectares	0.0001
to square feet	10.7639
to square inches	1,550.00
to square yards	1.19599
Square miles to acres	640.00
to hectares	259.20
to square kilometers	2.59
Square millimeters to square inches	0.00155
Square yards to square meters	0.83613

Volume

To convert	Multiply by
Acre-feet to cubic feet	43,560.00
to cubic hectometers	0.0012335
to cubic meters	1,233.5
to cubic yards	1,613.3
to gallons	325,850.00
to cubic kilometers	0.0000012335
Cubic centimeters to cubic feet	0.0000353
to cubic inches	0.061023
to milliliters	1.00
Cubic decimeters to cubic feet	0.035314
to liters	1.00

Volume (cont'd)

To convert	Multiply by
Cubic feet to acre-feet	0.0000229
to cubic centimeters	28,317.00
to cubic decimeters	28.317
to cubic inches	1,728.00
to cubic meters	0.02832
to cubic yards	0.03704
to gallons	7.48
to liters	28.317
to quarts	29.922
Cubic inches to cubic centimeters	16.387
to cubic feet	0.00058
to fluid ounces	0.554
to gallons	0.0043
to liters	0.0164
to pints	0.0346
to quarts	0.0173
Cubic hectometers to acre-feet	810.70
Cubic meters to acre-feet	0.0008107
to cubic feet	35.314
to cubic yards	1.30794
to gallons	264.170
to liters	1,000.00
Cubic yards to acre-feet	0.0006198
to cubic feet	27.00
to cubic meters	0.7646
Cubic yards to gallons	201.974
to liters	764.559
Gallons to acre-feet	0.00000307
to cubic feet	0.1337
to cubic inches	231.00
to cubic meters	0.003785
to cubic yards	0.00495
to fluid ounces	128.00
to liters	3.78543
Liters to cubic decimeters	1.00
to cubic feet	0.035314
to cubic inches	61.0234
to cubic meters	0.001

Volume (cont'd)

To convert	Multiply by
Liters to cubic yards	0.0013079
to gallons	0.26417
to pints	2.11336
to quarts	1.05668
Milliliters to cubic centimeters	1.00
Ounces (fluid) to cubic centimeters	29.5737
to cubic inches	1.8047
Pints to cubic inches	28.875
to liters	0.4732
Quarts to cubic feet	0.03342
to cubic inches	57.75
to liters	0.94636

Weight

To convert	Multiply by
Grams to kilograms	0.001
to pounds	0.002205
to ounces	0.03527
Kilograms to grams	1,000.00
to pounds	2.205
to tons (metric)	0.001
to tons (short)	0.0011025
Ounces to grams	28.349527
to pounds	0.0625
Pounds to grams	453.5924
to kilograms	0.45359
to ounces	16.00
to tons (metric)	0.0004536
to tons (short)	0.0005
Tons (metric) to kilograms	1,000.00
to pounds	2,205.00
to tons (short)	1.1025
Tons (short) to kilograms	907.18
to pounds	2,000.00
to tons (metric)	0.90718

Volume/Time (Flow)

To convert	Multiply by
Acre-feet per day to cubic feet per second	0.5043
to cubic meters per second	0.0143
to gallons per minute	226.24
to million gallons per day	0.3258
Cubic feet/second to acre-feet/day	1.983
to acre-inch per hour	0.992
to cubic feet per day	86,400.00
to cubic meters per second	0.028317
to gallons per day	646,272.00
to gallons per minute	448.80
to gallons per second	7.48
to liters per second	28.317
Cubic meters/second to acre-feet/day	70.0456
to cubic feet per second	35.314
to gallons per minute	15,850.37
to liters per second	1,000.00
to million gallons per day	22.824
Gallons per minute to acre-feet per day	0.00442
to cubic feet per second	0.00223
to cubic meters per second	0.00006309
to gallons per day	1,440.00
to liters per second	0.06309
Liters/second to cubic feet/second	0.035314
to cubic meters per second	0.001
to gallons per minute	15.85
Million gallons/day to acre-feet/day	3.0689
to cubic feet per second	1.547
to cubic meters per second	0.043813
to gallons per minute	695.00

Yield

To convert	Multiply by
Kilograms per hectare to pounds per acre	0.8916
Pounds per acre to kilograms per hectare	1.122

Temperature

°C is equal to (°F - 32) × 5 / 9

°F is equal to (°C × 1.8) + 32

Miscellaneous Water Measurements

1 gallon of water weighs 8.34 pounds
1 cubic foot of water weighs 62.4 pounds

Acre-feet × 43560 / 86400 × X = cubic feet/second discharge over a period of X days

ABBREVIATIONS

Spell out

acres(s)	mile(s)	ton(s)
cent(s)	month(s)	
dollar(s)	ohm(s)	

Abbreviate

alternating current	ac
barrel(s)	bl
body weight	body wt
bushel(s)	bu
centimeter(s)	cm
count per minute	count/min
count per second	count/s
cubic centimeter(s)	cm^3
cubic foot (feet)	ft^3
cubic foot per second	cfs
cubic kilometer(s)	km^3
cubic meter(s)	m^3
cubic meter per second	m^3/s
cubic microns(s)	μ^3
cubic millimeter(s)	mm^3
cubic yards(s)	yd^3

ABBREVIATIONS (cont'd)

Abbreviate	
Day	d
degree (space)	deg or °
degree, Celsius	°C
degree, Fahrenheit	°F
diameter	diam
direct current	dc
dozen	doz
dry weight	dry wt
east	E
fathom	fm
focal length	f/
foot (feet)	ft
gallon(s)	gal
grain(s)	gr
gram(s)	g
hectare	ha
horsepower	hp
hour(s)	h
hundredweight	cwt
inch	in.
kilogram(s)	kg
kilometer(s)	km
kilometer per hour	km/h
latitude	lat
lethal concentration, 50%	LC50
lethal dose, medial	LD50
liter	l
logarithm (common, base 10) in formulas	log, $\log_{10}$
logarithm (natural, base e) in formulas	ln, $\log_e$
longitude	long
meter(s)	m
megagram(s)	Mg
microgram	µg
micron(s) (10^{-3}mm)	µ
mile per hour	mile/h
milligram(s)	mg
milligram(s) per gram	mg/g
milligram(s) per liter	mg/l
milliliter(s)	ml

ABBREVIATIONS (cont'd)

Abbreviate	
millimeter(s)	mm
minimum or minute(s)	min
minute (time)	min
north	N
number (in enumeration)	no.
ounce	oz
page(s)	p.
parts per billion	ppb
parts per million	ppm
percent	%
per thousand	o/oo
pound(s)	lb
pounds per square inch	lb/in^2
second(s) (time)	s
second(s) (angular measure)	"
south	S
species (taxonomy only, singular)	sp.
species (taxonomy only, plural)	spp.
species, new	sp. nov.
specific gravity	sp gr
square	sq
square centimeter(s)	cm^2
square foot (feet)	ft^2
square meter(s)	m^2
square millimeter(s)	mm^2
standard deviation	SD
standard error	SE
subspecies	ssp.
Temperature	temp
Time	use 24-hr system
variety(ies)	var.
volt	v
volume (with number in tables)	V
volume/volume (conc.)	v/v
watt	W
week	wk
weight	wt
west	W

ABBREVIATIONS (cont'd)

Abbreviate	
Yard	yd
Year	yr

Write latitude in the form: lat 33°41'30"N
Write longitude in the form: long 118°09'05"W

APPENDIX H.

THE MANNING ROUGHNESS COEFFICIENT

Typical channel designs rely on hydraulic engineering criteria and geomorphic parameters, such as critical bed and bank shear stresses, considerations of bedload transport, and "equilibrium" valley slopes (Rundquist et al., 1986; Jackson and Van Haveren, 1984). Other work utilizes empirical equations, that despite their limitations, continue to demonstrate their utility (Dury 1973; Williams 1986). The reader is referred to Graf (1971), U.S. Army Corps of Engineers (1970), and Bray (1982) for a review of common design approaches. For our purposes, we will follow a utilitarian approach, that allows designers to predict if a modified cross-section will convey the bankfull discharge.

Geomorphic research (Wolman and Leopold 1957; Hey 1982) has shown that most rivers experience a bankfull flood once every two years, and that these flows are the most important in defining channel shape (Wolman and Miller 1960; Yu and Wolman, 1987). Although other flows are important, for our purposes, bankfull discharge (Qbf) is designated as the design discharge.

The Manning Equation and Profile Alterations

The Manning equation is a common mathematical method for designing channel modifications (Mott 1979; Dunne and Leopold 1978). One form of the Manning equation is presented here.

$$\mathbf{Qbf = (1.49\ R^{2/3} S^{1/2})(1/n)(A)}$$

Where: Qbf = bankfull discharge (ft^3/s)

R = hydraulic radius (ft) and R = WP/A, (the ratio of wetted perimeter to cross-sectional area of flowing water), where WP = wetted perimeter (ft)

A = area of cross-section below the Qbf elevation (ft^2)

S = average slope of the longitudinal profile or longitudinal template (ft/ft)

n = the dimensionless Manning roughness coefficient

For the form of the Manning equation described here, discharge (Qbf) can be calculated from a cross-section or preferably, derived from discharge records, slope (average for the reach) is derived from the longitudinal profile data. The Manning roughness coefficient "n" is selected from reference books, or more preferably, back calculated from a specific paired reference cross-section. Hydraulic radius (R) and cross-sectional area (A), both descriptors of cross-sectional configuration, are manipulated using reference templates as a guide, through the introduction of structures or other features to create a suitable geometry for a particular site. It is evident that different channel shapes can have the same hydraulic radius and cross-sectional area, (e.g., a trapezoidal channel verses a semi-circular or triangular channel). Consequently, the real test of this approach is to arrive at an inherently stable channel geometry that also provides quality instream habitat for fish. In this work, there is no better help available than that provided by existing stream features. Since the reference templates serve as examples of existing stream conditions, designers should rely on them as valuable references. Again: Mimic nature.

Because this equation is sensitive to the value of the "n" coefficient, it is easy to under-design or over-design a channel modification. Consequently, references have been developed to assist in assigning an "n" value. These references are based on actual calculations of "n" from known discharge and cross-sectional data (Barnes 1967; Dunne and Leopold 1978; and Jarrett 1985). Because most channels in mountain environments have a high degree of bed armor and channel roughness, "n" values for these channels usually range between 0.05 and 0.08. For specific enhancement cross-sections an "n" value should be back calculated from the matched reference cross-section.

Guidelines for cross-sectional channel shapes are difficult to categorize, because of the range of variation in natural channels. However, a modified trapezoid shape is usually appropriate for riffle and run sections . Pool cross-sections vary with their location in the channel (e.g. bends vs inflections), but most commonly encountered pool cross-sections are asymmetric. In other words, they have shallow slip-off slopes on the inner bank and near steep slopes on the outer bank. Pools also tend to be about 25 percent less wide than riffles. Cross-sectional modifications should mimic these shapes as close as practical. Again, use the matched reference templates as guides for new channel configurations.

Designers only need to fit, through trial and error calculation with the Manning equation, an altered cross-section to the design discharge (Qbf). For example, the first trial cross-section (existing shape with an added structural modification), when solved for its component parts of hydraulic radius (R) and area (A), may produce a configuration which cannot convey the design discharge. With this knowledge, the trial cross-section is modified, using the reference cross section as a guide, but with a larger area, and a greater R value. When this new trial cross-section is broken down into its component parts and inserted into the Manning equation, the design discharge may be slightly higher than necessary. At this point in the iterative process it is often helpful to refer back to the field notes and longitudinal templates to reconfirm or reject earlier assumptions concerning the reference cross-section and the modified cross-section.

The designer should pay close attention to all the channel forming variables (e.g., a bedrock bank, sudden change in stream direction, instream roughness objects, slope and length of up stream riffle, slope and length of down stream riffle, slope and length of pool feature, etc.) when modifying a cross-section. Designers should attempt to simulate as many of these variables as possible using the reference section, field notes and longitudinal profile templates as guides. If a channel design is too "large" for a given Qbf, the section may have a tendency to fill with sediment. Conversely, if a cross-section is too "small" for a given Qbf, then the section may have a tendency to scour. It is important to persevere, and reach a final configuration that fits the channel forming discharge or Qbf. Eventually, an appropriate altered channel cross-sectional shape is derived along with a set of assumptions that must be met during construction.

Another dimension to this process is to observe changes in discharge capacity by varying "n" values. For example, a channel described as having a cobble bottom and clean sides may have an "n" of 0.040, while the same channel with bank vegetation may have an "n" of 0.055. Because it is better to over-design than under-design a channel modification, "n" should be chosen conservatively. For more accuracy in complex situations, individual cross-sections can be divided into vertical segments, with individual "n" values assigned to each segment. This procedure enables greater precision, particularly for complex asymmetrical cross-sections, and is described in detail by Chow (1959). This design process can be simplified by using computer programs for either programmable calculators or micro-computers. Most computer-based drawing programs easily calculate areas for non-symmetrical polygons and perimeters, facilitating rapid iterations.

Channel Manipulation Through Placement of Instream Structures

Longitudinal and Cross-Sectional Analysis of an Actual Reach.

Longitudinal and cross-sectional data for a tributary of the Klamath River in northern California were selected to provide an example of how a designer might install a wing deflector within a reach to create a pool. To illustrate the design methodology described herein, only one of the final cross-section designs is presented; normally, a complete series of design cross-sections would be compiled. The number of cross-sections needed depends on the complexity of the site and the degree of channel changes required. Usually a minimum of 3 or 4 design cross-sections are required, while lengthy or complex sites may require dozens.

Figure H-1 shows a segment of the longitudinal profile identified as a run with the potential for modification into a pool. Notice that the average slope for the reach is similar for both the reference pool and the design site. Also the slopes of both the up and down stream riffles correspond favorably. The field notes identify, "Station 42+23...what appears to be an overly wide channel at this point allows stream energy to be dissipated over a broad cross-section...". Confining the cross-sectional area through the design site might transform this run into a pool.

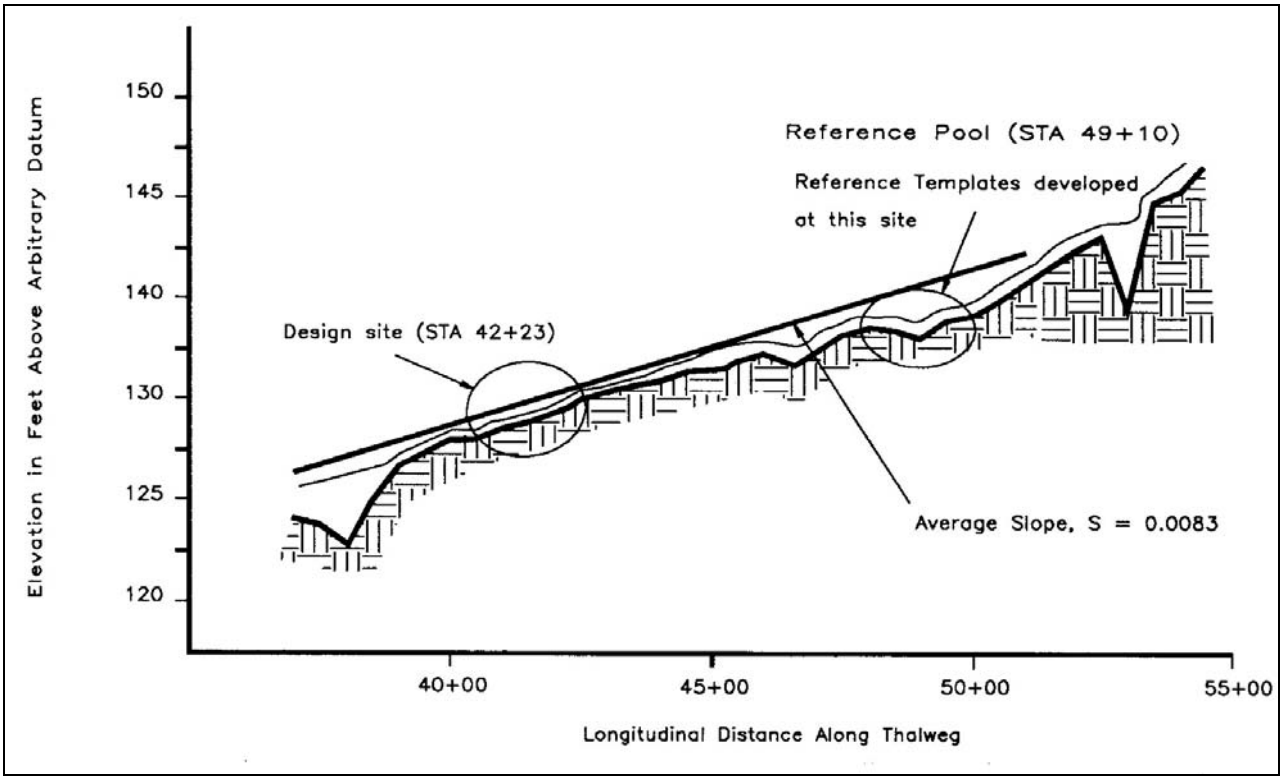

Figure H-1. Longitudinal profile of a design reach, Tarup Creek, Del Norte County, California. (Inter-Fluve, Inc. 1984).

Drafting the cross-sectional survey for the run at Station 42+23 produces the profile in Figure 2. When compared with the selected reference cross section for a pool (Station 49+10), the previously derived conclusions of the field notes can be confirmed; the cross section at STA 42+23 is overly wide and shallow. Since this run is located on a shallow bend to the left, a pool will be designed on the outside of this bend using a log wing deflector to alter the cross section and simulate the shape of the reference section. Note that the reference template matched with the station 42+23 cross section in Figure H-2 has been flipped horizontally to correspond with a left bank pool.

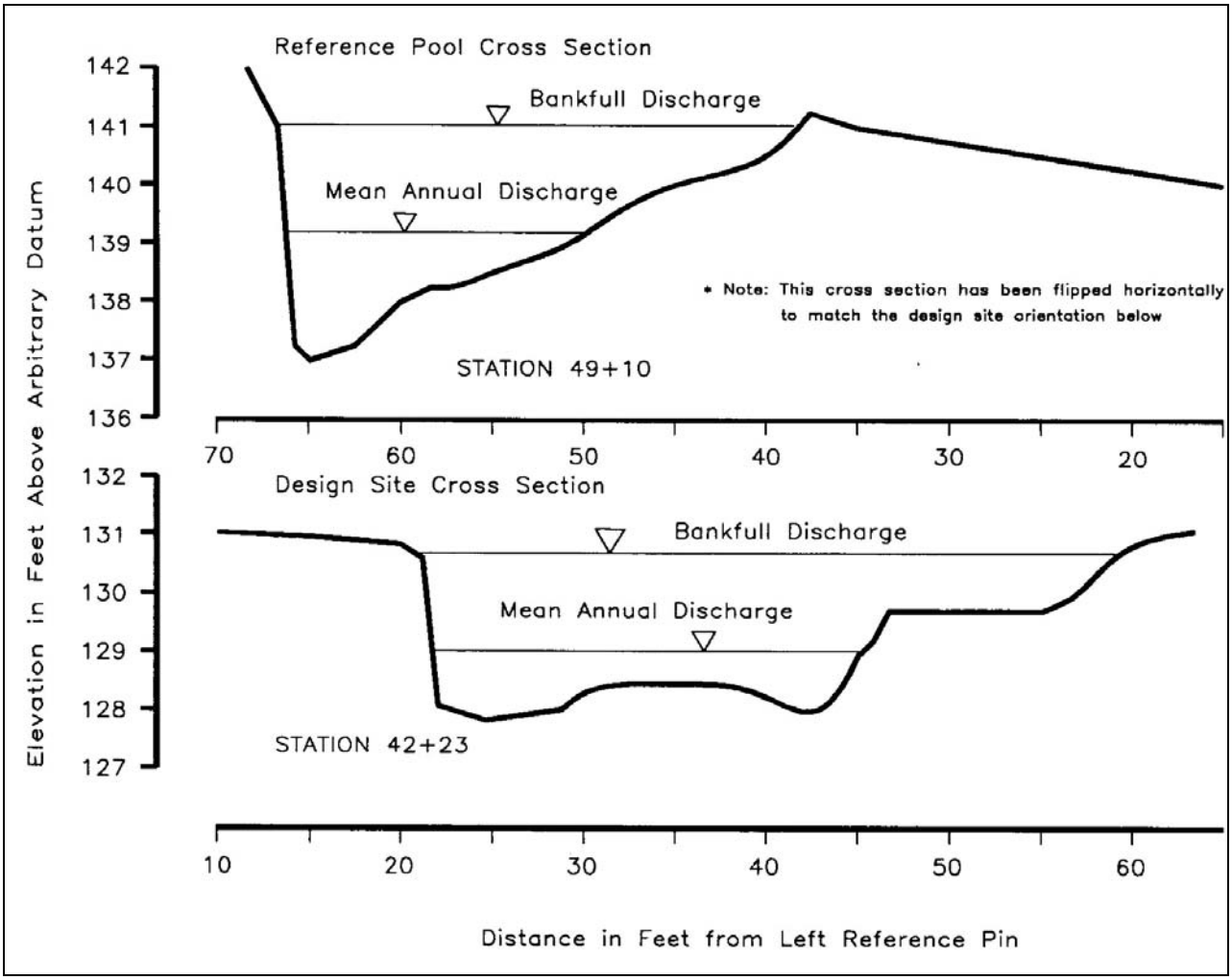

Figure H-2. Cross-sectional profiles of a reference pool and a selected design site, Tarup Creek, Del Norte County, California. (Inter-Fluve, Inc. 1984).

Design of a Habitat Alteration Using the Manning Equation as a Guide.

As previously stated, altered cross-section designs should closely resemble the reference template. The ability to emulate the stability and function of the reference cross section plays a major role in the success of this technique. Remember too, if a channel design is too "large" for a given bankfull discharge (Qbf), the section will have a tendency to fill, and if too "small", the section will have a tendency to scour.

Bankfull discharge elevations for the reference pool and new design criteria are matched by superimposing the reference pool template on the design site template. For clarity, the two templates are shown separately in Figure H-3. Matching bankfull discharge elevations is required to maintain water surface continuity. The "New Design Site Cross Section" replaces the gravel bar of the existing cross section with a log-wing deflector. The new cross section now matches the template. This combination of the reference template, STA 42+23 cross section, and the log-wing deflector becomes the first trial cross section to be subjected to hydraulic analysis.

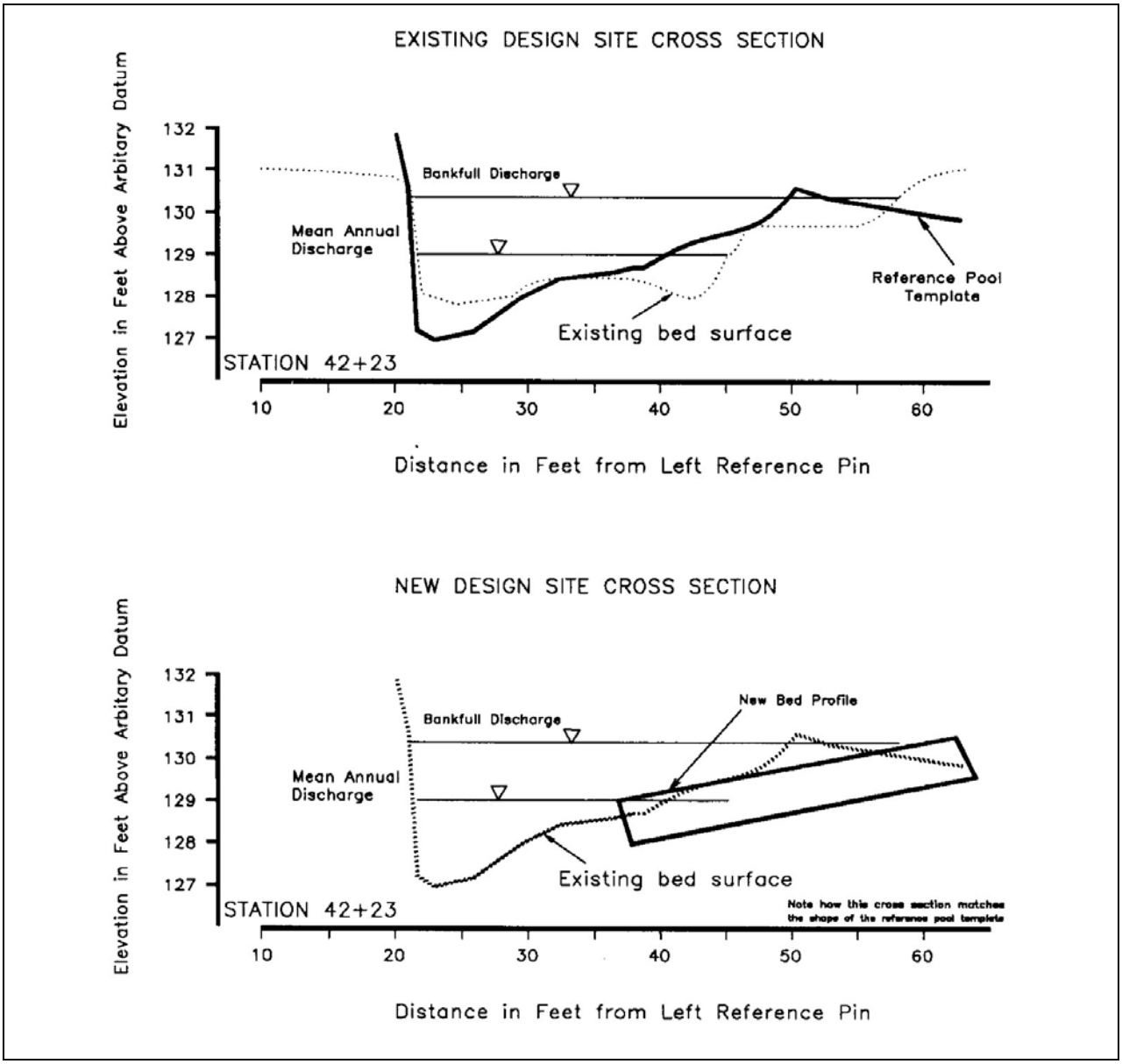

Figure H-3. Cross-sectional profile of a reference pool superimposed on a selected design site, Tarup Creek, Del Norte County, California (Inter-Fluve, Inc. 1984).

Multiple iterations, each time substituting different values for A and R in the Manning equation, results in the final cross section, shown as Figure H-4. Notice that to maintain the same bankfull discharge and provide exemplary pool habitat, cross-sectional area was altered and consequently some bottom material must be removed from the channel to form the pool. Actual construction specifications should depict the placement of this material around the wing deflector, smoothing the log's transition into the existing topography. Further similar hydraulic analysis (not shown in this example) for upstream and downstream stations would produce a series of cross-section designs fully describing the site.

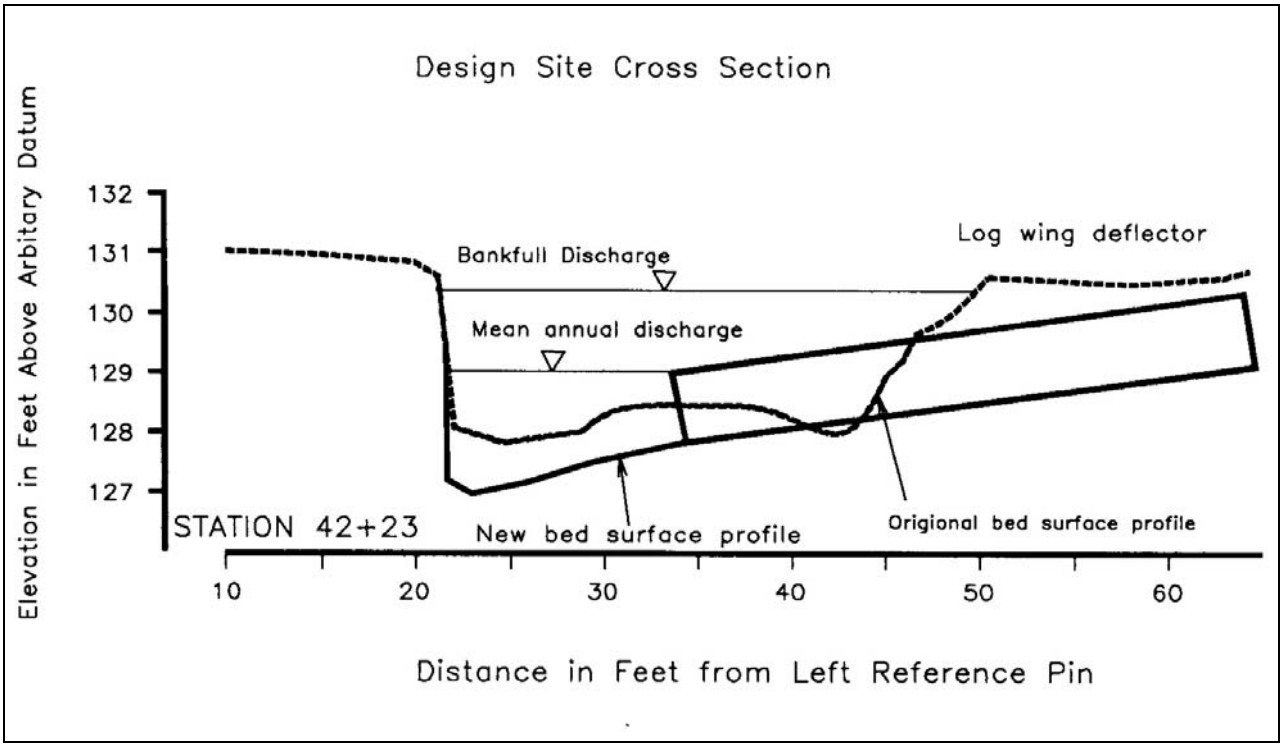

Figure H-4. Final cross-sectional design profile for station 42+23, Tarup Creek, Del Norte County, California. (Inter-Fluve, Inc. 1984).

This hydraulic analysis method enables the designer to estimate the bankfull discharge passed by the enhanced cross-section and clarifies the intensity of work required to modify the stream channel. More importantly, this method allows designers to achieve a major enhancement goal: to faithfully emulate natural cross sections that are providing desirable fish habitats.

Background Theory

Two methods for determining the Manning roughness coefficient or "n" value will be given. The first is from a table of "n" values (Table 1) reproduced with permission from McGraw-Hill, Inc. from the *Handbook of Hydraulics*, Brater, Ernest F. and King, Horace Williams, 1976., Sixth Edition, McGraw-Hill, USA. The second is a method for actually calculating the Manning roughness coefficient "n" based on measurement of flow and channel cross sections by George Heise, Associate Hydraulic Engineer, California Department of Fish and Game. The "n" value from the table will be adequate most of the time. For precise work, the calculated "n" value is recommended.

Table H-1. Values of "n" to be used with the Manning equation.

Surface	Best	Good	Fair	Bad
Uncoated cast-iron pipe	0.012	0.013	0.014	0.015
Coated cast-iron pipe	0.011	0.012*	0.013	
Commercial wrought-iron pipe, black	0.012	0.013	0.014	0.015
Commercial wrought-iron pipe, galvanized	0.013	0.014	0.015	0.017
Smooth brass and glass pipe	0.009	0.010	0.011	0.013
Smooth lockbar and welded "OD" pipe	0.010	0.011*	0.013*	
Riveted and spiral steel pipe	0.013	0.015*	0.017*	
Vitrified sewer pipe	0.010 or 0.011	0.013*	0.015	0.017
Common clay drainage tile	0.011	0.012*	0.014*	0.017
Glazed brickwork	0.011	0.012	0.013*	0.015
Brick in cement mortar; brick sewers	0.012	0.013	0.015*	0.017
Neat cement surfaces	0.010	0.011	0.012	0.013
Cement mortar surfaces	0.011	0.012	0.013*	0.015
Concrete pipe	0.012	0.013	0.015*	0.016
Wood stave pipe	0.010	0.011	0.012	0.013
Plank Flumes:				
Planed	0.010	0.012*	0.013	0.014
Unplaned	0.011	0.013*	0.014	0.015
With battens	0.012	0.015*	0.016	
Concrete-lined channels	0.012	0.014*	0.016*	0.018
Cement-rubble surface	0.017	0.020	0.025	0.030
Dry-rubble surface	0.025	0.030	0.033	0.035
Dressed-ashlar surface	0.013	0.014	0.015	0.017
Semicircular metal flumes, smooth	0.011	0.012	0.013	0.015
Semicircular metal flumes, corrugated	0.0225	0.025	0.0275	0.030
Canals and Ditches:				
Earth, straight and uniform	0.017	0.020	0.0225*	0.025
Rock cuts, smooth and uniform	0.025	0.030	0.033*	0.035
Rock cuts, jagged and irregular	0.035	0.040	0.045	
Winding sluggish canals	0.0225	0.025*	0.0275	0.030
Dredged earth channels	0.025	0.0275*	0.030	0.033
Canals with rough stony beds, weeds on earth banks	0.025	0.030	0.035*	0.040
Earth bottom, rubble sides	0.028	0.030*	0.033*	0.035

Table H–1 (cont'd). Values of "n" to be used with the Manning equation.

Surface	Best	Good	Fair	Bad
Natural Stream Channels				
(1) Clean, straight bankfull stage, no rifts or deep pools	0.025	0.0275	0.030	0.033
(2) Same as (1), but some weeds and stones	0.030	0.033	0.035	0.040
(3) Winding, some pools and shoals, clean	0.033	0.035	0.040	0.045
(4) Same as (3), lower stages, more ineffective slope and sections	0.040	0.045	0.050	0.055
(5) Same as (3), some weeds and stones	0.035	0.040	0.045	0.050
(6) Same as (4), stony sections	0.045	0.050	0.055	0.060
(7) Sluggish river reaches, rather weedy or with very deep pools	0.050	0.060	0.070	0.080
(8) Very weedy reaches	0.075	0.100	0.125	0.150

* Values commonly used in designing.

Calculation of Manning Roughness Coefficient "n" Based on Field Measurements

The following procedure for back calculating Manning roughness coefficients from measured discharge and measured channel cross-sections is based on Geological Survey Water-Supply Paper 1849 *Roughness Characteristics of Natural Channels* (Barnes 1967).

The analysis is limited to turbulent flow in fully rough channels. This condition is usually present in natural channels. It should be noted that channel roughness may vary with depth from the influence of riparian vegetation or other roughness elements in the channel. Where possible, flow measurements should be taken and calculations made at more than one rate of discharge.

Background and Theory

Most open-channel flow formulas can be expressed in the following general terms,

$$Q = C\,A\,R^{X}\,S^{Y} \tag{1}$$

where: Q is the discharge, in cubic feet per second; C is a factor of flow resistance; A is the wetted cross-sectional area of the channel, in square feet; R is the hydraulic radius, in feet; and S is the energy gradient, in feet/feet. The Manning equation is a well known variation of equation (1) and can be used as the basis for computing reach properties and roughness coefficients. The Manning equation is

$$Q = \frac{1.486}{n}\,A\,R^{2/3}\,S^{1/2} \tag{2}$$

where: n is a roughness coefficient and other variables in the equation are as defined above.

The Manning equation was developed for conditions of uniform flow in which the water surface profile and energy gradient are parallel to the streambed, and the area, hydraulic radius, and depth remain constant throughout the reach. For lack of a better solution, it is assumed that the equation is also valid for nonuniform reaches, invariably found in natural channels, if the energy gradient is modified to reflect only the losses due to boundary friction. The energy equation for a reach of nonuniform channel between two adjacent sections is

$$(h + h_v)_1 = (h + h_v)_2 + (h_f)_{1.2} + k(\Delta h_v)_{1.2} \tag{3}$$

where:

h	=	Elevation of water surface at the respective sections above a common datum;
h_v	=	Velocity head at the respective section=$\alpha V^2/2g$;
h_f	=	Energy loss due to boundary friction in the reach;
h_v	=	Upstream velocity head minus the downstream velocity head;
$k(\Delta h_v)$	=	Energy loss due to acceleration or deceleration of velocity in a contracting or expanding reach; and
k	=	A coefficient taken to be zero for contracting reaches and 0.5 for expanding reaches.

In computing the values of n the value of α, the velocity head coefficient, can be considered to be 1.00.

The friction slope S to be used in the Manning equation is thus defined as

$$S = \frac{h_f}{L} = \frac{\Delta h + \Delta h_v - k(\Delta h_v)}{L} \tag{4}$$

where: Δh is the difference in water-surface elevation at the two sections and L is the length of the reach.

In using the Manning equation the quantity $(1.486/n)AR^{2/3}$, called conveyance and designated K, is computed for each section. The mean conveyance in the reach between any two sections is computed as the geometric mean of the conveyance of the two sections. The discharge equation in terms of conveyance is:

$$Q = \sqrt{K_1 K_2 S} \tag{5}$$

where: S is the friction slope as previously defined.

The average value of the Manning "n" is computed for each reach from the measured discharge, the water surface profile, and the hydraulic properties of the reach as defined by the number of cross sections measured. The following equation, which is based on the same concepts and definitions as equations 2 through 5, is used to compute the value of Manning "n". The equation is applicable to a multi-section reach of M cross sections which are designated 1, 2, 3, ... M-1, M.

$$n = \frac{1.486}{Q}\sqrt{\frac{(h+h_v)_1-(h+h_v)_M-[(k\Delta h_v)_{1.2}+(k\Delta h_v)_{2.3}+\ldots+(k\Delta h_v)_{(M-1).M}]}{\frac{L_{1.2}}{Z_1 Z_2}+\frac{L_{2.3}}{Z_2 Z_3}+\ldots+\frac{L_{(M-1).M}}{Z_{(M-1)} Z_M}}} \tag{6}$$

where: $Z = AR^{2/3}$ and other quantities are as previously defined.

Computation Procedure

Determine the channel discharge (Q) by using flow meters or any other standard methodology. The flow measurement should correspond to the discharge at which the water surface profile measurements are taken at the selected cross sections.

Prepare a planimetric map of the project reach of the channel by plotting data from a field survey of the site. The location of all cross sections measured should be shown on the map. The waters edge, corresponding to measured discharges, can also be shown on the map for clarification. The distance between cross sections (L) can be determined from the map or derived directly from survey field notes.

Develop the water surface profile along each bank for the measured discharge by plotting the elevation and stationing of the waters edge. The water surface elevations (h) at each cross section can be taken as the average of the water surface elevation on each bank as determined from the water surface profiles.

Plot the channel cross sections from the field survey data. Show the measured water surface elevation on each cross section corresponding to the measured flow.

From the cross section plots measure the wetted perimeter (P), the wetted area (A), and calculate the hydraulic radius (R=A/P) and Z ($=AR^{2/3}$).

From the measured flow and wetted area, calculate the average velocity for the cross section (V=Q/A) and the velocity head ($h_v=V^2/2g$). Calculate deceleration losses between cross sections ($k\Delta h_v$).

Substitute the measured and calculated values of Q, L, Z, h, h_v, and $k\Delta h_v$ into equation 6 and solve for "n".

REFERENCES

Brater, Ernest F. and King, Horace Williams. 1976. Handbook of Hydraulics, Sixth Edition, McGraw-Hill, USA.

Barnes, H.H., Jr. 1967. Roughness Characteristics Of Natural Channels. United States Geological Survey Water Supply Paper 1849.

Bray, D.I. 1982. Regime equations for gravel-bed rivers. Pages 517-542 *in* Gravel-Bed Rivers, ed. by R.D. Hey, J.C. Bathurst and C.R. Thorne, John Wiley and Sons, Chichester.

Chow, V.T. 1959. Open Channel Hydraulics. McGraw-Hill Book Co., New York, 680 pp.

Dunne, T. and L.B. Leopold. 1978. Water In Environmental Planning. W.H. Freeman and Company, New York, 877 pp.

Dury, G.H. 1973. Magnitude-frequency analysis and channel morphometry. Pages 91-121 *in* Fluvial Geomorphology, State University of New York, Binghampton, Publications in Geomorphology, ed. by M. Morisawa.

Graf, W.H. 1971. Hydraulics Of Sediment Transport. McGraw-Hill Book Co., New York, 513 pp.

Hey, R.D. 1982. Design equations for mobile gravel-bed rivers. Pages 553-574 *in* Gravel-Bed Rivers, ed. by R.D. Hey, J.C. Batherst, and C.R. Thorne, John Wiley and Sons, Chichester.

Inter-Fluve, Inc. 1984. In-house computer design program for in-channel modifications. Inter-Fluve, Inc. Bozeman, MT.

Jackson, W.L. and B.P. Van Haveren. 1984. Design for a stable channel in coarse alluvium for riparian zone restoration. Water Resources Bulletin, 20: 695-703.

Jarrett, R.D. 1985. Determination Of Roughness Coefficients For Streams In Colorado. USGS Water Resources Investigation Report 85-4004, 54 pp.

Mott, R.L. 1979. Applied Fluid Mechanics. Charles Merrill Publishing Co. Columbus, Ohio, 405 pp.

Rundquist, L.A., N.E. Bradley, J.E. Baldridge, P.D. Hampton, T.R. Jennings and M.R. Joyce. 1986. Best Management Practices For Placer Mining, Reference Manual and Technical Report. Entrix, Inc., for Alaska Department of Fish and Game, 459 pp.

United States Army Corps of Engineers. 1970. Hydraulic Design Of Flood Control Channels. EM 1110-2-1601.

Williams, G.P., 1986. River meanders and channel size. Journal of Hydrology, 88:147-164.

Wolman, M.G. and J.P. Miller. 1960. Magnitude and frequency of forces in geomorphic processes. Journal of Geology, 68:54-74.

Wolman, M.G. and L.B. Leopold. 1957. River Floodplains: Some Observations on Their Formation. U.S. Geological Survey Paper 282C.

Yu, B. and M.G. Wolman. 1987. Some dynamic aspects of river geometry. Water Resources Research, 23:501-509.

APPENDIX I.

COMPUTER PROGRAMS AND DATABASE STRUCTURES

Documentation for Data Entry and Analysis Program

The Inland Fisheries Division of the Department of Fish and Game has developed an IBM compatible PC program for entering, storing, analyzing, editing, and creating uniform summary tables of fishery habitat and large woody debris inventory data. These programs are written and compiled in dBASE IV language and distributed as public domain software ("Preface, p. i" has information on obtaining a program diskette. The program's menu driven design exactly follows protocol established in this manual and will output data summary tables as illustrated in this manual. The following description is to facilitate use of the program.

Program Hardware Requirements. The program requires a hard disk with a least 3.0 megabytes (mb) of available space and an IBM-compatible PC with at least a 286 processor and 1 mb of random access memory (RAM). The program will run quite slowly under the minimum system configuration. Minimum recommended system configuration is a 386 processor with 4 mb of RAM. The habitat inventory program supports use of a HP Laserjet printer. The large woody debris program supports use of HP Laserjet and dot matrix printers. Neither program supports a mouse.

Installing the Program. The program is distributed on a single 3.5-inch high- density floppy disk in a ZIP file named HABITAT (version). Insert the program diskette in drive A or B and type INSTAL_A or INSTAL_B at the drive prompt. A directory called HABITAT will be created on your hard drive and all necessary program files will be copied to the HABITAT directory. When installation is complete you will be prompted to start the program by typing HABITAT8 at the C> prompt. Follow the instructions on the screen to use the desired programs. Store the diskette in a safe location for backup purposes.

Starting the Habitat Inventory or Large Woody Debris program. The program is started by typing HABITAT8 at the C:\HABITAT> prompt and pressing <Enter>. Follow the menu driven instructions to access the appropriate program.

The program creates new dBASE-type database files to contain the fishery habitat inventory or the large woody debris data, and stores the files in the program directory, although they may also be directed for storage on floppy disks. In order to edit, analyze, or print existing database files, the files must first reside in the program directory (C:\HABITAT) so the program to find them.

Main menu. Selections are made by using the arrow keys to move the highlighted selection bar and then pressing <Enter>.

1. Habitat Typing Program

Create a New Database. This option allows for the creation of a new database. Enter a one to eight character name for the new file with no extension. New database files will be created in the dBASE IV format and located in the current directory. In order to use an existing database file, it must be located in the same directory as the program and it must match the dBASE IV structure created by this program.

Use an Existing Database. This option presents a list of existing database files in the current directory. Choose one by highlighting it, but make sure it is a file of the appropriate structure. Do not use LWD.DBF or NODELETE.DBF.

Exit Program. This selection is the only exit from the program.

Action menu. This menu offers different actions that may be taken with the selected database.

Add. This option allows for adding additional records. The entry screen follows the format of the Habitat Inventory Data Form data sheets present in Part III of the manual. Follow the on-screen instructions for navigating through the screens. Many of the specific data entry lines have error checking routines that limit the range as type of data that may be entered. Pressing <F10> will allow access to dBASE pull-down menus, at the top of the screen. Hold down the <Ctrl> key and press the <End> key to exit when finished entering data.

Edit. This option allows reviewing and editing any records or data in the currently selected database. The default screen shows one record at a time, but you may toggle between this screen and a multiple record or BROWSE screen by pressing <F2>. Press <F10> to access the dBASE pull down menus at the top of the screen and <Ctrl><End> to exit.

Print. This option allows selection of nine different tables of summarized data for printing on HP Laserjet compatible printers.

View. Allows selection of 10 different screen views of summarized data from the currently selected database.

Export. Allows selection of data summaries to be converted to Lotus spreadsheet formats and copied to the hard disk or floppy disks.

File. Allows copying your currently selected database to a floppy disk or deletion of selected database files from the hard disk. **DO NOT DELETE FILES NAMED NODELETE.DBF OR LWD.DBF**

Return to Main Menu. This option allows returning to the main menu to select a different database for action.

Documentation for Geographic Information Systems Analysis

The Inland Fisheries Division of the Department of Fish and Game has developed a data model and Geographic Information System (GIS) interface for viewing, querying and displaying the HABITAT data. The Department of Fish and Game has used software licensed by Environmental Systems Research Institute8 (ESRI). This software has specific hardware requirements. It is beyond the scope of this manual to discuss GIS, the complexity of ESRI software, or the hardware requirements of the software. However, we would like to provide a brief outline for how GIS analysis of the HABITAT data can be developed. A data model was developed in ESRI=s Arc/Info8 software (see http://www.esri.com). The interface was developed in ESRI=s ArcView8 software. This section describes the ArcView interface and functionality. More information on the data model is available on the Internet at:

http://www.esri.com/base/common/userconf/proc96/TO250/PAP218/p218.htm

Byrne, Michael. 1996. California Salmonid Stream Habitat Inventory: A Dynamic Segmentation Application. Proceedings from the 1996 Arc/Info Users Conference.

For more information on Geographic Information Systems in general refer to:

Environmental Systems Research Institute. 1992. Understanding GIS The Arc/Info Method. ESRI. Redlands CA;

or

Environmental Systems Research Institute. 1996. ArcView GIS the Geographic Information System for Everyone. ESRI. Redlands CA.

Documentation For ArcView Habitat Inventory Project

An extension has been created in ESRI=s ArcView 3.0 8 software for spacial analysis of stream habitat inventory databases created.with the HABITAT program. Before these databases can be used, they need.to be converted using the dynamic segmentation process and saved as ArcView8 shape files (see above data model reference for this process). For more accuracy, these files should be calibrated in Arc/Info8 to correct for stream length discrepancies. No other files are required, however, other GIS coverages are often useful and can be added to the views if needed.

The ArcView8 extension, habitat.avx, can be acquired from the Inland Fisheries Division anonymous ftp site. The site is located at maphost.dfg.ca.gov/pub/outgoing/ifd. This file must be placed in the extension directory located with the ArcView8 software. This is usually c:\esri\av_gis30\arcview\ext32\, but might be different depending on where ArcView8 was loaded. To use the extension, open ArcView and go to the file menu. Choose the Extension option, and HABITAT Extension should appear among the available choices. Check the box for this option.

Now notice a new menu on the Project Menu Bar. The new menu is Stream Views and has the following options:

Stream Views
Rearing Habitat
Riparian Veg./Bank Comp.
Spawning Habitat
Miscellaneous
All Of The Above
Switch to Combining Views (or Switch to Separating Views)
Options

Choosing "Rearing Habitat" will create a view for the stream of your choice containing themes that portray the rearing habitat. Before the view is created, it is necessary to choose a dynamically segmented stream shape file. It is possible to choose more than one stream at a time by holding down the <SHIFT> key. The next two menu choices do the same for riparian vegetation/bank composition and spawning habitat. "Miscellaneous" creates themes not belonging in any of the other views. "All Of The Above" creates all four views for the stream(s) of your choice.

When multiple streams are chosen (by holding down the <SHIFT> key), the project allows these stream views to be combined into one view, or made into separate views for each stream. The last choice in the menu simply changes between "Switch to Combining Views" and "Switch to Separating Views" when it is chosen. Combining streams into one view is a useful way to create a single view for an entire watershed.

The base project contains a view named "*** Included Themes - Don't Delete ***", with no themes in it. This view needs to stay in the project for the project to function properly. It can be left empty or filled with themes that automatically will be included in the views created from the "Stream Views" menu. This is a useful way to include streams, roads, vegetation, cities, fish restoration sites, or other pertinent coverages to each view. To create a custom habitat inventory project, save it under a different name with themes added to this view. However, none of the automated views should be in the project when it is saved.

The "Options" menu item allows the user to specify which themes, based on the habitat inventory, are created in the various views. A list of themes is presented with an "X" marking the themes that will be created. Select one or more from the list to toggle the theme(s) on/off. Any new views created will only include the themes that are marked with an "X". The default setting is all themes turned on. However, any changes made will be saved automatically for subsequent sessions.

It is not recommended to save the project after the automated views are created. In most situations, the time required to create new views, is only slightly greater than the time required to open a project in which the automated views were saved. This is because most of the time goes toward querying the database, which needs to be done regardless. However, if subsequent additions or modifications were made to the automated views, it would be necessary to save these changes if needed in the future. In this case, save the project under a different name (e.g. "Mill.apr").

Problems and Potential Problems:

There is a limit as to how many views a project can hold. Depending on computer memory and speed, there may be a long wait or inadequate memory to create views for many streams at once. A little experimentation and caution is advised before choosing many streams simultaneously.

For many of the themes, habitat inventories conducted with the 10% sample protocol display as less complete than those conducted with 100% methodology. If this is not recognized, it could lead to misleading information.

Because the habitat units are small in relation to the stream as a whole, it is often necessary to zoom in to see the individual habitat units. However, zooming in often results in only part of the stream being displayed on the monitor, making it difficult to do spacial analysis for the entire stream.

Often, only one theme can be turned on at a time because the various themes display the same stream line in different ways. However, other streams combined in the same view or included with themes such as roads, boundaries, etc. can be displayed simultaneously.

Some themes created have an empty table and display nothing when turned on. This was left as is for the information it contains. For example an empty "Backwater Pools" theme indicates no backwater pools in the stream or an empty "LGR W/ Gravel/Small Cobble" theme indicates little or no spawning habitat.

Fish Habitat Inventory Database

When a new database is created using the HABITAT program, the following database structure is created (see Part III).

Field	Field Name	Type	Width	Field Description
1	STREAM	Character	25	Stream name
2	LEGAL	Character	11	Legal description using township, range, section
3	LATD	Numeric	2	Latitude in degrees at stream mouth
4	LATM	Numeric	2	Latitude in minutes
5	LATS	Numeric	4	Latitude in seconds
6	LOND	Numeric	3	Longitude in degrees at stream mouth
7	LONM	Numeric	2	Longitude in minutes
8	LONS	Numeric	4	Longitude in seconds
9	QUAD	Character	10	7.5 minute USGS quadrangle name
10	RF3RCHID	Character	17	EPA reach file number
11	PNAME	Character	30	EPA stream name
12	PNMCD	Character	11	EPA stream name unique code at mouth
13	SURVEYORS	Character	25	Names of data collection team
14	DLAT	Numeric	8	Decimal degrees latitude at stream mouth
15	DLONG	Numeric	8	Decimal degrees longitude at stream mouth

Field	Field Name	Type	Width	Field Description
16	FLOW	Character	6	Stream flow in cfs
17	DATE	Date	8	Sample date in day/month/year
18	CHANNLTYPE	Character	4	Channel type, Rosgen system
19	REACH	Character	2	Stream reach number, starting at mouth
20	TIME	Character	5	Time of sample collection start
21	WATER	Character	3	Water temperature in degrees Fahrenheit
22	AIR	Character	3	Air temperature in degrees Fahrenheit
23	HABUNITNUM	Character	16	Habitat unit no. starting at stream mouth
24	HABTYPE	Character	9	Habitat type as defined in manual
25	SIDECHANNL	Character	3	Side channel habitat type
26	MEANLENGTH	Numeric	8	Length (ft) of each habitat type
27	STRM_LGNTH	Numeric	7	Total stream length (ft) from mouth
28	MEAN_WIDTH	Numeric	6	Mean width (ft) of each habitat unit
29	MEAN_DEPTH	Numeric	5	Mean depth (ft) for each habitat unit
30	MAX_DEPTH	Numeric	5	Maximum depth (ft) for each habitat unit
31	AREA	Numeric	10	Area (sq-ft) for each habitat unit
32	DPTPLCREST	Numeric	4	Depth of pool tail crest (ft), pools only
33	RESPOLDPTH	Numeric	5	Residual pool depth (ft), pools only
34	VOLUME	Numeric	10	Water volume (cu-ft) for every unit
35	RESPOOLVOL	Numeric	10	Residual pool volume (cu-ft)
36	EMBEDDED	Numeric	1	Measure cobble embeddedness 1-4
37	SHEL_VALUE	Numeric	1	Estimated shelter value per manual
38	PCT_COVER	Numeric	3	% of unit providing fish cover
39	SHELT_RATN	Numeric	3	Shelter value x % fish cover
40	UNDER_BANK	Numeric	3	% cover provided by undercut banks
41	PER_SWD	Numeric	3	% cover provided by small woody debris
42	PER_LWD	Numeric	3	% cover provided by large woody debris
43	PER_ROOT	Numeric	3	% cover provided by root masses
44	TERR_VEG	Numeric	3	% cover provided by terrestrial vegetation
45	AQUA_VEG	Numeric	3	% cover provided by aquatic vegetation
46	WHITEWATER	Numeric	3	% cover provided by white water
47	PER_BOLDER	Numeric	3	% cover provided by boulders
48	BEDROCKLED	Numeric	3	Dominate substrate bedrock
49	SILT_CLAY	Numeric	1	Dominate substrate silt-clay
50	SAND	Numeric	1	Dominate substrate sand
51	GRAVEL	Numeric	1	Dominate substrate gravel
52	SMCOBBLE	Numeric	1	Dominate substrate small cobble
53	LGCOBBLE	Numeric	1	Dominate substrate large cobble
54	BOLDER	Numeric	1	Dominate substrate boulder
55	BEDROCK	Numeric	1	Dominate substrate bedrock
56	PCT_EXPOSE	Numeric	3	% exposed substrate in unit
57	PCT_CANOPY	Numeric	3	% vegetation canopy
58	PCT_DECID	Numeric	3	% deciduous canopy

Field	Field Name	Type	Width	Field Description
59	PCT_CONIF	Numeric	3	% coniferous canopy
60	RTBKCOMP	Numeric	1	Composition of right bank
61	RTBKDOMINT	Numeric	1	Dominant vegetation on right bank
62	PCT_RTBKCO	Numeric	3	% right bank vegetative cover
63	LFBKCOMP	Numeric	1	Composition of left bank
64	LFBKDOMINT	Numeric	1	Dominant vegetation on left bank
65	PCT_LFBKCO	Numeric	3	% left bank vegetative cover
66	CODE	Character	1	Field reserved for GIS reference
67	MEMO	Memo	10	Notes on stream and channel problems

2. Large Woody Debris Program

The LWD program creates one record within the database for each stream sample section or for each page of the LWD Survey Form. The entire LWD survey is contained within a single dBASE file.

Enter Data from LWD Survey Form. This option prompts the user for the year of survey and a four digit file name that identifies the stream surveyed. The program assigns the first four digits of the file name beginning with "LW" + year (e.g. LW97MILL.DBF). The first data entry screen prompts the user to enter stream background information. The remaining screens prompt for data entry. Data entry screens are organized to correspond with the LWD survey form format for ease of data entry.

Edit Records in Database. On selection of this option the user is prompted to select a stream for data editing from the drop down list. Be certain that the file name selected begins with "LW + year". Before editing, check that the stream name and PNMCD correspond with the correct data sheet. Use caution when editing, the program allows the user to directly access the database.

Select a Stream for Summary Report. This option allows the user to select a stream for a printed summary of each sample section. On selection of this option, the user is first prompted to identify the type of printer in use. The next screen prompts for the name of the stream for summary data. Since many streams have the same name, and several sample sections and reaches usually exist within each stream, the user is prompted to select the appropriate stream and sample section from the list presented. The user has a choice of printing one or both of the summary tables for the selected stream reach.

Exit Program. The only exit from the program is through this selection.

Large Woody Debris Stream and Riparian Survey Database

The following database was developed to store data developed when conducting a large woody debris stream and riparian survey as explained in Part 3 of this manual. The database structure has been standardized to facilitate data incorporation into the DFG statewide fishery GIS. To insure compatibility with the GIS, modifications to the structure should only be made by adding fields to the end of the database.

Field	Field Name	Type	Width	Field Description
1	STREAM	Character	20	Name of stream
2	SAMPLE	Character	2	Number of sample section in reach
3	REACH	Character	2	Number of reach
4	BASIN	Character	15	River basin or drainage system
5	DATE	Date	8	Date of survey
6	SMPLFEET	Numeric	3	Length of sample section in feet
7	TWNSHP	Character	3	Township at mouth
8	RANGE	Character	3	Range at mouth
9	SECTION	Character	2	Section number at number
10	START	Numeric	5	Feet from landmark at reach start
11	STOP	Numeric	5	Feet from landmark at reach end
12	LENGTH	Numeric	5	Total length of reach
13	QUAD	Character	15	Name of USGS 7.5 minute quad
14	LAT_D	Character	2	Degrees of latitude
15	LAT_M	Character	2	Minutes of latitude
16	LAT_S	Character	3	Seconds of latitude
17	LON_D	Character	3	Degrees of longitude
18	LON_M	Character	2	Minutes of longitude
19	LON_S	Character	4	Seconds of longitude
20	GRDIENT	Numeric	3	Water slope in percent
21	CHNTYPE	Character	2	Channel type
22	FLOW	Numeric	5	Stream flow in cfs
23	SID	Numeric	3	Obsolete field, no longer used
24	LANDMARK	Character	20	Permanent landmark or reference
25	A_TEMP	Character	3	Air temperature
26	W_TEMP	Character	3	Water temperature
27	MWETW	Numeric	2	Mean wetted stream width
28	MBFW	Numeric	2	Mean bankfull width
29	MBFD	Numeric	4	Mean bankfull depth
30	MFPW	Numeric	3	Mean flood prone area width
31	SINU	Character	3	Sinuousity ratio
32	SUBST_1_3	Character	3	% substrate with boulders 1-3 feet
33	SUBST_G3	Character	3	% substrate with boulders > 3 feet
34	RBSLOPE	Character	3	Right bank slope in percent
35	RBVEG	Character	3	Dominate vegetation on right bank

Field	Field Name	Type	Width	Field Description
36	STRMVEG	Character	3	Dominate vegetation in stream
37	LBSLOPE	Character	3	Left bank slope in percent
38	LBVEG	Character	3	Dominate vegetation on left bank
39	RBDD1L20	Numeric	2	Rt bank dead/down 1-2'dia. <20'long
40	RBDS1L20	Numeric	2	Rt bk dead/standing 1-2'dia. <20'long
41	RBPER1L20	Numeric	2	Rt bank perched 1-2'dia. <20'long
42	RBRWDD1	Numeric	2	Rt bank root wad dead/down 1-2'dia.
43	RBRWDS1	Numeric	2	Rt bank root wad dead/standing 1-2'dia.
44	RBRWPR1	Numeric	2	Rt bank root wad perched 1-2'dia.
45	STRMDD1L20	Numeric	2	Stream dead/down 1-2'dia. <20'long
46	STRMDS1L20	Numeric	2	Stream dead/standing 1-2'dia. <20'long
47	STMPER1L20	Numeric	2	Not used; no instream “perched” LWD
48	STRWDD1	Numeric	2	Stream root wad dead/down 1-2'dia.
49	STRWDS1	Numeric	2	Stream root wad dead/standing 1-2'dia.
50	LBDD1L20	Numeric	2	Lt bank dead/down 1-2'dia. <20'long
51	LBDS1L20	Numeric	2	Lt bk dead/standing 1-2'dia. <20'long
52	LBPER1L20	Numeric	2	Lt bank perched 1-2'dia. <20'long
53	LBRWDD1	Numeric	2	Lt bank root wad dead/down 1-2' dia.
54	LBRWDS1	Numeric	2	Lt bank root wad dead/standing 1-2'dia.
55	LBRWPR1	Numeric	2	Lt bank root wad perched 1-2' dia.
56	RBDD1G20	Numeric	2	Rt bank dead/down 1-2'dia. >20'long
57	RBDS1G20	Numeric	2	Rt bk dead/standing 1-2'dia. >20'long
58	RBPER1G20	Numeric	2	Rt bank perched 1-2'dia. >20'long
59	RBLVC1G20	Numeric	2	Rt bank live conifer 1-2'dia. >20'long
60	RBLVD1G20	Numeric	3	Rt bank live deciduous 1-2'dia. >20'long
61	STRMDD1G20	Numeric	2	Stream dead/down 1-2'dia. >20'long
62	STRMDS1G20	Numeric	2	Stream dead/standing 1-2'dia. >20'long
63	STMPER1G20	Numeric	2	Not used; no instream “perched” LWD
64	STMLVC1G20	Numeric	2	Stream live conifer 1-2dia.>20'long
65	STMLVD1G20	Numeric	2	Stream live deciduous 1-2dia.>20'long
66	LBDD1G20	Numeric	2	Lt bank dead/down 1-2dia.>20'long
67	LBDS1G20	Numeric	2	Lt bank dead/standing 1-2dia.>20'long
68	LBPER1G20	Numeric	2	Lt bk perched 1-2dia.>20'long
69	LBLVC1G20	Numeric	3	Lt bank live conifer 1-2dia.>20'long
70	LBLVD1G20	Numeric	3	Lt bank live deciduous 1-2dia.>20'long
71	RBDD2L20	Numeric	2	Rt bank dead/down 2-3dia. <20'long
72	RBDS2L20	Numeric	2	Rt bk dead/standing 2-3dia.<20'long
73	RBPER2L20	Numeric	2	Rt bank perched 2-3dia. <20'long
74	RBRWDD2	Numeric	2	Rt bank root wad dead/down 2-3' dia
75	RBRWDS2	Numeric	2	Rt bank root wad dead/standing 2-3'dia.
76	RBRWPR2	Numeric	2	Rt bank root wad perched 2-3' dia
77	STRMDD2L20	Numeric	2	Stream dead/down 2-3dia. <20'long
78	STRMDS2L20	Numeric	2	Stream dead/standing 2-3dia.<20'long

Field	Field Name	Type	Width	Field Description
79	STMPER2L20	Numeric	2	Not used; no instream “perched” LWD
80	STRWDD2	Numeric	2	Stream root wad dead/down 2-3' dia
81	STRWDS2	Numeric	2	Stream root wad dead/standing 2-3'dia
82	LBDD2L20	Numeric	2	Lt bank dead/down 2-3dia. <20'long
83	LBDS2L20	Numeric	2	Lt bk dead/standing 2-3dia.<20'long
84	LBPER2L20	Numeric	2	Lt bank perched 2-3dia. <20'long
85	LBRWDD2	Numeric	2	Lt bank root wad dead/down 2-3' dia.
86	LBRWDS2	Numeric	2	Lt bank root wad dead/standing 2-3'dia.
87	LBRWPR2	Numeric	2	Lt bank root wad perched 2-3' dia
88	RBDD2G20	Numeric	2	Rt bank dead/down 2-3dia. >20'long
89	RBDS2G20	Numeric	2	Rt bk dead/standing 2-3dia.>20'long
90	RBPER2G20	Numeric	2	Rt bank perched 2-3dia. >20'long
91	RBLVC2G20	Numeric	3	Rt bank live conifer 2-3dia.>20'long
92	RBLVD2G20	Numeric	3	Rt bank live deciduous 2-3dia.>20'long
93	STRMDD2G20	Numeric	2	Stream dead/down 2-3dia. >20'long
94	STRMDS2G20	Numeric	2	Stream dead/standing 2-3dia.>20'long
95	STMPER2G20	Numeric	2	Not used; no instream “perched” LWD
96	STMLVC2G20	Numeric	2	Stream live conifer 2-3dia.>20'long
97	STMLVD2G20	Numeric	2	Stream live deciduous 2-3dia.>20'l
98	LBDD2G20	Numeric	2	Lt bank dead/down 2-3dia.>20'long
99	LBDS2G20	Numeric	2	Lt bank dead/standing 2-3dia.>20'long
100	LBPER2G20	Numeric	2	Lt bk perched 2-3dia.>20'long
101	LBLVC2G20	Numeric	3	Lt bank live conifer 2-3dia.>20'long
102	LBLVD2G20	Numeric	2	Lt bank live deciduous 2-3dia.>20'long
103	RBDD3L20	Numeric	2	Rt bank dead/down 3-4dia. <20'long
104	RBDS3L20	Numeric	2	Rt bk dead/standing 3-4dia.<20'long
105	RBPER3L20	Numeric	2	Rt bank perched 3-4dia. <20'long
106	RBRWDD3	Numeric	2	Rt bank root wad dead/down 3-4'dia.
107	RBRWDS3	Numeric	2	Rt bank root wad dead/standing 3-4'd
108	RBRWPR3	Numeric	2	Rt bank root wad perched 3-4'dia.
109	STRMDD3L20	Numeric	2	Stream dead/down 3-4dia. <20'long
110	STRMDS3L20	Numeric	2	Stream dead/standing 3-4dia.<20'long
111	STMPER3L20	Numeric	2	Not used; no instream “perched” LWD
112	STRWDD3	Numeric	2	Stream root wad dead/down 3-4'dia.
113	STRWDS3	Numeric	2	Stream root wad dead/standing 3-4'dia.
114	LBDD3L20	Numeric	2	Lt bank dead/down 3-4dia. <20'long
115	LBDS3L20	Numeric	2	Lt bk dead/standing 3-4dia.<20'long
116	LBPER3L20	Numeric	2	Lt bank perched 3-4dia. <20'long
117	LBRWDD3	Numeric	2	Lt bank root wad dead/down 3-4'dia
118	LBRWDS3	Numeric	2	Lt bank root wad dead/standing 3-4'dia.
119	LBRWPR3	Numeric	2	Lt bank root wad perched 3-4'dia
120	RBDD3G20	Numeric	2	Rt bank dead/down 3-4dia. >20'long
121	RBDS3G20	Numeric	2	Rt bk dead/standing 3-4dia.>20'long

Field	Field Name	Type	Width	Field Description
122	RBPER3G20	Numeric	2	Rt bank perched 3-4dia. >20'long
123	RBLVC3G20	Numeric	2	Rt bank live conifer 3-4dia.>20'long
124	RBLVD3G20	Numeric	2	Rt bank live deciduous 3-4'd>20'long
125	STRMDD3G20	Numeric	2	Stream dead/down 3-4dia. >20'long
126	STRMDS3G20	Numeric	2	Stream dead/standing 3-4dia.>20'long
127	STMPER3G20	Numeric	2	Not used; no instream “perched” LWD
128	STMLVC3G20	Numeric	2	Stream live conifer 3-4dia.>20'long
129	STMLVD3G20	Numeric	2	Stream live deciduous 3-4dia.>20'long
130	LBDD3G20	Numeric	2	Lt bank dead/down 3-4dia.>20'long
131	LBDS3G20	Numeric	2	Lt bank dead/standing 3-4dia.>20'long
132	LBPER3G20	Numeric	2	Lt bk perched 3-4dia.>20'long
133	LBLVC3G20	Numeric	3	Lt bank live conifer 3-4dia.>20'long
134	LBLVD3G20	Numeric	3	Lt bank live deciduous 3-4dia.>20'long
135	RBDD4L20	Numeric	2	Rt bank dead/down > 4dia. <20'long
136	RBDS4L20	Numeric	2	Rt bk dead/standing > 4dia.<20'long
137	RBPER4L20	Numeric	2	Rt bank perched > 4dia. <20'long
138	RBRWDD4	Numeric	2	Rt bank root wad dead/down >4'dia
139	RBRWDS4	Numeric	2	Rt bank root wad dead/standing >4'dia.
140	RBRWPR4	Numeric	2	Rt bank root wad perched >4'dia
141	STRMDD4L20	Numeric	2	Stream dead/down >4dia. <20'long
142	STRMDS4L20	Numeric	2	Stream dead/standing >4dia.<20'long
143	STMPER4L20	Numeric	2	Not used; no instream “perched” LWD
144	STRWDD4	Numeric	2	Stream root wad dead/down >4'dia
145	STRWDS4	Numeric	2	Stream root wad dead/standing >4'dia
146	LBDD4L20	Numeric	2	Lt bank dead/down >4dia. <20'long
147	LBDS4L20	Numeric	2	Lt bk dead/standing >4dia.<20'long
148	LBPER4L20	Numeric	2	Lt bank perched >4dia. <20'long
149	LBRWDD4	Numeric	2	Lt bank root wad dead/down >4'dia
150	LBRWDS4	Numeric	2	Lt bank root wad dead/standing >4'd
151	LBRWPR4	Numeric	2	Lt bank root wad perched >4'dia
152	RBDD4G20	Numeric	2	Rt bank dead/down >4dia. >20'long
153	RBDS4G20	Numeric	2	Rt bk dead/standing >4dia.>20'long
154	RBPER4G20	Numeric	2	Rt bank perched >4dia. >20'long
155	RBLVC4G20	Numeric	2	Rt bank live conifer >4dia.>20'len
156	RBLVD4G20	Numeric	2	Rt bank live deciduous >4dia.>20'l
157	STRMDD4G20	Numeric	2	Stream dead/down >4dia. >20'long
158	STRMDS4G20	Numeric	2	Stream dead/standing >4dia.>20'long
159	STMPER4G20	Numeric	2	Not used; no instream “perched” LWD
160	STMLVC4G20	Numeric	2	Stream live conifer >4dia.>20'l
161	STMLVD4G20	Numeric	2	Stream live deciduous >4dia.>20'l
162	LBDD4G20	Numeric	2	Lt bank dead/down >4dia.>20'long
163	LBDS4G20	Numeric	2	Lt bank dead/standing >4dia.>20'long
164	LBPER4G20	Numeric	2	Lt bk perched >4dia.>20'long

Field	Field Name	Type	Width	Field Description
165	LBLVC4G20	Numeric	2	Lt bank live conifer >4dia.>20'long
166	LBLVD4G20	Numeric	2	Lt bank live deciduous >4dia.>20'long
167	COMMENT	Memo	10	Comments or remarks

Biological Survey Database

The following database was developed to store species occurrence data collected during stream surveys. The database structure was standardized by a technical committee of fishery scientists representing government, industry and private consultants so that the results would be compatible with a statewide geographic information system (GIS). To insure compatibility with the GIS, modifications to the structure should only be made by adding fields to the end of the database.

A database file named BIOSAMPL.DBF is on the floppy disk that accompanies this manual. This is a stand-alone database and is included in the compiled HABITAT program.

Field	Field Name	Type	Width	Field Description
1	SID	Numeric	4	Obsolete field, no longer used
2	BASIN	Character	10	Name of major river basin
3	STREAM	Character	20	Stream name
4	QUAD	Character	10	7.5-minute USGS quadrangle name
5	OBSERVERS	Character	20	Observers or data collectors
6	DATE	Date	8	Sample date in day/month/year
7	LATD	Numeric	2	Latitude in degrees at stream mouth
8	LATM	Numeric	2	Latitude in minutes
9	LATS	Numeric	4	Latitude in seconds
10	LOND	Numeric	3	Longitude in degrees at stream mouth
11	LONM	Numeric	2	Longitude in minutes
12	LONS	Numeric	4	Longitude in seconds
13	UTM_REG	Numeric	2	UTM zone coordinate
14	UTM_N	Numeric	10	UTM north distance in meters
15	UTM_E	Numeric	10	UTM east distance in meters
16	SITE	Character	2	Sample site # (numbered upstream from mouth)
17	DIST	Numeric	5	Distance upstream from mouth in feet
18	TIME	Numeric	4	Time of sampling
19	AIRTEMP	Numeric	2	Air temperature F°
20	H20_TEMP	Numeric	2	Water temperature F°
21	H20_VISIBL	Numeric	2	Water visibility in feet
22	FLOW_CFS	Numeric	4	Stream flow in cubic feet per second
23	REACH	Numeric	3	Stream reach no. from habitat typing data
24	HABTYP1	Numeric	3	Primary habitat type of sample unit
25	HABTYP2	Numeric	3	Secondary habitat type of sample unit
26	HABTYP3	Numeric	3	Tertiary habitat type of sample unit

Field	Field Name	Type	Width	Field Description
27	SAMPL_DIST	Numeric	3	Sampled stream distance in ft.
28	SAMPL_AREA	Numeric	4	Surface area of sampled area sq.ft.
29	EFFORT	Numeric	4	Minutes of electrofishing, seining, etc.
30	METHOD	Character	12	Sample by SNORKEL, BANK, ELECTROFISH, or SEINE
31	TROUT_YOY	Numeric	3	Number of all trout young-of-year
32	STHD_1YR	Numeric	3	Number of 1+ steelhead
33	STHD_2YR	Numeric	3	Number of 2+ steelhead
34	COHO_YOY	Numeric	3	Number of young-of-year coho
35	COHO_1YR	Numeric	3	Number of 1+ coho
36	CHINOOK	Numeric	3	Number of chinook
37	SQUAW_YOY	Numeric	3	Number of squawfish young-of-year
38	SQUAW_1YR	Numeric	3	Number of squawfish adults
39	SUCKER	Numeric	3	Number of suckers, all species
40	ROACH	Numeric	3	Number of roach
41	DACE	Numeric	3	Number of dace
42	SCULPIN	Numeric	3	Number of sculpin
43	STICKLEBAC	Numeric	3	Number of stickleback
44	CRAYFISH	Numeric	3	Number of crayfish
45	SHRIMP	Numeric	3	No. of Syncaris pacifica Federal listed
46	LAMP_LARV	Numeric	3	Number of lamprey ammocetes
47	LAMPREY	Numeric	3	Number of lamprey adults
48	RAINBOW	Numeric	3	Number of rainbow trout
49	CCT_1YR	Numeric	3	Number of cutthroat 1yr+
50	CCT_ADULT	Numeric	3	Number of cutthroat adults
51	SALAMAND	Numeric	3	Number of salamanders of all species
52	TADPOLES	Numeric	3	Number of tadpoles of all species
53	FROGS	Numeric	3	Number of adult frogs of all species
54	WARM_H20	Character	10	Warmwater species by abbrev.
55	TISUESAMPL	Character	1	Tissue samples collected: “Y” or “N”

Examples of optional additional species fields:

Field	Field Name	Type	Width	Field Description
56	GOLDEN	Numeric	3	Number of golden trout
57	BROWNTROUT	Numeric	3	Number of brown trout
58	BROOKTROUT	Numeric	3	Number of brook trout
59	LAKETROUT	Numeric	3	Number of lake trout
60	WHITEFISH	Numeric	3	Number of whitefish
61	L_REDSIDE	Numeric	3	Number of Lahontan redsides
62	KOKANEE	Numeric	3	Number of kokanee

Watershed Overview Database

The following database was developed to store data developed when conducting a watershed overview as explained in Part II of this manual. The database structure has been standardized to facilitate data incorporation into the DFG statewide fishery GIS. To insure compatibility with the GIS, modifications to the structure should only be made by adding fields to the end of the database.

A database file named WATERSHD.DBF is on the floppy disk that accompanies this manual. This is standalone database and included in the compiled HABITAT program.

Field	Field Name	Type	Width	Field Description
1	DATE	Character	8	Data collection date
2	RESEARCHER	Character	20	Investigators names
3	STREAM	Character	20	Stream name from USGS quadrangle
4	TRIB1_TO	Character	15	Receiving stream name
5	TRIB2_TO	Character	15	Name of stream receiving “Trib 1_To”
6	TRIB3_TO	Character	15	Continue down stream-web to the ocean
7	COUNTY	Character	12	County of stream mouth location
8	QUAD	Character	15	Name of USGS quad at stream mouth
9	USGS_QUAD2	Character	15	Name of USGS quad containing stream
10	USGS_QUAD3	Character	15	Name of USGS quad containing stream
11	USGS_QUAD4	Character	15	Name of USGS quad containing stream
12	PNAME	Character	20	EPA reach file designated stream name
13	PNMCD	Character	11	EPA reach file unique code at stream mouth
14	LEGAL	Character	11	Township, Range, Section at stream mouth
15	LATD	Numeric	2	Latitude in degrees at stream mouth
16	LATM	Numeric	2	Latitude in minutes
17	LATS	Numeric	4	Latitude in seconds
18	LOND	Numeric	3	Longitude in degrees at stream mouth
19	LONM	Numeric	2	Longitude in minutes
20	LONS	Numeric	4	Longitude in seconds
21	ACCESS_VIA	Memo	10	Access description
22	HYDROUNIT	Character	8	Hydrologic unit number
23	AERIALS	Logical	1	Are aerial photos available Y or N
24	AERIAL_COM	Memo	10	Comment on aerial photos
25	PRE_SURVE	Logical	1	Previous survey information Y or N
26	SURVEYINFO	Memo	10	Location of previous survey info
27	CR_ORDER	Character	1	Stream order
28	TOT_LENGTH	Numeric	6	Total stream length in miles
29	FED_LENGTH	Numeric	6	Stream length on Federal land
30	STA_LENGTH	Numeric	6	Stream length on State land
31	PRV_LENGTH	Numeric	6	Stream length on private land
32	LENGTH_COM	Memo	10	Comment on stream length

Field	Field Name	Type	Width	Field Description
33	INVENTORY	Logical	1	Fish habitat inventory complete?
34	INVEN_DATE	Character	16	Fish habitat inventory date
35	INVEN_LGTH	Numeric	6	Fish habitat inventory length
36	END_LATD	Numeric	2	End of survey, degrees of latitude
37	END_LATM	Numeric	2	End of survey, minutes of lat.
38	END_LATS	Numeric	4	End of survey, seconds of lat.
39	END_LONGD	Numeric	3	End of survey, degrees of longitude
40	END_LONGM	Numeric	2	End of survey, minutes of long.
41	END_LONGS	Numeric	4	End of survey, seconds of long.
42	INVENT_COM	Memo	10	Comment on fish habitat inventory
43	E_O_ANADRO	Logical	1	Did survey reach end of anadromy?
44	DIST_CHIN	Numeric	5	Distance where chinook were found
45	DIST_COHO	Numeric	5	Distance where coho were found
46	DIST_SH	Numeric	5	Distance where steelhead were found
47	DIST_S_SH	Numeric	5	Distance summer steelhead were found
48	BASIN_AREA	Numeric	8	Watershed area in square miles
49	PCNT_FED	Numeric	3	% watershed in Federal ownership
50	PCNT_STA	Numeric	3	% watershed in State ownership
51	PCNT_PRV	Numeric	3	% watershed in private ownership
52	AREA_COM	Memo	10	Comment on watershed area
53	BASE_FLOW	Numeric	7	Base stream flow in cfs
54	MOUTH_ELEV	Numeric	5	Elevation of stream mouth
55	HEAD_ELEV	Numeric	5	Elevation of stream headwaters
56	LAKE_NUM	Numeric	3	Number of lakes in watershed
57	LAKE_AREA	Numeric	5	Area of all lakes in watershed
58	FISH_CHIN	Logical	1	Chinook present in watershed?
59	FISH_COHO	Logical	1	Coho present in watershed?
60	FISH_SH	Logical	1	Steelhead present in watershed?
61	FISH_SH_S	Logical	1	Summer steelhead present?
62	FISH_SQ_S	Logical	1	Squawfish present?
63	FISH_OTHER	Logical	1	Are other species present?
64	FISH_COM	Memo	10	Comments about fish community
65	ETS_SPECIE	Logical	1	Threatened & endangered spp. present?
66	ETS_COM	Memo	10	Comment about T&E species
67	ENDEM_PR	Logical	1	Are endemic fish stocks present?
68	ENDEM_COM	Memo	10	Comment on endemic fish stocks
69	MAN_CW_NAT	Logical	1	Natural stock coldwater fishery
70	MAN_CW_MIX	Logical	1	Mixed stock coldwater fishery
71	MAN_AN_NAT	Logical	1	Natural stock anadromous fishery
72	MAN_AN_MIX	Logical	1	Mixed stock anadromous fishery
73	MAN_WW	Logical	1	Warm water fishery
74	MAN_OTHER	Logical	1	Other management objectives
75	FLOW_DATA	Logical	1	Is stream flow data available?

Field	Field Name	Type	Width	Field Description
76	FLOW_COM	Memo	10	Comment on stream flow data
77	WQUAL_DATA	Logical	1	Is water quality data available?
78	WQUAL_COM	Memo	10	Comment on water quality data
79	LAND_1A	Logical	1	Land use code - paved roads
80	LAND_1B	Logical	1	Land use code - unpaved roads
81	LAND_2	Logical	1	Land use code - timber harvest
82	LAND_3A	Logical	1	Land use code - open pit mining
83	LAND_3B	Logical	1	Land use code - hard rock mining
84	LAND_3C	Logical	1	Land use code - suction dredging
85	LAND_4A	Logical	1	Land use code - grazing
86	LAND_4B	Logical	1	Land use code - cultivation
87	LAND_5A	Logical	1	Land use code - Federal wilderness
88	LAND_5B	Logical	1	Land use - State park or wilderness
89	LAND_6A	Logical	1	Land use code - large hydro project
90	LAND_6B	Logical	1	Land use code - small hydro project
91	LAND_6C1	Logical	1	Out of basin water diversion
92	LAND_6C2	Logical	1	Land use - in basin water diversion
93	LAND_7A	Logical	1	Land use code - ski areas
94	LAND_7B	Logical	1	Land use code - campgrounds
95	LAND_8	Logical	1	Land use code - dispersed recreation
96	LAND_9	Logical	1	Land use code - urbanization
97	LAND_10	Logical	1	Land use - off highway vehicle area
98	LAND_COM	Memo	10	Land use comments
99	GEN_COM	Memo	10	General comments

Carcass Survey Database

The following database was developed to store data collected during carcass surveys using the methodology explained in Part IV of this manual. The database structure has been standardized to facilitate data incorporation into the DFG statewide fishery GIS. To insure compatibility with the GIS, modifications to the structure should only be made by adding fields to the end of the database.

A database file named CARCASS.DBF is on the floppy disk that accompanies this manual. This is a stand-alone database and is included in the compiled HABITAT program.

Field	Field Name	Type	Width	Field Description
1	DATE	Date	8	Date of survey
2	BASIN	Character	15	Drainage basin name
3	COUNTY	Character	3	County at creek mouth
4	PNAME	Character	20	EPA reach file designated stream name
5	PNMCD	Character	11	EPA reach file unique code at stream mouth
6	STREAM	Character	15	Stream name on USGS quadrangle
7	LEGAL	Character	15	Township, Range, and Section at mouth
8	LATD	Numeric	2	Latitude degrees at stream mouth
9	LATM	Numeric	2	Latitude minutes at stream mouth
10	LATS	Numeric	4	Latitude seconds at stream mouth
11	LOND	Numeric	3	Longitude degrees at stream mouth
12	LONM	Numeric	2	Longitude minutes at stream mouth
13	LONS	Numeric	4	Longitude seconds at stream mouth
14	ST_LAT_D	Numeric	2	Lat. degrees at downstream start
15	ST_LAT_M	Numeric	2	Lat. minutes at downstream start
16	ST_LAT_S	Numeric	4	Lat. seconds at downstream start
17	ST_LON_D	Numeric	3	Lon. degrees at downstream start
18	ST_LON_M	Numeric	2	Lon. minutes at downstream start
19	ST_LON_S	Numeric	4	Lon. seconds at downstream start
20	END_LAT_D	Numeric	2	Lat. degrees at upstream end
21	END_LAT_M	Numeric	2	Lat. minutes at upstream end
22	END_LAT_S	Numeric	4	Lat. seconds at upstream end
23	END_LON_D	Numeric	3	Lon. degrees at upstream end
24	END_LON_M	Numeric	2	Lon. minutes at upstream end
25	END_LON_S	Numeric	4	Lon. seconds at upstream end
26	MILES	Numeric	4	Approximate miles of survey
27	NLCHIN	Numeric	3	No. of live chinook
28	NLCOHO	Numeric	3	No. of live coho
29	NLSTH	Numeric	3	No. of live steelhead
30	NLOTHER	Numeric	3	No. of live unknown species
31	NFCHINM	Numeric	3	No. of fresh male chinook carcasses
32	NFCHINF	Numeric	3	No. of fresh female chinook carcasses
33	NFCOHOM	Numeric	3	No. of fresh male coho carcasses
34	NFCOHOF	Numeric	3	No. of fresh female coho carcasses
35	NFSTH	Numeric	3	No. of fresh steelhead carcasses
36	NNFCHIN	Numeric	3	No. of non-fresh chinook carcasses
37	NNFCOHO	Numeric	3	No. of non-fresh coho carcasses
38	NNFSTH	Numeric	3	No. of non-fresh steelhead carcasses
39	NNFOTHER	Numeric	3	No. of non-fresh non-ID'ed carcasses
40	CWT_REC	Numeric	3	No. of coded-wire tag recoveries
41	REDDS	Numeric	3	Number of redds counted

Habitat Project Evaluation Survey Database

The following databases were developed to store habitat project evaluation data collected during evaluation surveys. To insure compatibility with the GIS, modifications to the structure should only be made by adding fields to the end of the database.

Database files named EVLDATA.DBF and EVALGEN.DBF are on the floppy disk that accompanies this manual.

Database File: EVALGEN.DBF General project information

Field	Field Name	Type	Width	Field Description
1	STREAM	Character	20	Name of stream
2	BASIN	Character	15	Name of drainage or system
3	PNAME	Character	20	EPA reach file designated stream name
4	PNMCD	Character	11	EPA reach file unique stream
5	EVALUATOR	Character	15	Name of evaluator
6	DATE	Date	8	Date of evaluation
7	CNTRNO	Character	7	Contract number of project
8	FY	Character	5	Fiscal year of contract
9	SOURCE	Character	10	Funding source
10	CONTACT	Character	12	DFG contact person
11	CONTRACTOR	Character	15	Project contractor
12	MULTI_LOC	Logical	1	Multiple site contract? (Y/N)
13	AMOUNT	Character	6	Dollar amount of project
14	P_OWNER	Character	15	Property owner
15	ACCESS	Character	50	Description of access to site
16	CHANNLTYPE	Character	3	Channel type(s) in project reach
17	STR_ORDER	Character	1	Stream order of project stream
18	DRAIN_AREA	Numeric	5	Drainage area in sq. mi.
19	QUAD	Character	15	Name of USGS 7.5 min. quad. map
20	LATD	Numeric	2	Degrees of latitude
21	LATM	Numeric	2	Minutes of latitude
22	LATS	Numeric	4	Seconds of latitude
23	LOND	Numeric	3	Degrees of longitude
24	LONM	Numeric	2	Minutes of longitude
25	LONS	Numeric	4	Seconds of longitude
26	P_COMPL	Character	8	Month and year project completed (mm/yy)
27	LAST_EVAL	Character	8	Month and year of last evaluation (mm/yy)
28	PREPROJ	Logical	1	Preproject data available
29	PRE_LOC	Character	20	Location of preproject data
30	ASBUILT	Logical	1	As-built plans available
31	ASBILT_LOC	Character	20	Location of as_built plans
32	NCONST	Numeric	2	Number of structures built

Field	Field Name	Type	Width	Field Description
33	NEVAL	Numeric	2	Number of structures observed
34	PAGES	Character	2	Number of evaluation pages
35	COMMENTS	Memo		Comments of project/evaluation

Database File: EVLDATA.DBF Structure or site evaluation.

Field	Field Name	Type	Width	Field Description
1	STREAM	Character	20	Name of stream
2	BASIN	Character	15	Name of drainage or basin
3	PNAME	Character	20	EPA reach file designated stream name
4	PNMCD	Character	11	EPA reach file unique code at mouth
5	DATE	Date	8	Date of evaluation
6	CNTRNO	Character	7	Contract number of project
7	FY	Character	5	Fiscal year of contract
8	RPOINT	Character	15	Reference point in stream
9	DLAT	Numeric	6	Decimal degrees latitude at mouth
10	DLONG	Numeric	7	Decimal degrees longitude at mouth
11	RPOINT_FT	Numeric	5	Feet from reference point
12	FT	Numeric	5	Stream length of habitat type(s) effected
13	CHANNLTYPE	Character	4	Channel type in project area
14	OBJECTV	Character	1	Restoration objective of structure
15	TYPE	Character	3	Type of habitat structure
16	OBJ_RATE	Character	1	Rating of objective
17	OBJ_COM	Character	150	Comments of objective rating
18	CON_RATE	Character	1	Rating of condition
19	CON_COM	Character	150	Comments of condition rating
20	PROBLEM1	Numeric	2	Structural problems
21	PROBLEM2	Numeric	2	Structural problems
22	PROBLEM3	Numeric	2	Structural problems
23	PROBLEM4	Numeric	2	Structural problems
24	PROB_COM	Character	150	Comments of structural problems
25	MAN_MOD	Logical	1	Maintenance or repair recommended
26	IMPROVE	Logical	1	Improvements to increase effectiveness
27	MOD_COM	Character	150	Comments on maintenance or improvements
28	HABTYP	Character	4	Habitat type associated with structure
29	WIDTH	Numeric	3	Bankfull stream width
30	MAXPOOL	Numeric	4	Maximum depth of pool
31	TAILCRST	Numeric	4	Depth of the pool tail crest
32	COMPLX	Numeric	1	Shelter complexity
33	COVER	Numeric	2	Percent cover
34	FISH	Character	150	Comments of fish observed
35	PHOTO	Character	1	Photo taken (Y/N)