Salmonid Habitat Information Project (S.H.I.P.): A Strategic Level Inventory Approach

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A STRATEGIC LEVEL INVENTORY APPROACH

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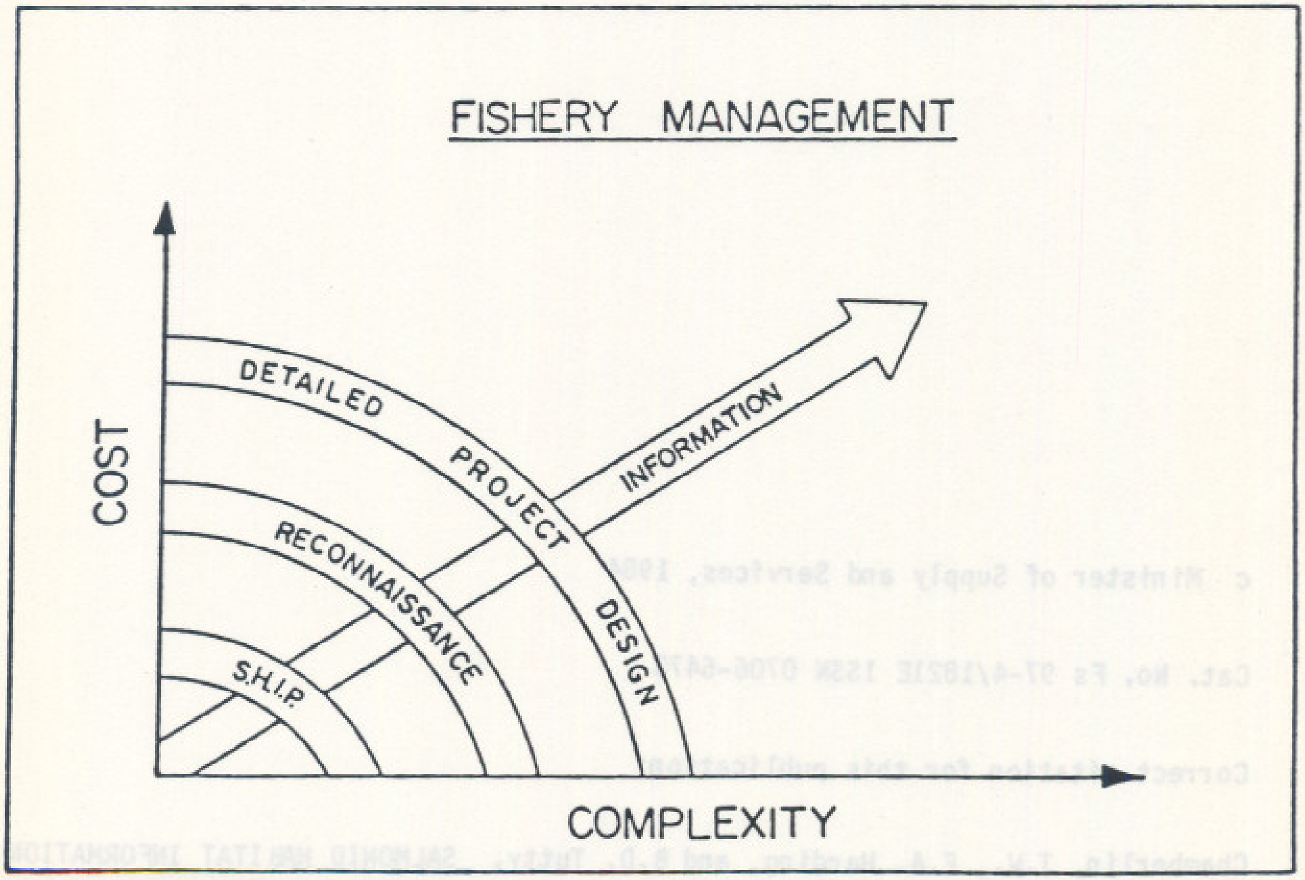

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S.H.I.P.
EXECUTIVE SUMMARY

The pilot Federal/Provincial Salmonid Habitat Information Project (S.H.I.P.) was designed to:

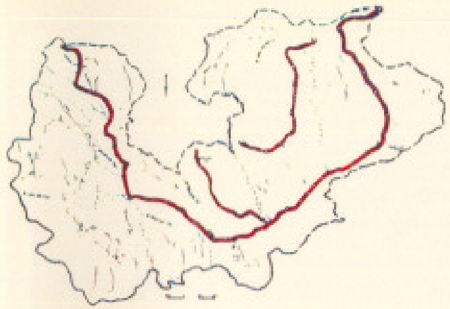
1) aid in a rapid evaluation of some proposed S.E.P. projects in the South Coast Division; and,
2) test the costs and applicability of the evaluation method for large groups of watershed (pilot areas).

The S.H.I.P. methodology used available information about fish distribution, air-photo interpretation of significant stream features and quantitative measurements of gradient classes from topographic maps to estimate the relative value of present and potential fish habitat. The spatial distribution of these habitat classes within and between basins was plotted on coloured interpretive maps for each species. The amount (Km) of each habitat class was also tabulated by species.

Costs of producing the S.H.I.P. product were estimated from detailed time and cost accounting. For a production product, approximately $19/km is required, which can be reduced at least 25% with appropriate computerization. Detailed component costs are presented in the report.

The S.H.I.P. product was designed for application to strategic level fish production planning. Additional application areas have become evident and include habitat management (pesticide and logging referrals), inventory design and major development review.

KOKSILAH RIVER



PRESENT DISTRIBUTION

HIGH VALUE

MODERATE VALUE

ADDITIONAL POTENTIAL

HIGH VALUE

MODERATE VALUE

LEGEND

Cascade Obstruction

Obstruction
F - Falls
R - Rock
D - Dam
Bd Beaver Dam

Log Jam

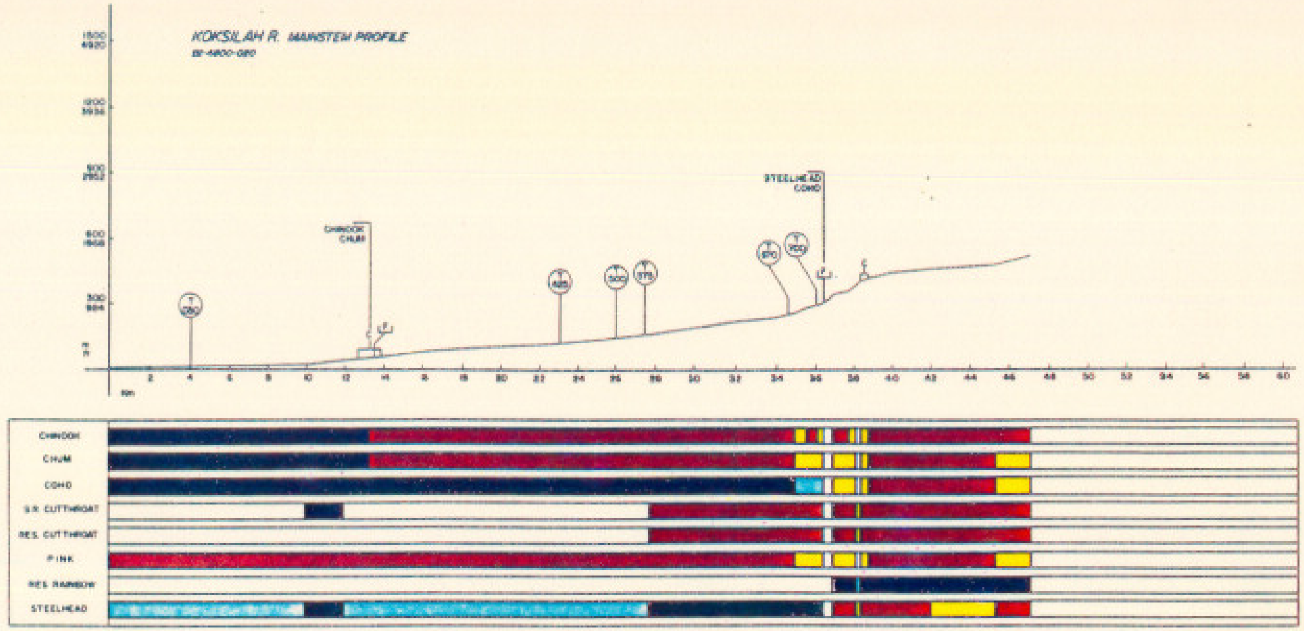
SEP Project Proposal

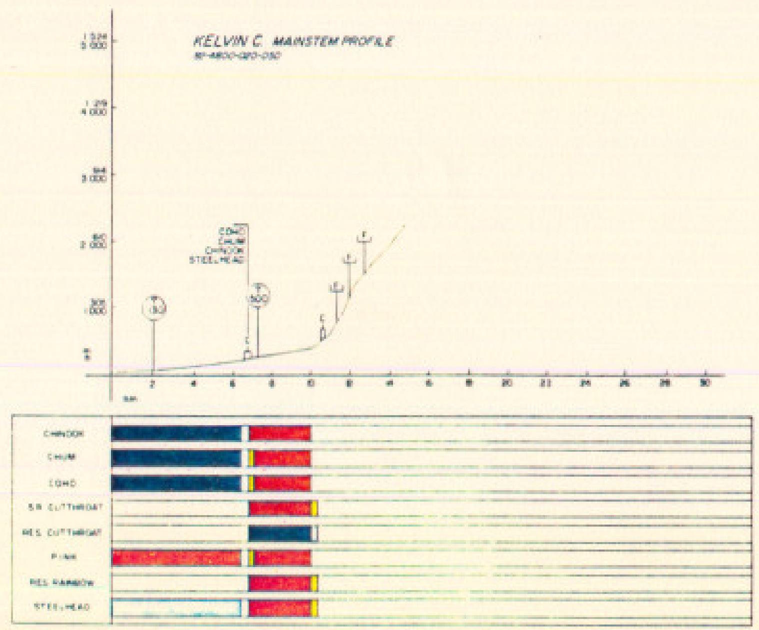
DFO Information Source
Dept Fisheries & Oceans

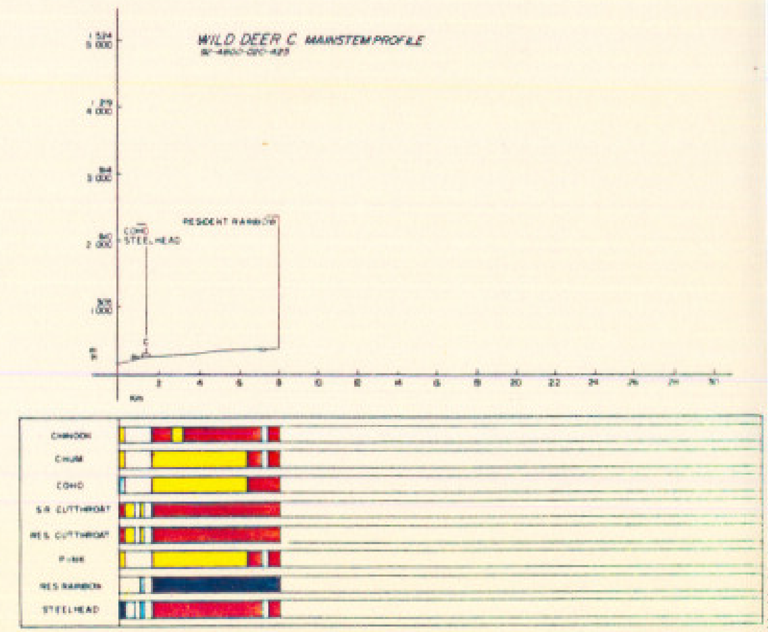
Lake

Wetland

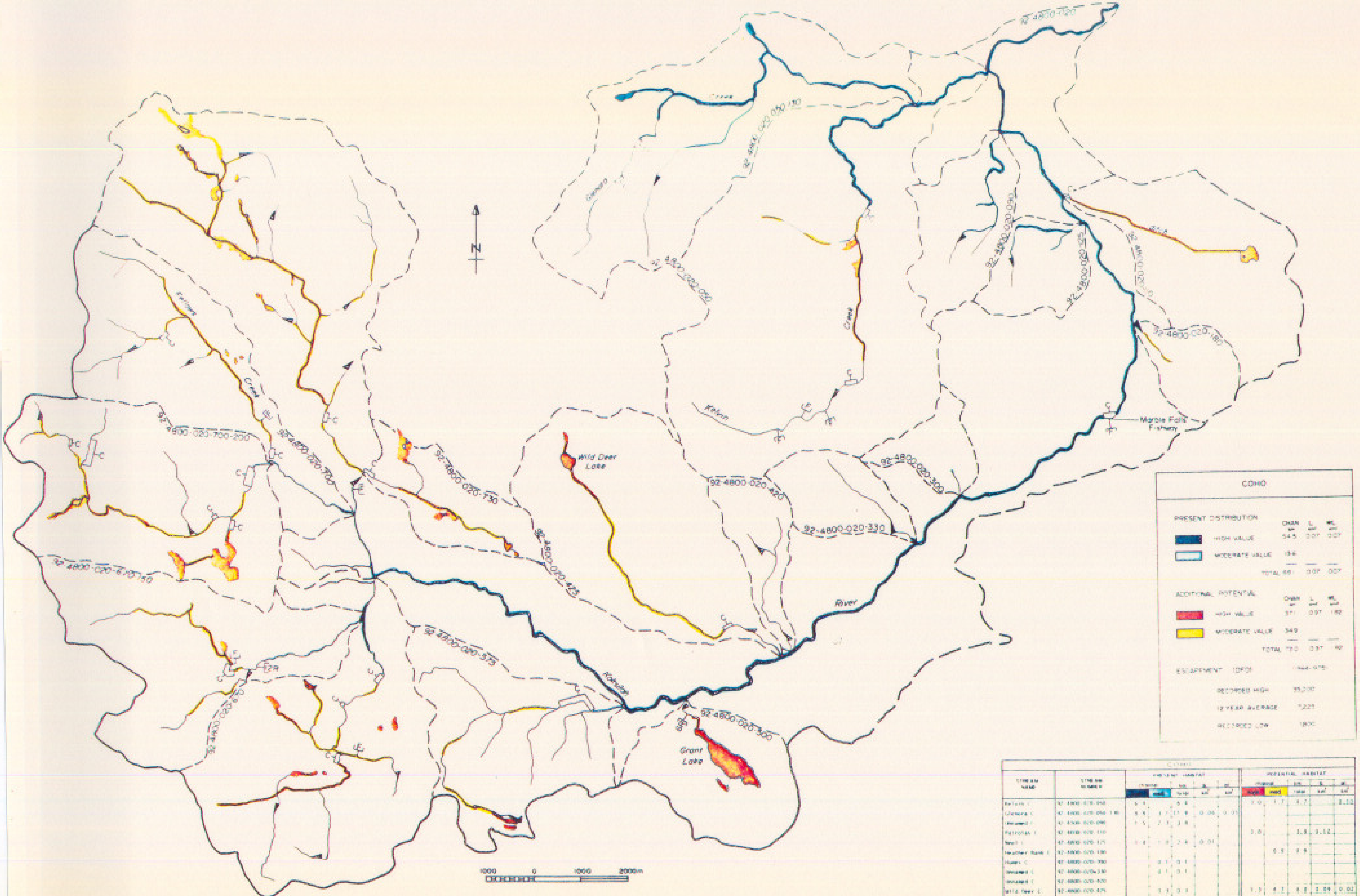
Point of Difficult Passage







COHO SALMON



STREAM NAME	STREAM NUMBER	PRESENT HABITAT: CHANNEL high	PRESENT HABITAT: CHANNEL mod	PRESENT HABITAT: total km	PRESENT HABITAT: L km²	PRESENT HABITAT: WL km²	POTENTIAL HABITAT: CHANNEL high	POTENTIAL HABITAT: CHANNEL mod	POTENTIAL HABITAT: total km	POTENTIAL HABITAT: L km²	POTENTIAL HABITAT: WL km²
Kelvin C.	92-4800-020-050	6.5		6.5			3.0	1.7	4.7		0.12
Clemens C.	92-4800-020-090-110	9.9	1.7	11.6	0.06	0.05					
Unnamed C.	92-4800-020-090	1.5	2.1	3.6							
[illegible] C.	92-4800-020-110						3.6		1.8	0.12	
[illegible] C.	92-4800-020-125	0.8	1.6	2.4	0.01						
[illegible] C.	92-4800-020-180							0.9	0.9		
[illegible] C.	92-4800-020-300		0.1	0.1							
Unnamed C.	92-4800-020-330		0.1	0.1							
Unnamed C.	92-4800-020-420										
Wild Deer C.	92-4800-020-475		1.1	1.1			1.5	4.1	6.8	0.09	0.02
Grant Lake C.	92-4800-020-500						0.1	0.2	1.5	0.54	0.04
Unnamed C.	92-4800-020-575		0.9	0.9				2.2	2.2	0.04	0.05
Unnamed C.	92-4800-020-670	1.1	0.6	1.7			4.4	5.6	10.8	0.04	0.12
Unnamed C.	92-4800-020-670-150		1.7	1.7			1.2	3.6	4.8		0.03
Fellows C.	92-4800-020-700	0.4	1.7	2.1			2.9	3.1	6.0		0.04
Unnamed C.	92-4800-020-700-200		0.1	0.1			5.1	4.1	9.2	0.01	0.08
Unnamed C.	92-4800-020-730						2.0	2.3	4.3	0.05	0.21
[illegible] R. Up Marble Falls		13.4		13.4							
Marble Falls to 92-4800-020-730		21.8	1.7	23.5		0.02					
[illegible] R. above 92-4800-020-730							13.1	6.0	19.1	0.06	0.71

CRITERIA FOR FISH HABITAT EVALUATION				
SPECIES	CHANNEL SLOPE		LAKES	WETLANDS
COHO	0 to 2.0%	2.1 to 5.0%	HIGH	HIGH

SOMMAIRE POUR LA DIRECTION DU PIHS

Le projet pilote féderal-provincial d'information sur l'habitat des salmonidés (PIHS) a été concu afin de 1) faciliter une évaluation rapide de certains projets proposés dans le cadre du PMVS dans la division de la cote sud et de 2) vérifier les couts et l'applicabilité de la méthode d'évaluation pour des groupes importants de bassins-versants (secteurs pilotes).

En ce qui concerne la méthodologie du PIHS, on s'est servi des renseignements disponibles sur la répartition des poissons, de l'interprétation de photographies aériennes pour ce qui est des caractéristiques importantes des cours d'eau et de mesures quantitatives des catégories de pente tirées de cartes topographiques pour évaluer la valeur relative de l'habitat du poisson actuel et éventuel. La distribution spatiale de ces catégories d'habitat a l'intérieur des bassins et entre ceux-ci a été reportée sur des cartes d'interprétation en couleurs pour chaque espece. La quantité (km) des catégories d'habitat a été mise sous forme de tableau, par espece.

Les couts de réalisation du PIHS ont été évalués a partir d'une comptabilité détaillée du temps et des couts. On a déterminé qu'il faillait environ $19/km, chiffre qui peut etre réduit d'au moins 25% si on utilise une méthode d'automatisation appropriée. On présente dans ce rapport les couts détaillés des éléments constituants.

Le PIHS a été concu pour s'appliquer a la planification de la production de poissons a un niveau stratégique. D'autres domaines d'application sont apparus, qui comprennent la gestion de l'habitat (recommandations touchant les pesticides et l'exploitation forestiere), la conception des inventaires, et l'examen des grands aménagements.

1. INTRODUCTION

1.1 BACKGROUND

Systematic information about streams, lakes and watersheds is of value to both federal and provincial fisheries management programs. The Pearse commission on Pacific Fisheries Policy further identified the need to document the resource base underlying fisheries production.

Provincial inventory and information systems for both streams, lakes and estuaries have been operational for several years. Working level biologists in both the B.C. Ministry of Environment (MOE) and the Canada Department of Fisheries and Oceans (DFO) recognized the value of cooperative efforts to compile, coordinate and present existing habitat information in the management process. Accordingly, a pilot program was designed (S.H.I.P.) to test the value and efficiency of a cooperative federal/provincial habitat information gathering project.

1.2 OBJECTIVES

Two separate but related objectives guided this project:

1) To assemble habitat profile components on selected watersheds so that technical feasibility and desireability of salmonid enhancement projects for the South Coast Division Transition Plan can be assessed (Figure 1).
2) To assemble habitat profiles for watershed within specified pilot regions (groups of watersheds) so that the methods and costs for improved fishery production opportunity can be compared and evaluated (Figure 1).

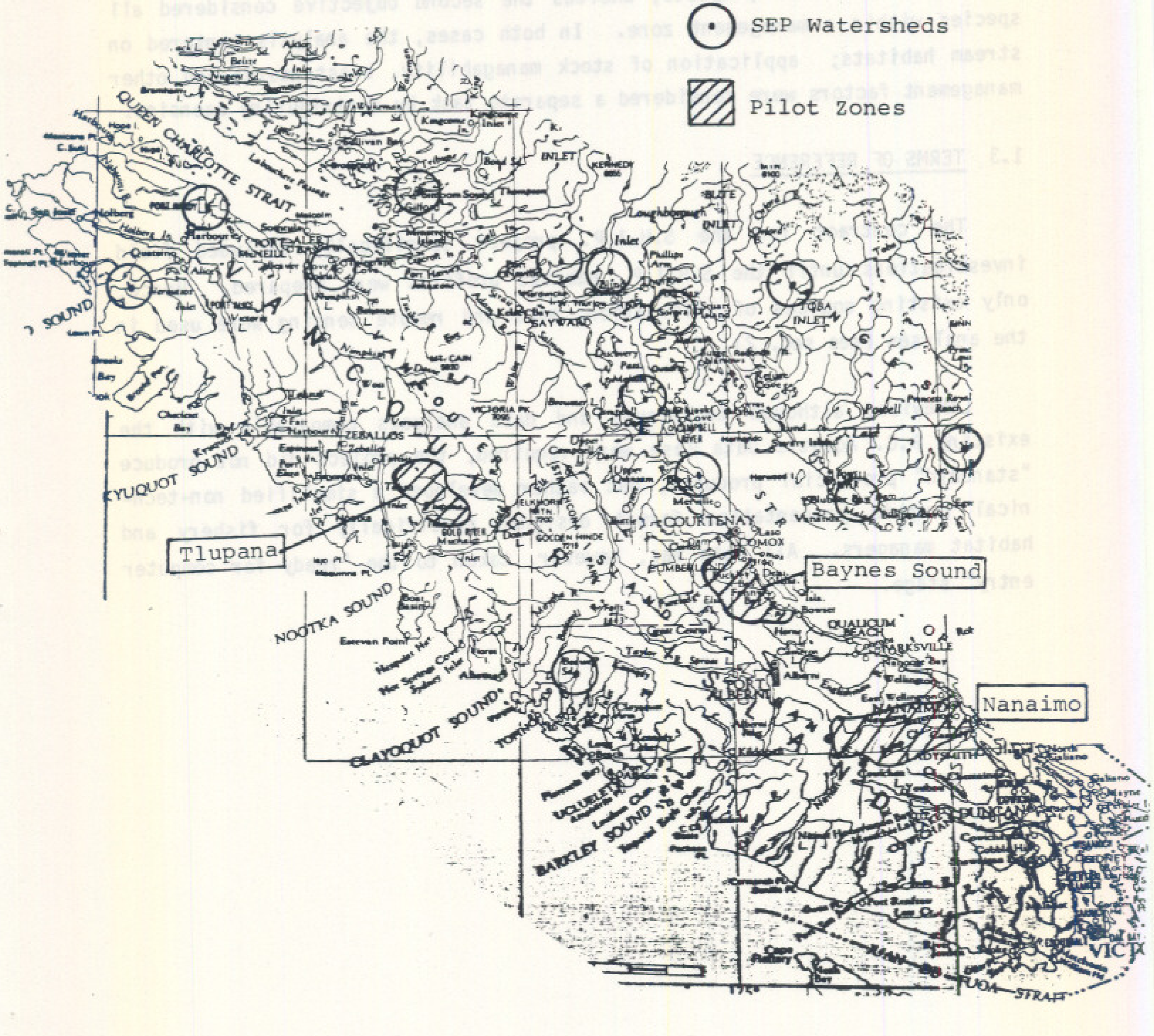


Figure 1: SHIP Watershed Area Locations

In the first objective (S.E.P. watersheds), the analysis focused on the effects of potential projects, whereas the second objective considered all species within a management zone. In both cases, the analysis centered on stream habitats; application of stock managability, biostandards and other management factors were considered a separate task by contributing agencies.

1.3 TERMS OF REFERENCE

The contract for the S.H.I.P. project specifically excluded field investigations until the S.H.I.P. habitat profiles were prepared. Hence, only existing sources of information, maps and remote sensing were used in the analyses (see sec. 2).

Likewise, although techniques and data analyses compatable with the existing B.C. Aquatic Data Base were required, the project did not produce "standard" provincial products, but rather developed a simplified non-technical graphic presentation format designed specifically for fishery and habitat managers. All data was, however, taken to the "ready for computer entry" stage.

2. METHODS

This section describes the methods for producing the S.H.I.P. habitat profile maps and data summaries. These products summarize all potential fish habitat in a stream system. Techniques for air photo interpretation, reach identification and map digitizing are not described here.

The S.H.I.P. product represents a level 1 to 2 survey, (see Chamberlin, 1980), using remote sensing and presently available field data. No additional aerial observation (level 2) or ground sampling (level 3) was done.

Data compilation and analysis for the S.H.I.P. products was done manually. Implications on project costs are discussed in section 3.

Figure 2 illustrates the components of the S.H.I.P. process discussed below.

2.1 DATA COMPILATION

Available information on fish species presence, location of barriers, escapement numbers and sport fishing catch statistics were compiled. Sources of information include:

1) Preliminary Catalogue of Salmon Streams and Spawning Escapements.
2) Escapement files of district fisheries offices and the Department of Fisheries and Oceans' S.E.D. system summaries.
3) Inventory data files in Fish and Wildlife Branch, Nanaimo, and Inventory Operations Unit, Ministry of Environment, Victoria.
4) Personal communications with federal and provincial fisheries biologists, technicians, fisheries officers and private consultants.

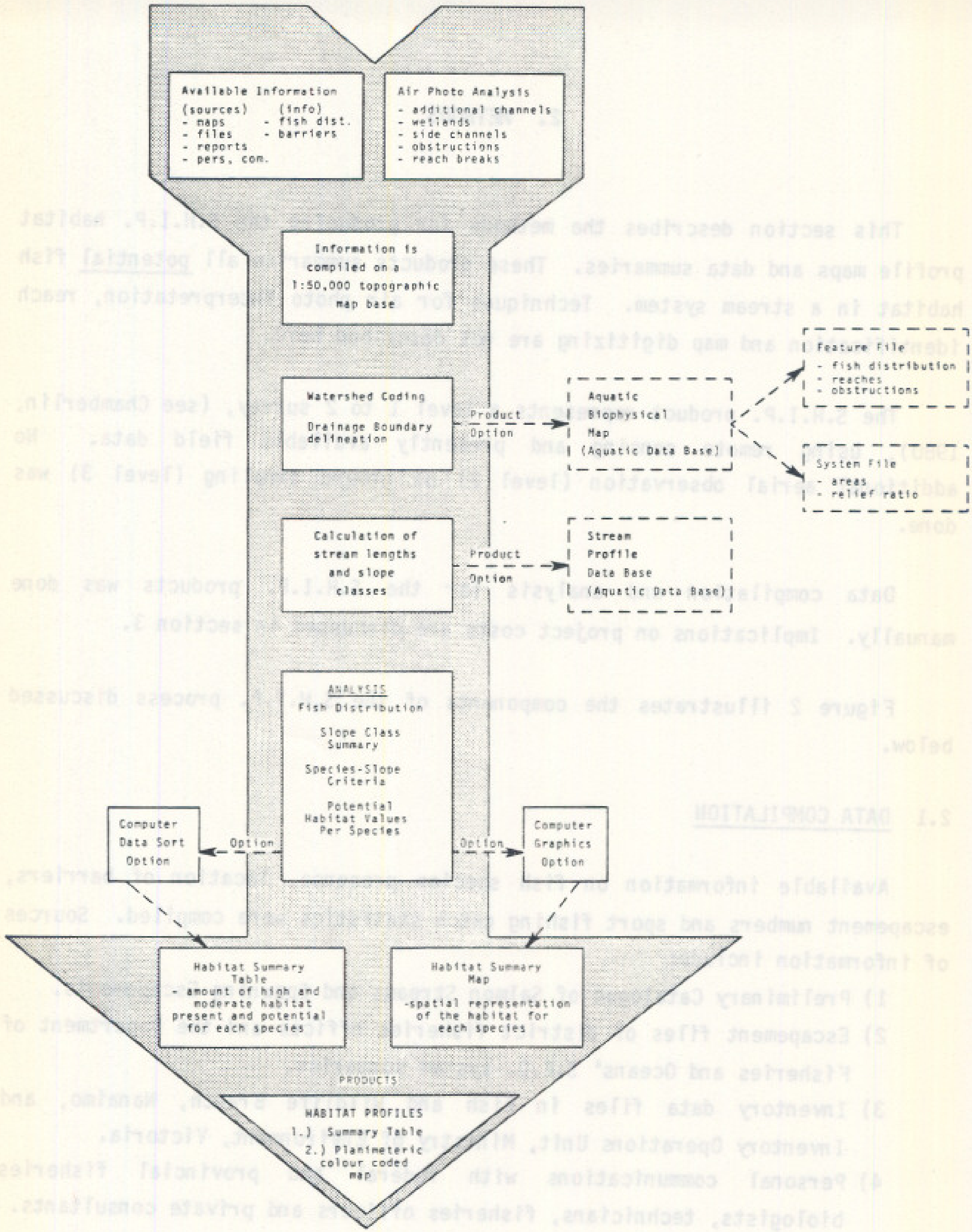


Figure 2: SHIP HABITAT PROFILE ANALYSIS

2.2 AIR PHOTO INFORMATION

The airphoto interpretation was from 1:63 000 black and white 1982 air photos using a Zeiss Scanning Stereoscope with 6x objectives. Four basic pieces of information were collected from the air photos:

1) the location of falls and chutes,
2) the location of streams not shown on the 1:50 000 topographic maps,
3) the location and size of wetlands,
4) the location and number of side channels.

The usefulness of the air photo interpretation varied as a function of stream size and density of overhanging vegetation. Most significant barriers could be identified at this scale.

The available file data and air photo information was then transferred to a 1:50 000 topographic base map.

2.3 FISH DISTRIBUTION INTERPRETATION

Fish production potential was restricted to stream segments of less than 20% slope.

2.3.1 PRESENT DISTRIBUTION CRITERIA

Present distribution of fish species was determined from available documented information or best reliable source, such as a fisheries biologist or fisheries officer familiar with the watershed., Anadromous distribution was either reduced or extended to correspond to the location of barriers mapped from air photos. Stream segments with slopes of 10% or greater were suspected to contain barriers in the absence of upstream fish presence.

If the presence of a species could not be verified but was strongly implied by all available information, the habitat was only mapped as potential and the species was tabulated as suspected. This criteria was often applied to resident cutthroat trout habitat for which confirmation of fish presence was lacking.

2.3.2 POTENTIAL DISTRIBUTION CRITERIA

Several arbitrary rules were required to define species for which potential habitats were calculated. These were based on historical presence and life history requirements.

If a species was historically recorded as present within a pilot zone, then the potential for that species was included in the analysis. However if a species was not historically recorded, it was excluded from the analysis of potential habitat. Note that for pink and chum salmon, access was assumed for all potential spawning areas.

In the S.E.P. transition plan watersheds, however, only those stream segments accessed by the proposed S.E.P. project were tabulated (see sec. 2.5). No assessment of the costs of barrier removal was provided.

In the Baynes Sound pilot area pink salmon potential was only shown for streams where they were historically present, and then only in the lower accessible sections.

Sockeye salmon in Tlupana Inlet were found only in association with rivers, as opposed to the more typical lake rearing types. Therefore, due to the uncertainty regarding the origin of sockeye smolt production in these streams only systems with lakes which could be stocked with sockeye fry were included in the calculation of potential sockeye habitat.

2.4 TOPOGRAPHIC MAP MEASUREMENTS

All stream lines on 1:50 000 topographic base maps, plus stream lines added from air photo interpretation, were included if any portion was less than 20% slope. This process exluded the high gradient habitat unsuitable as potential productive fish habitat.

Following the assignment of B.C. watershed code numbers, all stream lines were digitized using a HP 9225A system. The length and the average slope of stream segments between each contour line were automatically calculated. The length of side channels, the area of lakes and wetlands and the basin area were also digitized.

Data input was from manual paper tape, which was transcribed onto data entry forms for keypunching. As Figure 2 illustrates, this step can be computerized as a part of the B.C. Aquatic Data Base for greater cost efficiency.

2.5 DATA ANALYSIS

The stream systems were divided into potential management units based on management options and existing conditions using the criteria of:

1) presently accessible habitat, by species;
2) all inaccessible habitat, by species;
3) habitat accessed by a barrier removal, by species.

For each management unit the channel slopes were grouped as shown in Table 1 and the total length of channel in each slope class was calculated.

Table 1. Slope Classes Used in S.H.I.P. Calculations

Group	Slope Class
1	0 to .1%
2	.11 to 1.0%
3	1.1 to 2.0%
4	2.1 to 3.0%
5	3.1 to 4.0%
6	4.1 to 5.0%
7	5.1 to 10.0%
8	10.1 to 20.0%
9	20.1% and greater

The length of all identified side channels was also summarized by slope class and included in the summary table of total channel length. Potential habitat was then classified and modelled into high, moderate or low using the species criteria of Table 2.

Table 2. Slope Class Criteria for Fish Habitat Evaluation

SPECIES	CHANNEL SLOPE HIGH	CHANNEL SLOPE MOD	LAKES	WETLANDS
CHINOOK	.1 to 3.0%	3.1 to 5.0%	LOW	LOW
CHUM	.1 to 2.0%	2.1 to 5.0%	LOW	LOW
COHO	0 to 2.0%	2.1 to 5.0%	HIGH	HIGH
CUTTHROAT (and coho)	1.1 to 5.0%	5.1 to 10.0%	LOW	LOW
CUTTHROAT (no coho)	0 to 5.0%	5.1 to 10.0%	HIGH	HIGH
PINK	.1 to 2.0%	2.1 to 5.0%	LOW	LOW
SOCKEYE	.1 to 2.0%	2.1 to 5.0%	HIGH	LOW
STEELHEAD	1.0 to 5.0%	0 to 1.0% 5.1 to 10.0%	LOW	LOW

A summary table of the amount of high and moderate habitat was included in the S.H.I.P. habitat profile. These individual stream classification summaries were aggregated for the entire pilot areas.

2.6 HABITAT MAPPING

The spatial distribution of high and moderate habitat was plotted on a colour coded planimetric base map reduced to an appropriate scale. Despite the time associated with colour reproduction, it was considered necessary for ease of communication with non-technical personnel. Current reproduction technology is capable of cost effective colour duplication for distribution purposes.

The mapping sequence included:

1) reading the slope of a stream segment from the digitizing paper tape.
2) determining the value from the habitat criteria (Table 2).
3) locating the stream segment on the topographic base map.
4) colour coding the stream segment.

In most cases stream segments were defined between each adjacent contour interval. Note that this process can also be computerized (Figure 2).

2.7 LONGITUDINAL STREAM PROFILES

The basic slope data was used to make a gradient profile for the mainstem of each stream on which significant features and fish distributions are plotted. The profile is useful in discussing management options and visually summarizes the tabulated gradient class data for the mainstem of the system.

2.8 ROLE OF THE B.C. AQUATIC DATA BASE

The B.C. Aquatic Data Base is an integral part of the S.H.I.P. process and serves as a long term data base storage system. Steps which link the S.H.I.P. products to the B.C. Aquatic Data Base include (see Figure 2):

1) heirarchical watershed coding, which facilitates data organization and storage and identifies tributary relationships.
2) mapping fish species distribution and features in a common base, which can lead to an Aquatic Biophysical base map (optional product).
3) finally all channel slope/distance data were also coded and entered into the B.C. Aquatic Data Base (morphometry file).

3.0 S.H.I.P. TIME AND COST ANALYSIS

3.1 OBJECTIVES

The objectives of the time and cost analysis were to:

1) Determine the total cost of the pilot region set of S.H.I.P. products (Baynes Sound and Tlupana Inlet areas).
2) Determine the component cost per kilometer of each function leading to the products (e.g. digitizing, graphics).
3) Estimate the production costs per kilometer of applying the S.H.I.P. process to a larger area.
4) Estimate the influence of computerized procedures on these costs.

3.2 METHODS

Two main cost components were identified: direct costs (paid by S.H.I.P. budget) and external costs (contributed by participating agencies). Examples of external costs include loaned office space and equipment, agency staff time and reproduction services.

Weekly time sheets were kept of detailed tasks (see Figure 3) to facilitate later analysis. Note the column headed "O" which indicates times provided by persons outside the S.H.I.P. staff. These included agency staff and other contracts (e.g. HIP Job Creation employees).

Total basin unit area and stream length were measured during the stream digitizing process. The total length of stream digitized in a basin was assumed to represent the product, whereas in fact many channels are productive for only a portion of their length. Hence unit length extrapolations to new areas must be made with caution.

Also, many productive streams do not appear on 1:50,000 NTS maps, and hence were not digitize. Results from this pilot study should thus be considered as conservative estimates of productive capacity.

The drafting component of time included manual reproduction of two coloured copies of each basin's habitat profile. Several alternatives exist for map reproduction which would reduce the unit cost, but the time frame of the S.H.I.P. contract did not permit research and development in this area.

Finally, it must be emphasized that all calculations, data entry coding and map production were done manually. Significant reductions in time are possible when the process is linked to a computer. These are discussed later.

3.3 RESULTS: DATA

3.3.1 TIME DATA

Table 3.1 displays total hours by task for each of S.H.I.P.'s two geographic objectives. The S.E.P. Project watersheds were completed during the first three months of the contract, and hence include project start up time, office and equipment assembly and major project development planning and format design. It also coincided with the provincial government employees strike.

The pilot zones (Baynes Sound and Tlupana Inlet) were completed during the last two contract months, and are assumed to be representative of the production level associated with the manual methods described. The pilot zone product included habitat calculations and distribution maps for fish species in all cases, whereas the S.E.P. project zones often required products for only 2 or 3 species.

Table 3. S.H.I.P. Project Task Hours

TASKS	S.E.P. WATERSHEDS S.H.I.P.	S.E.P. WATERSHEDS EXT.[3]	S.E.P. WATERSHEDS TOTAL	PILOT ZONES S.H.I.P.	PILOT ZONES EXT.	PILOT ZONES TOTAL	PROJECT TOTAL HOURS
Planning [1]	423	113	536	147	1	148	684
Contact Mgt. [2]		230	230		158	158	388
Accounting	36		36	25		25	61
Airphotos	83		83	49		49	132
Watershed coding	96		96	41		41	137
Digitizing coding	120		120	70		70	190
Digitizing	42		42	23		23	65
Data compilation	119	50	169	190	15	205	374
Graphics	230	154	384	243	156	399	783
TOTAL HOURS	1149	547	1696	788	330	1118	2814

[1] Includes program development, model research, liaison with related projects and workshops.

[2] Calculated at 20% of actual contract hours.

[3] External support provided.

3.3.2 AREA AND DISTANCE DATA

Table 4 displays the total area and length of streams digitized for the S.E.P. project watersheds and each of the three pilot zones (Baynes, Tlupana, Nanaimo). Note that in the case of the S.E.P. project watersheds, more streams were measured than were included in the set of final products. This was due to repriorizing basins during the project. Also, although the Nanaimo area streams were digitized, habitat calculations were not completed. Hence only the Baynes and Tlupana pilot area streams are included in the unit production calculations below.

Table 4. Digitized Areas and Stream Lengths of S.H.I.P. Project Watersheds

	Area (Km^2)	Mainstem (Km)	Mainstem plus Tributaries (Km)
S.E.P. Watersheds	939	230	775
Baynes Sound	421	184	398
Nanaimo Area	1002	116	667
Tlupana Inlet	371	100	299

Note that the density of stream lengths per unit area (km/km^2) ranges from 0.67 (Nanaimo area) to 0.95 (Baynes Sound). These are not true basin drainage densities, however, since only those streams with a segment less than 20% gradient were measured. Since an average 1:50 000 map sheet is about 1000 km^2, between 670 and 950 km of streams fall into this catagory.

The influence of small tributaries on total potential production is also apparent from Table 4. Mainstem lengths ranged from 17% of total length (Nanaimo area) to 46% of total length (Baynes Sound). In general, smaller systems will have a greater portion of their productive area in the mainstem reaches.

3.4 COST DATA

Direct costs included drafting supplies and paper, and totaled about $500/mo.

External costs, for which commercial equivalent estimates were made, include the following:

Office rental	$600/mo
Utilities	100/mo
Office furniture	500/mo
Office equipment	150/mo
	$1350/mo

In addition, the following services were provided by contributing agencies, and are included in external costs.

Digitizer		$100/day
Map reproduction	3084 @	$4.82/sheet
Topographic maps	411 @	$3.21/sheet
Air photos	3646 @	$2.41/photo

Although 1513 air photos were purchased, only 250 were used. Full coverage for Vancouver Island was purchased to allow for changing area priorities.

For the purposes of the following analysis, total costs are summarized in Table 6 by total S.H.I.P. project and by Pilot Zone, corresponding to the time data in Table 3.

Table 5. Direct and External Operation Costs for Total SHIP Project and for Pilot Areas

	S.H.I.P. PROJECT TOTAL (Cost $)		PILOT AREAS (Cost $)	
	Direct	External	Direct	External
Office Rental		3000		1200
Utilities		500		200
Furniture		2500		1000
Equipment[1]		750		300
Digitizer		1000		250
Reproduction		3000		1200
Maps & air photos		4000		250[2]
Supplies	2500		1000	
	$2500	$14750	$1000	$4400
Total Costs	$17250		$5400	

[1] Excluding capital costs.

[2] Based on commercial cost of actual photos used.

3.5 RESULTS: ANALYSIS

3.5.1 TOTAL COSTS

For the purpose of this analysis, time (hours) has been converted to equivalent dollars at a nominal rate of $12/hr.

Table 6. Dollar Equivalents of S.H.I.P. Project Hours @ $12/hr.

	Hours	Total Cost $
S.E.P. Watersheds and Pilot Zones		
Direct	1,937	23,244
External	877	10,524
	2,814	Total $33,768
Pilot Zones Only		
Direct	788	9,456
External	330	3,960
	1,118	Total $13,416

The time and costs in equivalent dollars for direct and external components of the S.H.I.P. project are illustrated in Figure 3. It therefore combines the results of Tables 5 and 6.

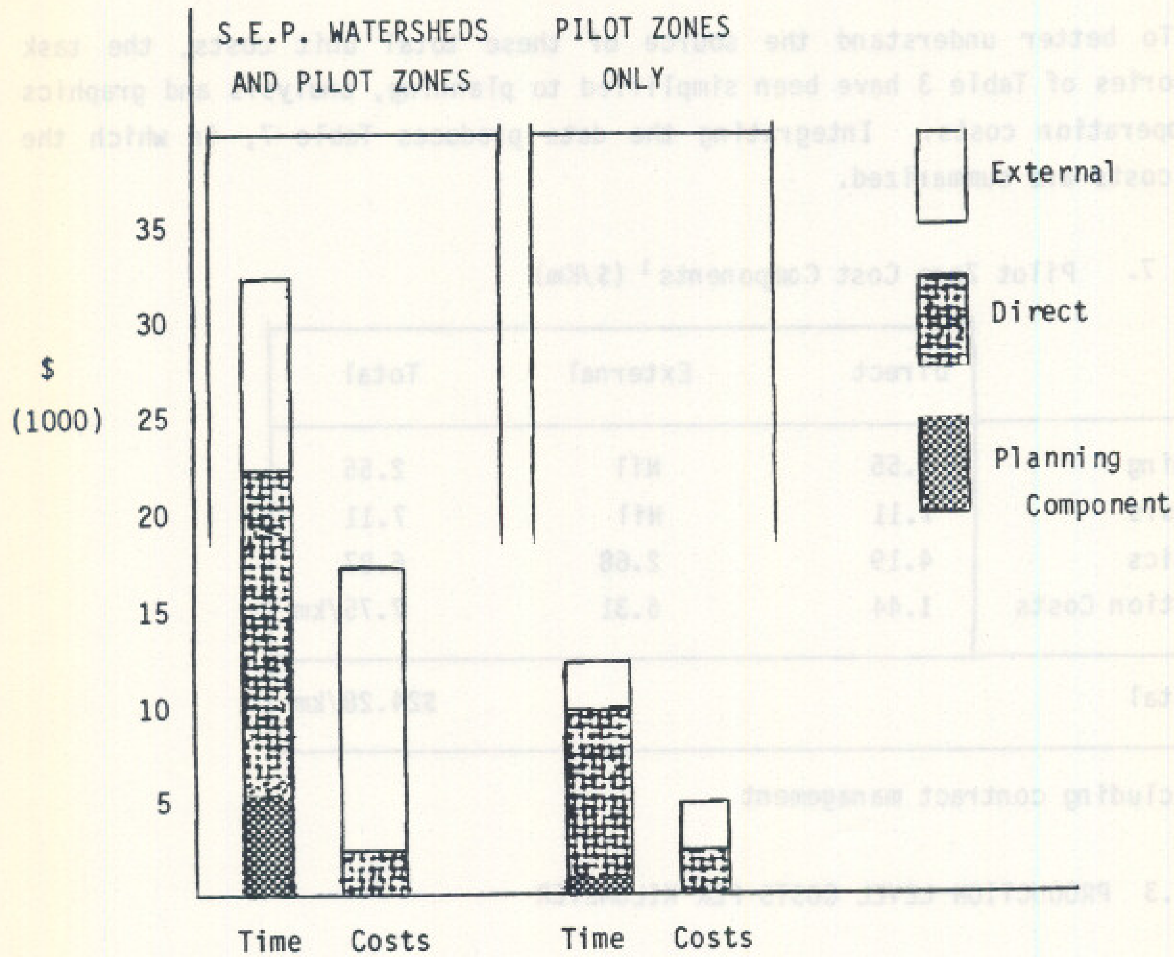


Figure 3. Time and Cost Comparisons for S.H.I.P. products.

3.5.2 COMPONENT COSTS PER KILOMETER

To better understand the source of these total unit costs, the task catagories of Table 3 have been simplified to planning, analysis and graphics and operation costs. Integrating the data produces Table 7, in which the unit costs are summarized.

Table 7. Pilot Zone Cost Components[1] ($/Km)

	Direct	External	Total
Planning	2.55	Nil	2.55
Analysis	7.11	Nil	7.11
Graphics	4.19	2.68	6.87
Operation Costs	1.44	6.31	7.75/km
Total			$24.28/km

[1] Excluding contract management

3.5.3 PRODUCTION LEVEL COSTS PER KILOMETER

On the basis of this analysis, we have attempted to project the costs of applying the S.H.I.P. process to arbitrarily larger areas. Several assumptions are made:

1) That the product formats are known, procedures are defined, data sheets are available and staff are trained. This saves about 50% of planning time.
2) That no time will be spent on workshops or other forms of "show and tell".
3) That detailed cost accounting will not be required (i.e. the data of this time and cost analysis).
4) That only one master product will be produced. Subsequent reproduction will be done under separate contract. This saves about 25% of manual graphics time.

On the basis of these assumptions, some modifications are made to the figures in Table 7, and are presented as Table 8.

Table 8. S.H.I.P. Production Cost Estimates ($/km)

Planning	1.25
Analysis	7.11
Graphics	5.15
Op. Costs	5.81
Total	19.32 / Km

3.5.4 COMPUTERIZED COSTS PER KILOMETER

Finally, it seemed reasonable to project the effects of computer based procedures on these tasks. Some crystal ball gazing, as well as assumptions about system development costs must be made, but two major benefits seem reasonable.

First, all data entry and habitat calculations following the digitizing of stream lengths and slopes can be computerized. This step eliminates about 90% of the data calculations and digitizing coding steps. Little computer system development would be required.

Second,, graphics production could also be computerized, utilizing the existing Intergraph system of the B.C. Ministry of Environment. This step would reduce graphics preparation time by about 50%. An unknown (but feasible) amount of system development would be required.

Both of the above steps provide additional benefits in enabling recalculation of habitat units according to different criteria with no manual labor, and replotting of habitat distributions on maps with little additional work. In addition, the digitizing of basins and stream lines is a first step for creating the computerized base map files for the plotting of all other water related data (water licences, effluent points, hydrometric stations, development sites, etc., etc.,) Section 4.3 discusses further benefits of computerized data systems.

Table 9 summarizes the costs of producing a S.H.I.P. product under these assumptions about computerized procedures.

Table 9. Computerized S.H.I.P. Production Cost Estimates Excluding the Costs of Computer System Development

	$/Km
Planning	1.25
Analysis	5.77
Graphics	2.60
Op. Costs	5.81
Total	$15.43/Km

4. DISCUSSION OF RESULTS

The S.H.I.P. process described above has several present and future implications. They are discussed here under the general headings of:

1) fish habitat and production models;
2) information delivery systems; and,
3) applications of habitat capability interpretations.

4.1 FISH HABITAT AND PRODUCTION MODELS

The S.H.I.P. habitat model, used to stratify and rank potential habitats is based on salmonid access and stream gradient. It cannot be used to estimate smolt output (or other production indicies) without biostandards which are based on gradient class. Unfortunately present management production models are based primarily on total length or area of stream habitat. However, crude production models can be used to estimate gross capability by watershed.

The S.H.I.P. habitat model is, however, an efficient tool for excluding unproductive habitats from further information gathering. It is hence a necessary, but not sufficient, habitat model for identifying productive habitats.

The S.H.I.P. model also helps to discriminate between potentially high, moderate and low value habitats within the present distribution of species. Stock management, enhancement and habitat management all use these criteria for priorizing their activities.

The reliability of habitat models improves as additional relevant habitat factors are known. We feel that a series of steps can be defined, each of which adds an incremental degree of reliability, as well as cost.

1) Stream channel classification on the basis of channel form and confinement.
2) Estimates of channel widths to permit habitat area calculations
3) Estimates of bed material composition, habitat complexing, water chemistry and discharge regime.

Subsequent pilot studies should explore the incremental cost of aquiring these data so that the accuracy of required management production models can be matched with comparable habitat information.

4.2 INFORMATION DELIVERY SYSTEMS

The S.H.I.P. process produced a set of graphic map products which depended upon manual calculations, drafting and hand coloring. However, the data are not machine readable (ie. computerized) and would require significant time and costs to be reexamined for other management applications.

We strongly recommend that future projects of this type explore the costs and benefits of computer assisted mapping and data analysis. The rationale for this development lies in the assumption that:

1) many managers, fisheries officers, etc. would benefit from access to similar products and
2) that updating and reproducing baseline information such as represented by the S.H.I.P. products simply cannot be done manually for the number of users who would benefit from it.

As an interim step in this process, means for less expensive color map reproduction would be very welcome. Current costs for color reproduction of the S.H.I.P. habitat profile are about $8.50 per page.

4.3 APPLICATIONS OF HABITAT CAPABILITY INTERPRETATION

The S.H.I.P. products were designed to emphasize present and potential fish production locations and relative amounts of habitat over large regions. We see several applications of the products other than for fish production planning for which appropriate management models are still embryonic.

4.3.1 SOME HABITAT MANAGEMENT APPLICATIONS

1. Habitat protection and management priorities can be very easily generated by comparing species requirements and potential distribution with known or anticipated land use activities. Here, the overlay capabilities of computer mapping would be invaluable. For example, when combined with hyrologic information, habitats which are sensitive to low flow can be ranked and linked to fishery production limitations.

2. Major industrial or lineal development assessments can only be evaluated when extensive information about a region's production capability is available. The S.H.I.P. process is a cost-effective mechanism for obtaining these data before reaction to major developments are required.

3. The MOE pesticide application process requires DFO to specify sensitive fisheries areas. The S.H.I.P. products can significantly decrease the present DFO costs of participating in the pesticide referral system while increasing fishery agencies' effectiveness in the process.

4. Similarly, the forest harvesting referral process requires the identification of fishery sensitive areas. A S.H.I.P. product would vastly reduce the time required for responding to the 4000 (Provincial only) referrals per year.

4.3.2 INVENTORY DESIGN APPLICATIONS

1. The priorization of required additional information, both in kind and in location, would substantially reduce the costs and time of habitat (and fish) inventory. The level 1 (coarse) data of the S.H.I.P. product are well suited for inventory design purposes.

2. Hydrometric survey and analysis requirements for fishery management applications (e.g. low flow predictions) can be efficiently specified by a S.H.I.P. style product which illustrates that the river mouth is not always where flow data are needed.

4.3.3 APPLICATIONS TO FEDERAL/PROVINCIAL FISHERY PLANNING

1. The S.H.I.P. habitat profile is a necessary component at the strategic level for watershed based planning.