CHAPTER 6

Land Inventories for Land Use Planning in Canada

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PERSPECTIVES OF CANADA

Canada covers roughly 10 million sq km, having roughly 755,000 sq km of fresh water. Local conditions vary widely. Topography varies from high rugged mountains to flat lacustrine plains. Climate varies from the high arctic with extensive permafrost to dry prairies to near rainforest. Vegetation ranges from diverse forest communities to sparse desert and tundra. The effects of continental glaciation are present almost everywhere causing a wide diversity of soils and terrain. All of the above must be considered in designing land inventories.

Another factor which affects land use planning is the fact that less than 10% of the land is suitable for agriculture. These areas occur in the south where the greatest population lives. Another factor is political—the ownership, and thus the power of management and planning for resources is largely provincial. The federal government can only affect the uses and management of land indirectly, mostly through taxation, using both incentives and penalties. Another effective method of influencing planning is through the provision of land information, such as that of the Canada Land Inventory (CLI).

In the late 1950s and early 1960s, Canadians were becoming aware that land and related resources were not infinite. Problems of land use conflict, competition for land, and land misuses were becoming more common. These problems were faced in a series of conferences, particularly the Senate Committee on Land Use in 1958 and the Resources for Tomorrow in 1961.

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Planning Future Land Uses.

One major recommendation emerging from these conferences was that there should be a cooperative federal-provincial program to determine land capability for a range of uses or to provide data for regional land use planning. In 1963, under the Agricultural and Rural Development act (ARDA), the CLI was initiated.

The objectives of the inventory were:

a) To classify lands as to their capabilities.
b) To obtain a firm estimate of the extent and location of each land class.
c) To encourage the use of CLI data in planning.

The inventory mapped the southern, settled portions of Canada, and provided maps for soil capability for agriculture, land capability for forestry, land capability for recreation, and land capability for wildlife—ungulates, waterfowl, and sport fish. Also included was a section to map land use (circa 1967).

The first stage of the inventory was to design classification systems. These were set up to be parallel with seven capability classes and descriptive subclasses. A number of assumptions were made to ensure uniformity. The assumptions included good management of the resource; access, ownership, and economics were excluded; present use of the land was not considered (except that some areas, i.e. cities, military reserves were not rated).

The provincial governments undertook the mapping, with some assistance from federal agencies. Funding, coordination, and publication of results were the federal government's responsibility. Over 100 agencies participated; mostly federal and provincial, with some private and university.

Output from the program is large, roughly 20,000 maps at 1:50,000 scale. Over 1,000 maps at scales of 1:250,000 or 1:125,000 have been published. Numerous reports and analyses have been based on its data.

Because of the sheer volume of data, it was realized that computer analysis would be necessary. The Canadian Geographic Information System (CGIS), now part of the Canada Land Data Systems (CLDS) Lands Directorate, was established.

This information system has the capability to store and manipulate spatially defined data, and has an interactive capability to facilitate data analyses. Various national data sets have been input including sector maps at 1:250,000; watershed, political, and census maps. Current coverages include: CLI sectors—agriculture, forestry, recreation, wildlife-ungulates, wildlife-waterfowl, land use, some updated land use; shorelines—waterbodies; watershed boundaries; census boundaries; and political boundaries. In small selected areas, more detailed information has been input.

The system has the capability of analyzing overlays for selected study areas, which can range in size from a few hectares to the total national coverage. In practice, the maximum number of overlays is usually eight, depending on complexity.

Various outputs are possible. They include a tabular form. Data within a study area can be listed separately or can be combined. An example is the amount of high capability agricultural land which also has

high capability for forestry. A second output is the map format. Results can be mapped at any required scale.

A feature of the system of great interest to land planners is the interactive mode. Once a data base is prepared, it is possible for a user, with minimum training, to operate the system via a keyboard and CRT. Results, in map or tabular form, are shown on the screen, allowing the user to manipulate the data. Tables 1, 2, and 3 and Fig. 1 and 2 illustrate the range of analyses that have been done.

COSTS AND BENEFITS OF CLI

The CLI has cost Canada roughly $40 million. Canada has, for the major settled areas, a nationwide data base for regional planning, with published maps, manuscript maps, and computerized storage and analysis ability. The area mapped is roughly 2.6 million sq km (1 million sq miles).

Benefits are difficult to measure, but the impact of the program was described in a report by the Council on Rural Development Canada (1979):

> The CLI was (is) an elaborate program to supply information on rural and resource land capabilities in usable detail on a comparative basis across the country. The CLI provided the data base for studies by the Prince Edward Island Royal Commission on Land Use and Land Ownership in 1972. It provided a touchstone for British Columbia's farmland preservation order in 1973, and later on a defensible operating rationale for the B.C. Land Commission. It has become a major reference for rural and resource plans in B.C. regional districts and in Ontario counties; the extensive reports of the Alberta Land Use Forum rely on CLI documentation, and so it goes. Professional and lay bodies alike draw on the CLI data bank for their own various purposes. The provision of this land information, the CLI has fueled policy development in every Province. The CLI can be acclaimed as the single most significant and *productive* federal influence on rural land use.

USES OF CLI

The CLI provides a nationwide data base which has been used in regional planning to improve land use practices and management in a variety of ways.

Agriculture. Having a uniform data base has enabled some provinces to enact legislation or develop policies to preserve or protect agricultural land from development. Other uses have included identification of submarginal farmlands for conversion to other uses, usually forestry; restricting sales or leases of Crown lands for agriculture to areas in which the land is suitable; and as an important aid, where the scale is suitable, for farm base assessment.

Recreation. Planners have used the data to identify potential parks or sites for development. Along shorelines better sites have been re-

Table 1. Former agriculture capability of rural land converted to urban uses by urban area, province, and Canada 1966–1967. Sample data from Gierman, D. M., 1977, Rural to urban land conversion, Occasional Paper No. 16, Lands Directorate, Environment Canada, Ottawa.

	High capability—Classes 1, 2, and 3								Low capability—Classes 4 and 5			
	Class 1		Class 2		Class 3		Total		Class 4		Class 5	
Urban area and province†	Acres¶	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Canada	38,749	18.21	55,419	26.05	40,422	19.00	134,590	63.26	23,547	11.07	12,256	5.76
Alberta	6,963	19.17	9,232	25.42	5,823	16.03	22,018	60.62	3,261	8.98	2,040	5.62
Calgary	184	1.16	3,849	24.27	3,095	19.52	7,128	44.95	1,657	10.45	1,070	6.75
Edmonton	6,749	41.69	4,162	25.71	2,301	14.21	13,212	81.61	1,247	7.70	66	0.41
Lethbridge	30	2.85	--	--	--	--	30	2.85	--	--	184	17.63
Medicine Hat	--	--	--	--	--	--	--	--	357	23.86	720	48.05
Red Deer	--	--	1,221	70.47	427	24.68	1,648	95.15	--	--	--	--
British Columbia	308	1.61	1,489	7.80	1,387	7.26	3,184	16.67	2,323	12.17	2,859	14.97
Chilliwack	--	--	265	38.95	138	20.35	403	59.30	89	13.04	86	12.72
Kamloops‡	--	--	--	--	--	--	--	--	--	--	--	--
Kelowna	308	20.11	604	39.53	319	20.89	1,231	80.52	141	9.19	52	3.41
Nanaimo	--	--	54	4.95	7	0.61	61	5.56	48	4.44	704	64.44
Port Alberni	--	--	161	30.86	171	32.72	332	63.58	131	25.00	29	5.56
Prince George	--	--	241	8.21	244	8.32	485	16.53	872	29.72	143	4.87
Vancouver	--	--	164	1.81	508	5.61	672	7.42	1,042	11.52	1,845	20.39
Victoria‡	--	--	--	--	--	--	--	--	--	--	--	--
Manitoba	--	--	6,648	51.75	5,047	39.28	11,695	91.03	65	0.50	348	2.71
Brandon	--	--	466	23.15	395	19.60	861	42.75	65	3.23	348	17.31
Winnipeg	--	--	6,182	57.06	4,652	42.94	10,834	100.00	--	--	--	--
New Brunswick	--	--	36	0.81	685	15.38	721	16.19	1,449	32.53	403	9.05
Fredericton	--	--	36	3.54	153	15.00	189	18.54	119	11.72	76	7.42
Moncton	--	--	--	--	499	67.65	499	67.65	155	21.05	83	11.30
Saint John	--	--	--	--	33	1.21	33	1.21	1,175	43.52	244	9.03
Newfoundland	--	--	--	--	--	--	--	--	146	8.34	662	37.81
Corner Brook‡	--	--	--	--	--	--	--	--	--	--	--	--
St. John's	--	--	--	--	--	--	--	--	146	8.59	662	39.06

Nova Scotia	--	--	174	3.89	1,466	32.76	1,640	36.65	183	4.09	180	4.02
Halifax	--	--	2	0.07	874	24.81	876	24.88	84	2.37	151	4.30
Sydney	--	--	66	9.51	485	69.64	551	79.15	55	7.90	29	4.15
Sydney Mines	--	--	106	41.21	107	41.76	213	82.97	44	17.03	--	--
Ontario§	30,841	34.01	22,098	24.38	18.564	20.48	71,503	78.87	5,074	5.60	3,623	4.00
Barrie	246	32.49	74	9.79	221	29.20	541	71.48	138	18.27	10	1.38
Belleville	169	29.66	132	23.07	189	33.16	490	85.89	48	8.34	--	--
Brantford	225	15.23	891	60.23	101	6.81	1,217	82.27	21	1.42	210	14.22
Chatham	249	48.92	201	39.36	29	5.69	479	93.7	--	--	--	--
Cornwall	--	--	66	42.09	54	34.18	120	76.27	--	--	--	--
Guelph	564	46.45	279	22.96	179	14.80	1,021	84.21	32	2.66	6	0.47
Hamilton	1,399	27.69	1,467	29.03	1,404	27.78	4,271	84.50	58	1.14	3	0.06
Kingston	242	10.17	853	35.90	341	14.36	1,436	60.43	225	9.45	--	--
Kitchener	607	9.71	3,274	52.40	214	3.43	4,095	65.54	1,159	18.55	600	9.60
London	2,245	58.79	1,016	26.61	548	14.35	3,809	99.75	--	--	--	--
North Bay	--	--	35	5.62	54	8.64	89	14.26	113	18.07	31	5.02
Oshawa	907	60.34	383	25.44	120	8.01	1,410	93.79	72	4.81	2	0.10
Ottawa§	979	8.58	1,836	16.10	3,575	31.35	6,390	56.03	1,488	13.05	1,245	10.92
Peterborough	600	36.30	230	13.90	254	15.35	1,084	65.55	57	3.45	129	7.80
Sarnia	13	0.92	651	45.79	638	44.87	1,302	91.58	--	--	68	4.82
Sault Ste. Marie	--	--	11	0.94	489	42.62	500	43.56	383	33.41	--	--
St. Catharines—Niagara	639	5.08	5,128	40.79	4,600	36.59	10,367	82.46	115	0.92	54	0.43
Sudbury	--	--	10	0.34	403	13.51	413	1.85	825	27.69	84	2.81
Thunder Bay	--	--	--	--	122	8.61	122	8.61	75	5.28	540	38.10
Timmins	--	--	--	--	72	37.96	72	37.96	75	39.17	16	8.27
Toronto	21,021	72.37	2,986	10.28	4,256	14.65	28,263	97.30	183	0.63	273	0.94
Trenton	158	24.32	189	29.22	109	16.79	456	70.33	7	1.09	75	11.62
Windsor	32	1.07	2,308	76.24	418	13.80	2,758	91.11	--	--	255	8.41
Woodstock	546	65.86	78	9.41	174	20.99	798	96.26	--	--	22	2.66
P.E.I.	--	--	707	92.66	52	6.88	759	99.54	--	--	--	--
Charlottetown	--	--	707	92.66	52	6.88	759	99.54	--	--	--	--
Quebec§	637	1.65	13.463	34.78	6,621	17.11	20,721	53.54	10,686	27.61	2,048	5.29
Baie-Comeau	30	6.75	--	--	5	1.10	35	7.85	227	50.18	--	--
Chicoutimi-Jonquiere	--	--	657	36.14	251	13.79	908	49.93	291	16.01	78	4.30

(continued on next page)

Table 1—Continued.

Urban area and province†	High capability—Classes 1, 2, and 3								Low capability—Classes 4 and 5			
	Class 1		Class 2		Class 3		Total		Class 4		Class 5	
	Acres¶	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Drummondville	--	--	15	3.57	74	17.86	89	21.43	328	78.57	--	--
Granby	--	--	18	6.61	66	23.34	84	29.95	120	42.73	22	7.93
Joliette	--	--	364	16.77	137	6.31	501	23.08	1,348	62.01	228	10.47
Montreal	166	0.87	10,615	55.64	3,324	17.42	14,105	73.93	3,009	15.77	406	2.13
Quebec	6	0.08	275	4.05	1,963	28.91	2,244	33.04	2,515	37.04	746	10.99
Rimouski	--	--	--	--	42	28.73	42	28.73	93	64.37	--	--
Rouyn	--	--	--	--	9	6.79	9	6.79	37	27.78	15	11.11
Shawinigan	--	--	--	--	--	--	--	--	729	81.86	30	3.37
Sherbrooke	--	--	15	1.64	137	15.23	152	16.87	239	26.47	303	33.61
Sorel	--	--	44	5.93	23	3.06	67	8.99	372	50.29	--	--
St-Hyacinthe	--	--	144	86.40	--	--	144	86.40	19	11.24	1	0.59
St-Jean	349	25.61	966	70.96	15	1.10	1,330	97.67	32	2.33	--	--
St-Jerome	--	--	104	12.51	277	32.73	381	45.24	308	36.61	24	2.97
Thetford Mines	--	--	--	--	61	7.45	61	7.45	195	23.81	86	10.56
Trois-Rivieres	--	--	--	--	15	4.42	15	4.42	320	95.48	--	--
Valleyfield	86	16.82	246	48.15	34	6.65	366	71.62	39	7.63	68	13.31
Victoriaville	--	--	--	--	188	22.11	188	22.11	465	54.63	41	4.85
Saskatchewan	--	--	1,572	42.79	777	21.15	2,349	63.94	360	9.79	93	2.53
Moose Jaw	--	--	789	80.88	148	15.18	937	96.06	19	1.97	6	0.58
Prince Albert‡	--	--	--	--	--	--	--	--	--	--	--	--
Regina	--	--	783	83.30	134	14.22	917	97.52	--	--	23	2.48
Saskatoon	--	--	--	--	495	42.31	495	42.31	341	29.14	64	5.45

† Urban area refers to all land in a population area, census agglomeration, or other urban center over 25,000 population that is classified as "built up" according to CLI Land Use Classification.

‡ Agriculture capability maps were not available at the time of compilation of data for Kamloops, Victoria, Corner Brook, and Prince Albert.

§ The Ottawa urban area includes part of the province of Quebec. Therefore, the Quebec part of the Ottawa urban area is included in the totals for Ontario and is excluded from the totals for Quebec.

¶ 1 Acre = 0.404686 hectare.

tained in public ownership or bought by government to provide access to water.

Waterfowl. The CLI allows identification and evaluation of areas for acquisition as waterfowl reserves.

Recreation and waterfowl capability maps have been interpreted to develop indices of susceptibility of shorelands to oil spills for a planning comparison of potential deep water oil ports. All sectors have

Table 2. Summary of CLI recreation capability sample data from Taylor, M.C., 1978, Land capability for recreation-Summary report, CLI Report No. 15, Lands Directorate, Environment Canada, Ottawa.

	Class	Total class length	Subclasses†			Total length for subclasses	Total subclasses as a % of total class length
			Bathing	Lodging	Access to family boating		
		kilometers					
Province	Inventoried shoreline in Classes 1–3, first subclasses as "Bathing, "Lodging", or "Access to family boating", by province						
Province							
Saskatchewan	1	81	81	--	--	81	100.0
	2	209	195	3	--	198	94.7
	3	3,708	354	2,985	113	3,452	93.0
	Total	3,998	630	2,988	113	3,731	93.3
Alberta	1	76	76	--	--	76	100.0
	2	220	138	9	2	149	67.7
	3	1,518	196	587	77	860	56.6
	Total	1,814	410	596	79	1,085	59.8
British Columbia	1	346	243	--	--	243	70.3
	2	1,782	345	51	--	396	22.3
	3	10,698	497	2,962	316	3,775	35.3
	Total	12,826	1,085	3,013	316	4,414	34.4
Canada	1	1,607	1,425	--	31	1,456	90.6
	2	8,290	4,765	941	209	5,915	71.4
	3	75,284	7,588	50,431	1,717	59,736	79.4
	Total	3,998	630	2,988	113	3,731	93.3
	Inventoried shoreline in Classes 1–3 with first subclass as "Bathing", "Lodging" or "Access to family boating" within 121 kilometers of the center of all census metropolitan areas						
Census metropolitan areas							
Ottawa-Hull	1	80	78	--	--	78	90.0
	2	471	427	11	--	438	93.0
	3	3,076	107	2,649	5	2,761	89.8
	Total	3,627	612	2,660	5	3,277	90.4
St. Catharines	1	22	22	--	--	22	100.0
	2	106	69	--	--	69	65.1
	3	95	34	--	4	38	40.0
	Total	223	125	--	4	129	57.8
Sudbury	1	24	24	--	--	24	100.0
	2	221	135	64	--	199	90.0
	3	4,181	275	3,805	4	4,084	97.7
	Total	4,426	434	3,869	4	4,307	97.3

Table 3. Data in tabular form, accompanied by a map (see Fig. 1). (From Niemanis, V. P. 1979. Canada's cities and their surrounding land resource. CLI report no. 15. Lands Directorate, Environment Canada, Ottawa).

Circle radius		Agricultural land class									
		1	2	3	4	5	6	7	8	0	Total area
mi	km	Acres									
0–5	0–8	1,575	8,088	10,503	3,270	3,547	402	1,890	14,771	0	44,046
5–10	8–16	1,673	33,852	29,771	26,545	11,362	3,685	25,478	2,116	5,687	140,169
10–15	16–24	12,256	54,478	40,262	20,257	13,892	26,331	60,372	0	11,782	239,630
15–20	24–32	24,685	62,150	55,677	32,459	12,231	30,038	100,292	239	17,368	335,139
20–25	32–40	27,444	74,144	66,197	44,705	37,743	61,275	100,921	181	31,580	444,190
25–35	40–56	63,436	185,096	154,102	118,124	62,071	122,275	373,550	1,135	66,976	1,146,765
35–50	56–80	90,430	187,182	402,373	284,094	84,755	169,428	933,216	1,569	190,133	2,343,180
50–75	80–121	41,911	308,573	480,625	353,651	121,266	215,613	3,079,697	5,543	79,116	4,685,995
75–100	121–161	56,635	398,253	338,796	428,278	174,376	215,265	4,183,067	107,979	115,425	6,018,074

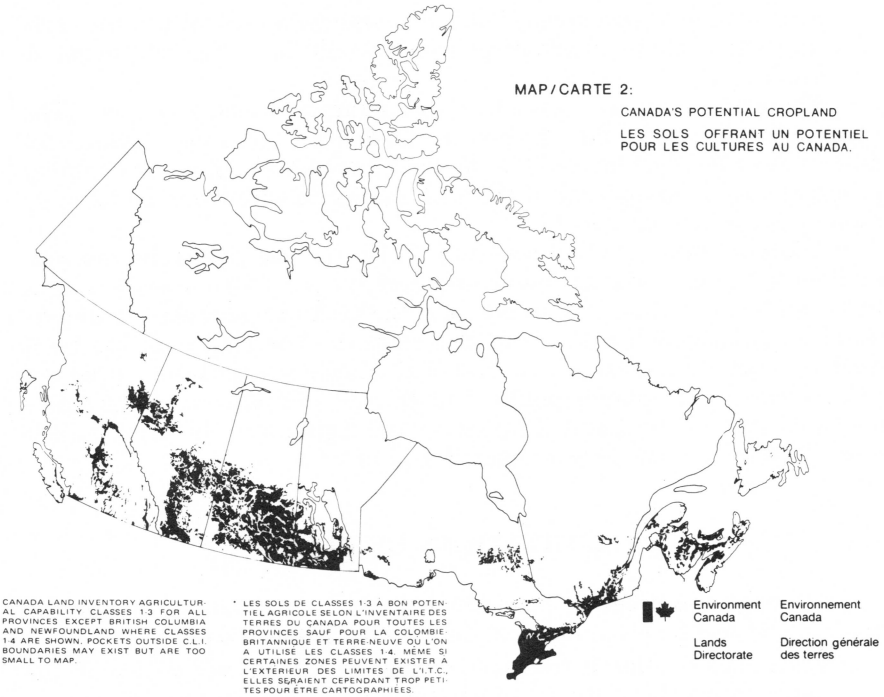

Fig. 1. Canada's potential cropland, from Canada Land Inventory, 1976, Land capability for agriculture-Preliminary report, CLI Report No. 10, Lands Directorate, Environment Canada, Ottawa.

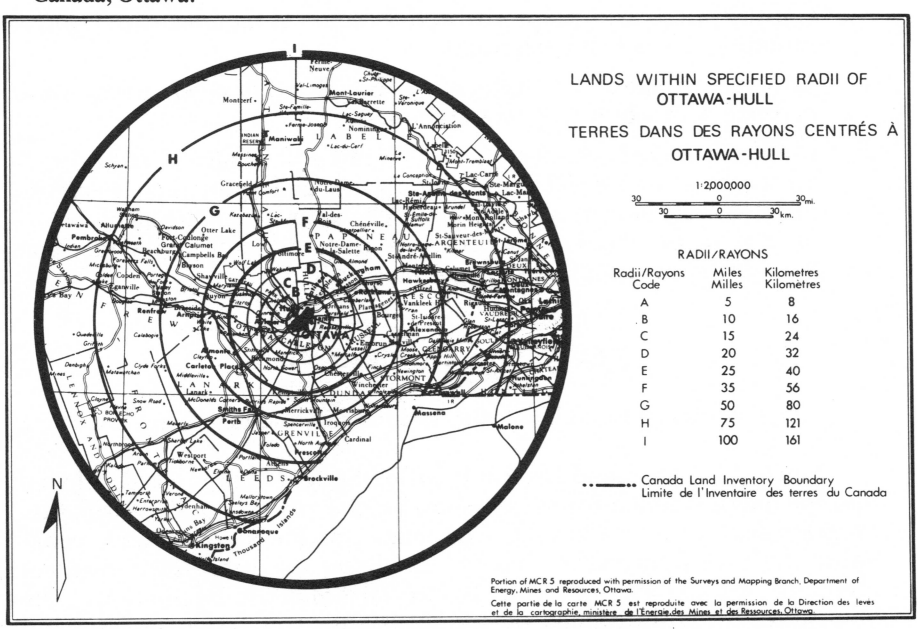

Fig. 2. Data in map format, accompanied by tabular form (see Table 3) from Niemanis, V.P., 1979, Canada's cities and their surrounding land resource, CLI Report No. 15, Lands Directorate, Environment Canada, Ottawa.

been used in environmental impact assessments—usually in the early stages to evaluate alternatives which would have the least negative impact.

There are several reasons why the program had such an impact. The mapping was done by the agencies responsible for resource management and many of the staff involved in the survey remained when the mapping program ended. Knowledge of the CLI and its potential was available to those who could make use of it.

Another reason for the success of CLI is the acceptance by the general public. In Canada, as elsewhere, there is concern over land use conflicts, and competition is growing, and the CLI provides readily understood material which helps focus this concern. The CLI data has been used in such diverse areas as: National Farmers Association brief on preservation of farmland; political platforms, and also in policy statements (Ontario Food Land Guidelines) and legislation; the press, which uses CLI data in many articles related to land.

LIMITATIONS OF CLI

Although the program has provided much information suitable for planning, it does have a number of limitations. These include:

Each classification is restricted in scope. It could not deal with the entire range of conditions which occur. Classifications could not consider for example specialty crops for agriculture, or short rotation forestry.

Classifications are interpretive and do not lend themselves to reinterpretation to meet new requirements.

Although roughly 1.6 million sq km (1 million sq miles) were mapped, this is only 25% of the country.

Comparisons between sectors is often difficult. Planners must develop economic and social value assumptions and apply them to classes to determine the relative values of each sector. Comparison of sectors for a given piece of land is also made more difficult by the fact that boundaries are usually nonconcordant.

RECENT DEVELOPMENTS

Northern Land Use Information Mapping Program

Since 1971, the Land Use Information Series of maps has developed into the major systematic environmental-social research and information program for northern Canada. The maps provide a convenient reconnaissance-level information base to facilitate comprehensive regional planning and application of the Territorial Land Use Regulations. The map series is jointly funded by the Department of Indian Affairs and Northern Development, and the Department of the Environment. The Federal Department of Fisheries and Oceans and the Northwest

Territories Wildlife Service are major participants. The project also relies on the cooperation and assistance of other federal and territorial government departments, private research groups, and local residents of the Yukon and Northwest Territories.

This information is presented in a format that combines colored overlays overprinted on existing 1:250,000 scale maps, with descriptive notes. The project covers the following range of environmental-social topics.

Wildlife. The delineation and description of important and critical areas for wildlife is a primary thrust of the research program. This datum, developed by Wildlife Service staff based in Yellowknife, is based on an extensive literature review and year-round field surveys. In addition to outlining critical and important areas, wildlife notes include comments on migration routes, waterfowl staging areas, nesting or calving areas, and winter range.

Fish Resources. The identification and description of important or critical aspects of fish resources also receives major emphasis. Department of Fisheries and Oceans research staff collect the information form reports, files, and a summer synoptic sampling survey. Data include descriptions of migration routes and spawning areas; species composition and abundance; and domestic, commercial, and recreational fishing activity.

Native Land Use. The delineation and description of local hunting and trapping activities are developed by the Land Resources and Data Systems Branch of Environment Canada. These descriptions are based on materials such as the Inuit Land Use and Occupancy Study, revised with the assistance of local Hunter's and Trapper's Associations. The notes include comments on the settlement base, species taken, seasons of use, and intensity of activity.

Recreation-Terrain Evaluation. The maps also provide a reconnaissance-level ecological description, an assessment of general landscape aesthetics, and a detailed site analysis to identify areas of high recreation-tourism potential. The data are developed by staff of the Lands Directorate through field surveys and an evaluation of air photographs and satellite imagery.

Socio-Economic and Cultural Data. Program staff are responsible for the collection and mapping of relevant socio-economic and cultural data including community information, climatic characteristics, break-up and freeze-up dates, hydrometric and water quality stations, archaeological sites, historical sites, campgrounds, fishing camps, fur-take statistics, transportation networks, mining and mineral resources existing and proposed development areas and block land transfers, proposed International Biological Programme reserves, and other information relevant to general land use planning and management.

The wide variety of topics covered by the Land Use Information Series makes it a unique tool for managing natural resources in the Canadian north. Although the maps cannot provide full answers for every

management decision, they succeed in providing the background information essential for responsible management. The maps are best viewed as a guide to potential land use conflict and as a tool to alert managers to topics which require special study. The maps assist industry in preparing exploration programs with a minimum of environmental and social conflict. They assist administrators in processing land use permit applications. The maps help physical and social scientists plan or evaluate impacts of northern development. And finally, research for the map series results in new baseline data for large areas of the north where such data previously did not exist.

Canada Land Use Monitoring Program

Another program is being developed to meet the needs for determining impacts of government policies and programs on land. Most of these are reflected in changes in land use. To provide information which will be useful in determining (and eventually in predicting) the impacts, the Canada Land Use Monitoring Program (CLUMP) has been started. The proposed objective is:

> To monitor the amount, location, and type of land use in Canada on national and regional scales in support of the production of statistics on land use trends, the production of maps and reports giving a national perspective on land use, and the evaluation and adjustment of federal programs having an impact on land use.

The project involves dividing the country into four domaines: productive forest, agricultural lands, urban centered regions, and special studies. Scale, timing, and intensity of monitoring vary from large-scale detailed mapping at 5 year intervals for urban areas to small-scale mapping at 10-year intervals for productive or transportation corridors, large resources development, etc. Pipeline or transportation corridors, large resources development, etc. will be handled on an ad hoc basis. At present, only the Land Use Monitoring in urban centered regions can be considered operational, all other areas are at the development stage.

ECOLOGICAL LAND SURVEY

Under the CLI program, several initiatives were taken to develop and test ecologically based inventory systems suitable for the rest of the country. Several pilot projects were carried out by the Subcommittee on Biophysical Land Classification. Although no national inventory programs developed, the biophysical classification techniques tested, now referred to as ecological land surveys (ELS), have come into widespread use (Table 4).

Ecological land survey is a form of data gathering which proposes integrations of all parts of the environment and evaluation in respect thereof. Information on the geology, landforms, water, soil, climate, vegetation, and wildlife is gathered by a team of specialists and integrated into a single data base. Map units are recognized on their relative uniformity—as characterized by the relationships, abundance, and patterns

Table 4. Levels of ecological generalization proposed by the Canada Committee on Ecological (Biophysical) Land Classification. (From Wiken, E. and D. Welch, 1979. An interdisciplinary basis for resource studies: The ecological land survey. Paper presented at Resources Inventory Workshop, Whitehorse, Yukon. Oct. 1979).

Level of generalization Common map scale†	Common benchmarks for recognition					
	Geomorphology	Soils§	Vegetation¶	Climate	Water#	Fauna
Ecoregion 1:3,000,000 to 1:1,000,000	Regional landforms or assemblages of regional landforms	Great groups or associations thereof	Plant regions or assemblages of plant regions	Meso or small-scale macro	Water regime	High species diversity; may correspond either to a widely distributed species (e.g. deer mouse), or to the habitat of individuals within a species
Ecodistrict 1:500,000 to 1:125,000	Regional landform or assemblages thereof	Subgroups or associations thereof	Plant districts or assemblages of plant districts	Meso or large-scale micro	Drainage pattern; water quality	
Ecosection 1:250,000 to 1:50,000	Assemblages of local landforms or a local landform	Family or associations thereof	Plant associations or a plant association	Large-scale micro to small-scale micro	River reaches, lakes and shoreland	Less diverse species complement habitat requirements of typical species more restricted (e.g. beaver, otters); may coincide with specialized areas of animal total habitat (e.g. wintering area, calving grounds)
Ecosite‡ 1:50,000 to 1:10,000	A local landform or portion thereof	Soil series or an association of series	Plant association or seral stage	Small-scale micro	Subdivision of above	
Ecoelement 1:10,000 to 1:2,500	Portion of a local local landform	Phases of soil series or a soil series	Parts of a plant association or subassociation	Small-scale micro	Sections of small streams	Low species density habitat of small mammals, reptiles and amphibians etc., specialized areas of some fauna's habitat requirements (e.g. denning areas, local wintering deer yards)

Definitions for the levels of generalization.
Ecoprovince—an area of the earth's surface characterized major structural or surface forms, faunal realms, vegetation, hydrological soil and climatic zones.
Ecoregion—a part of an ecoprovince characterized by distinctive ecological responses to climate as expressed by vegetation, soils, water, fauna, etc.
Ecodistrict—a part of an ecoregion characterized by a distinctive pattern of relief, geology, geomorphology, vegetation, soils, water, and fauna.
Ecosection—a part of an ecodistrict throughout which there is a recurring pattern of terrain, soils, vegetation, waterbodies, and fauna.
Ecosite—a part of an ecosection having a relatively uniform parent material, soil and hydrology, and a chronosequence of vegetation.
Ecoelement—a part of an ecosite displaying uniform soil, topographical, vegetative and hydrological characteristics.

† Map scales should not be taken too restrictively, as they will vary with the environment setting and objectives of the survey.
‡ This level is frequently subdivided into phases according to the stage of plant succession.
§ Canadian system of soil classification, Agriculture Canada, 1979.
¶ These vegetative groupings are only suggested ones; agreement on a common system is yet to be achieved.
# See D. Welch, 1978. Land/water classification. ELC Series No. 5, Lands Directorate, Ottawa.

of various component features. The classification is hierarchical, with each level of classification generally associated with a mapping scale range. At each level, the units are considered holistically. Figure 3 illustrates these.

The final product of the classification is ideally one common set of map units, each of which has a detailed description of the biological and physical characteristics. These can be presented either as a map with an open legend and/or as a map accompanied with textual material. From ELS information, a wide range of evaluations, such as land capabilities, can be made.

An ecological approach to collecting and evaluating land information has many advantages over a series of single discipline surveys. By reducing the number of crews, costs can be significantly reduced, especially in remote locations. Duplication of sampling is reduced, because the same sample can often be used by several sectors.

The greatest benefit, however, is the view of the environment that emerges as each team member (discipline) becomes integrated. This normally requires a strong team leader and much interactive discussion. It takes time and effort, but the holistic view and classification and evaluation system which emerges will provide an ecological data base.

The base is then used to derive maps for as wide a range of possible uses and capabilities as is needed. This interpretation can be done

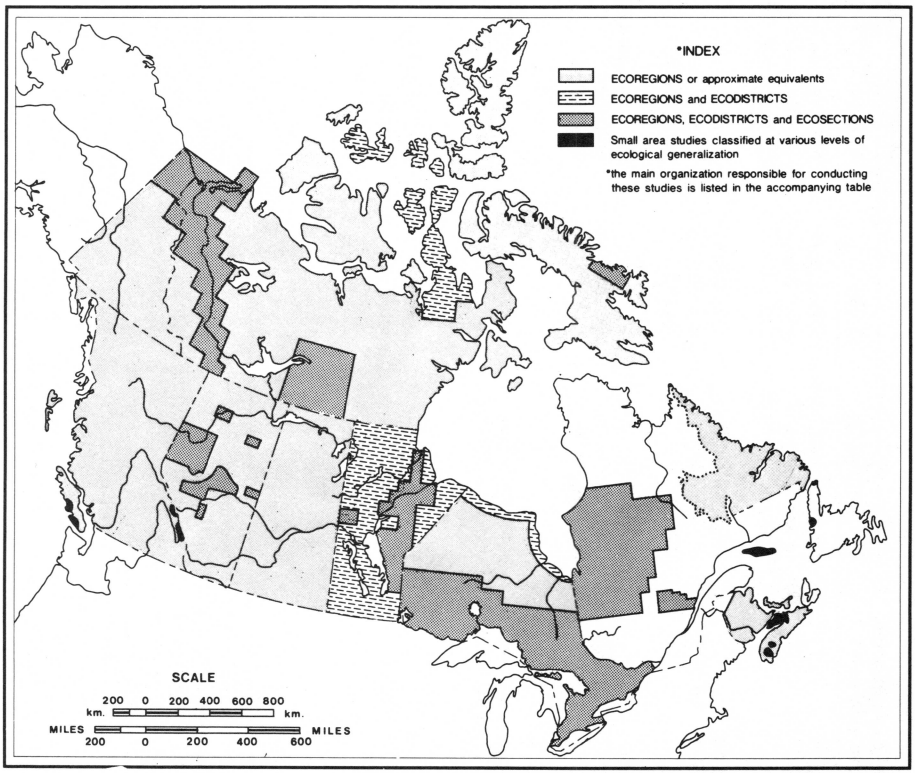

Fig. 3. Areas and levels of generalizations mapped in Canada. (From Wiken, E. and D. Welch, 1979. An interdisciplinary basis for resource studies: The ecological land survey, paper presented at Resource Inventory Workshop, Whitehorse, Yukon, Oct. 1979).

manually, but if large numbers of units and detailed information is involved, computer storage and analysis is the most practical method. Ecological data bases for several national parks have been entered into the CLDS mentioned earlier, and results are being analyzed for parks planning.

Although there are no national programs ongoing in Canada, there was sufficient interest in the field to form a national coordination committee. In 1976, the Canada Committee on Ecological (Biophysical) Land Classification (CCELC) was formed.

The objectives of the committee are "to encourage the continued development of a uniform ecological (biophysical) approach to land classification for resource planning, management, and environmental impact assessment."

The committee is composed of representatives of federal and provincial agencies, universities, and some consultants. A small secretariat is provided by Lands Directorate. A number of working groups were formed to deal with specific tasks such as: applications, methodology/philosophy, wetlands, land-water integrations, data systems, and ecoregions. Workshops have been held dealing with such topics as Canada's northlands, ecological classification in urban areas, and applications.

Further information on Canada Land Inventory, Canada Land Data Systems, and Canada Committee on Ecological Land Classification is available from:

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