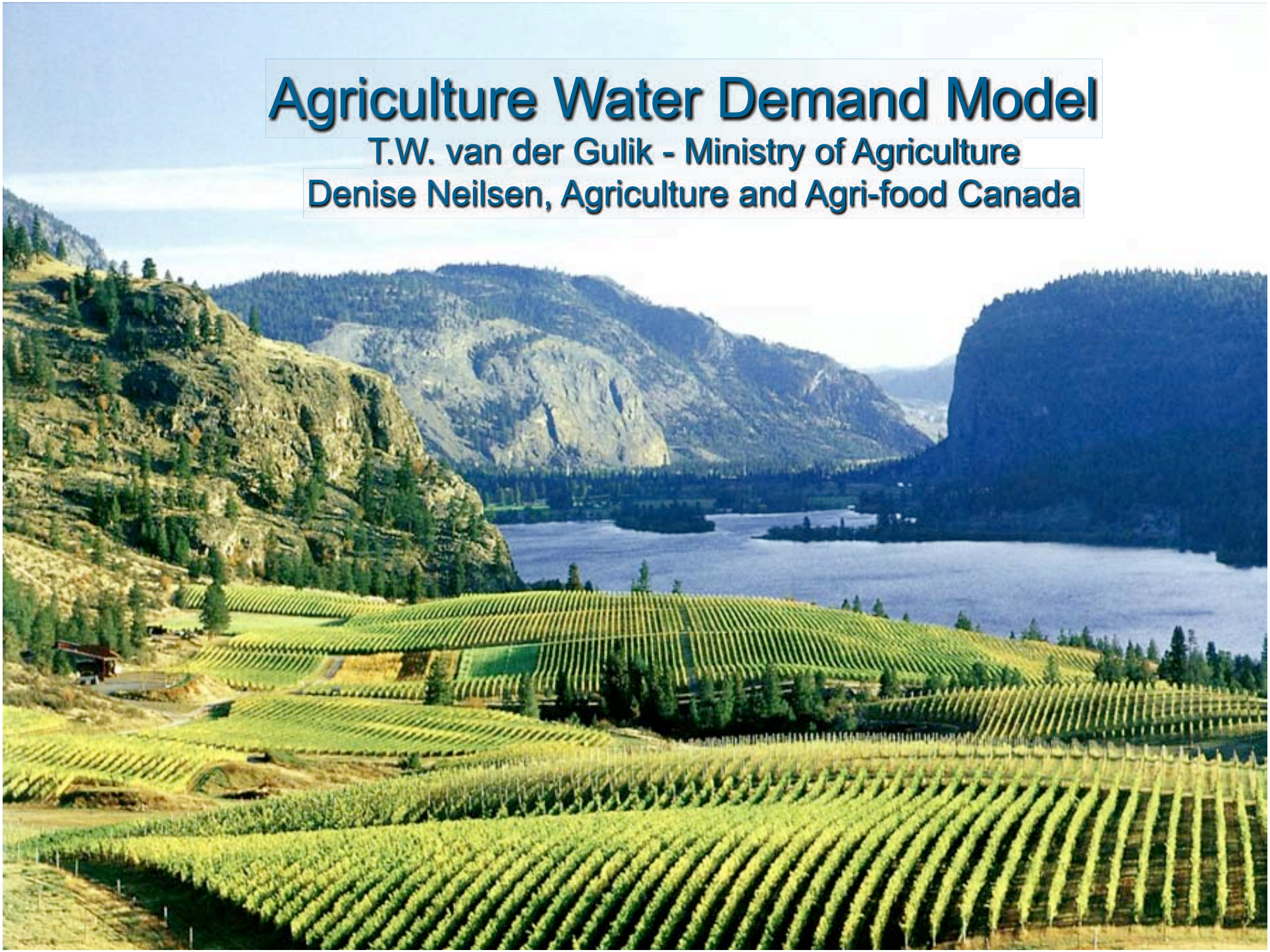
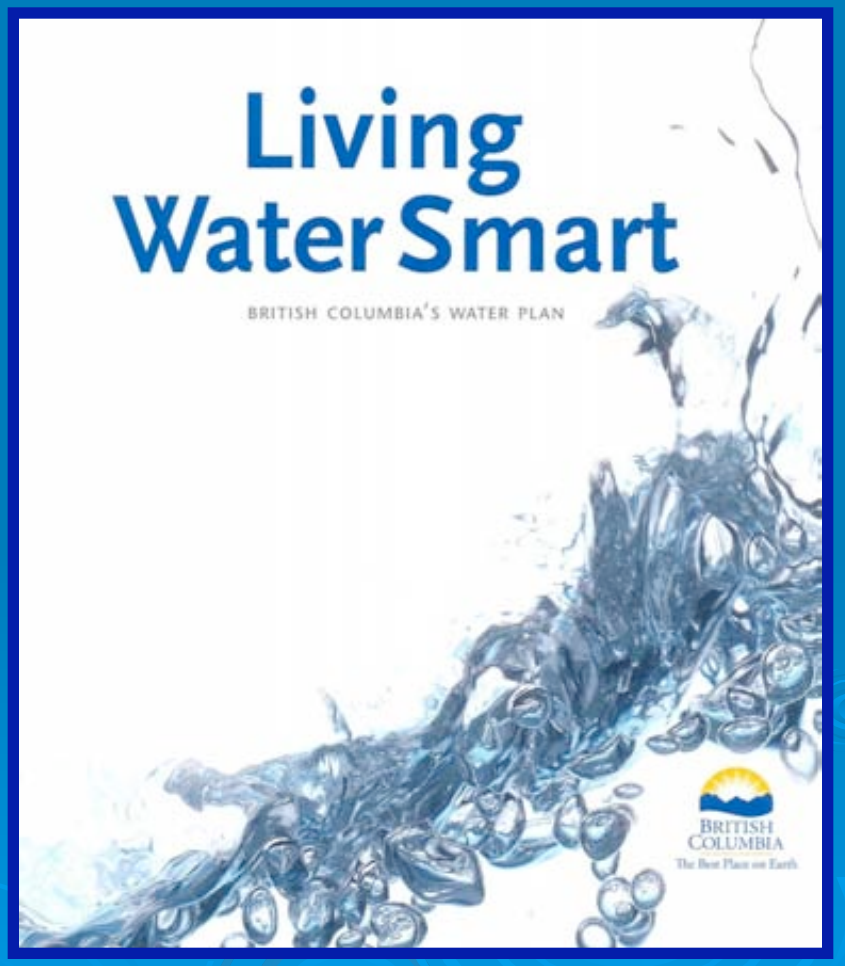
Agriculture Water Demand Model

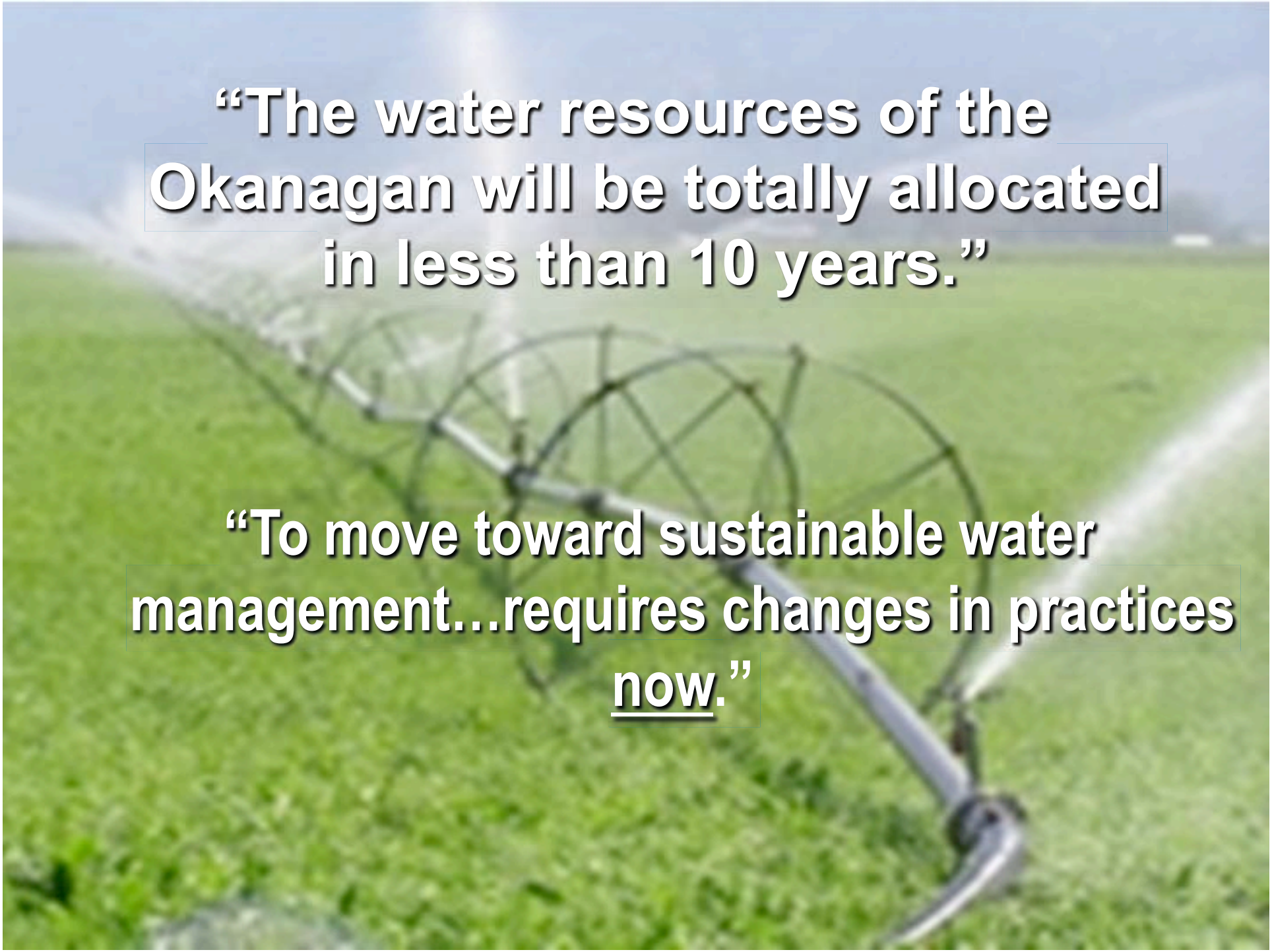
T.W. van der Gulik - Ministry of Agriculture
Denise Neilsen, Agriculture and Agri-food Canada



Province's Water Plan

- Plan requires increase in efficiency of 33% by 2020.
- Reserve water for agriculture
- Measure and report large water use by 2012




"The water resources of the Okanagan will be totally allocated in less than 10 years."
"To move toward sustainable water management…requires changes in practices now."

Irrigation Demand Model

AAFC – Denise Neilsen
Agri – Ted van der Gulik

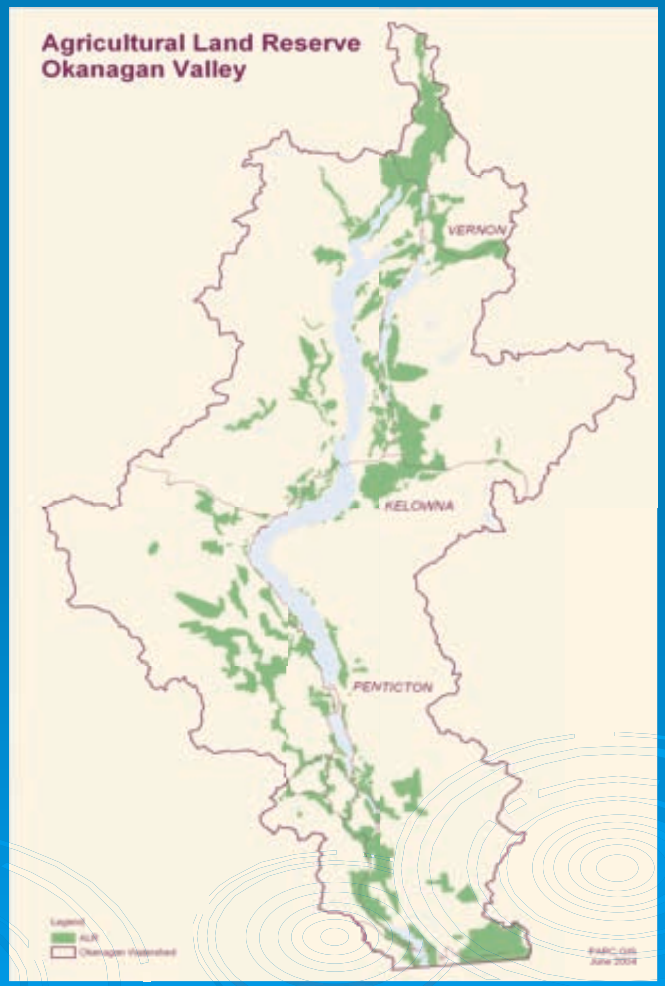
Objective:
Develop a model that calculates agriculture's irrigation needs by purveyor, municipality, district and sub-watershed.

Methodology:
Determine Property-by-Property water use

Result:
Planning Tools that secure water for current and future agricultural needs

Irrigation Water Demand Model

- MAL and AAFC have developed a GIS-based irrigation water demand model
- Originally developed for the Okanagan Basin



Land Use Inventories: Data Collection

DATA COLLECTED ON

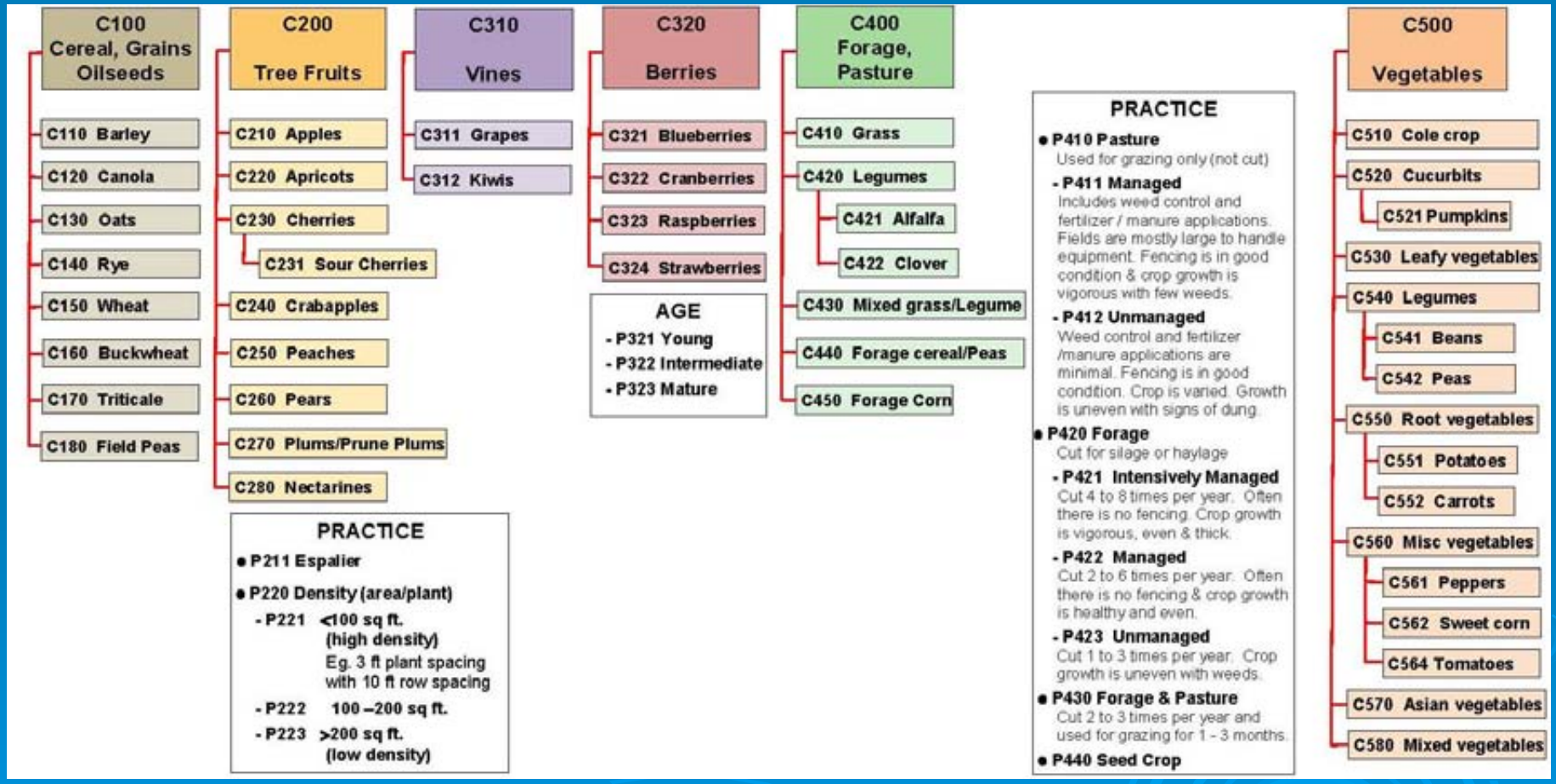
- General Land Use
- Land Cover
- Agricultural Activities
  (ex. Livestock)
- Agricultural Practices
  (ex. Wind machine)
- Irrigation Systems

FOR ALL PARCELS:

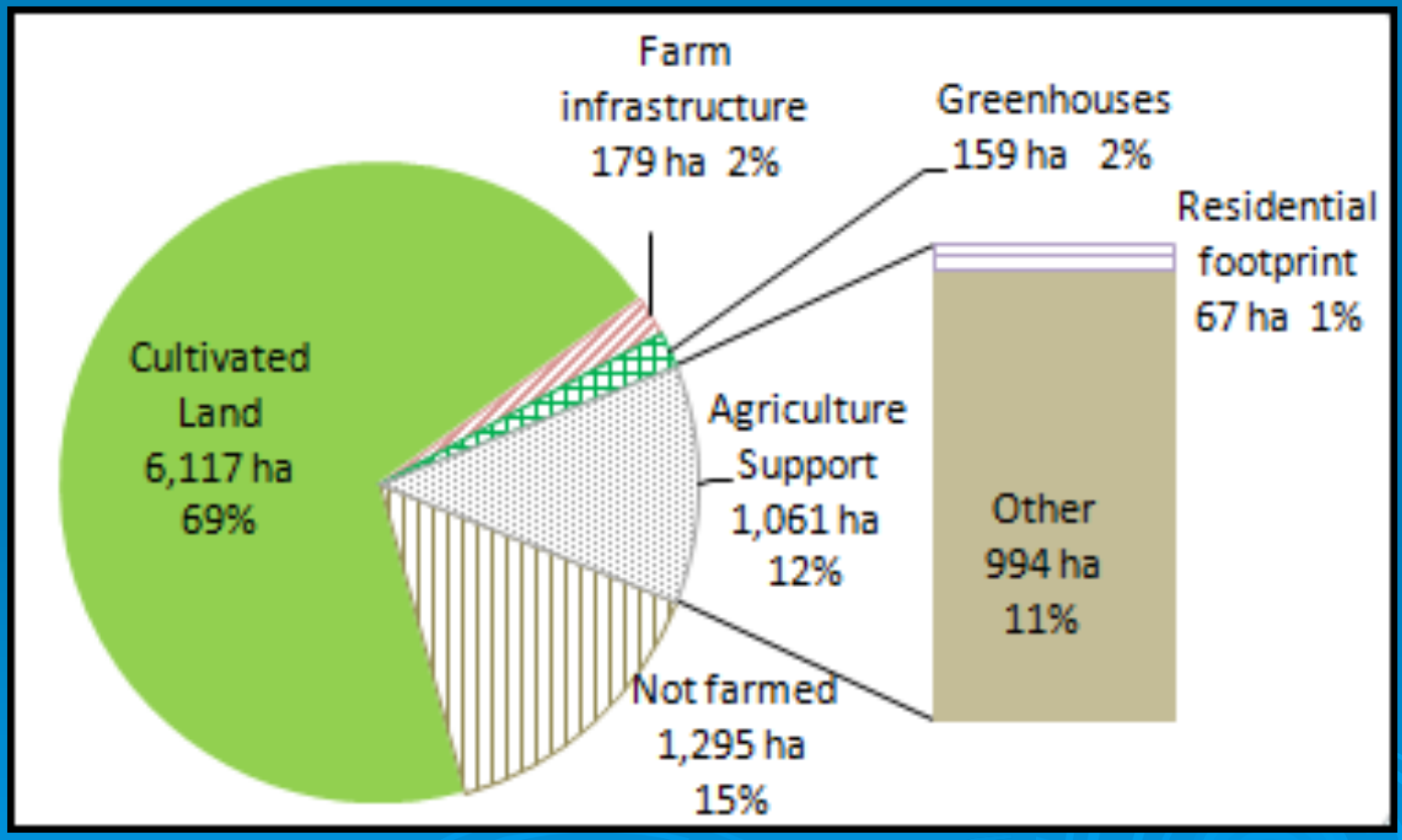
- In the ALR
- In an Agricultural Zone
- With Farm Class
- With agricultural use

Land Cover – Crop Type

An Example Classification:



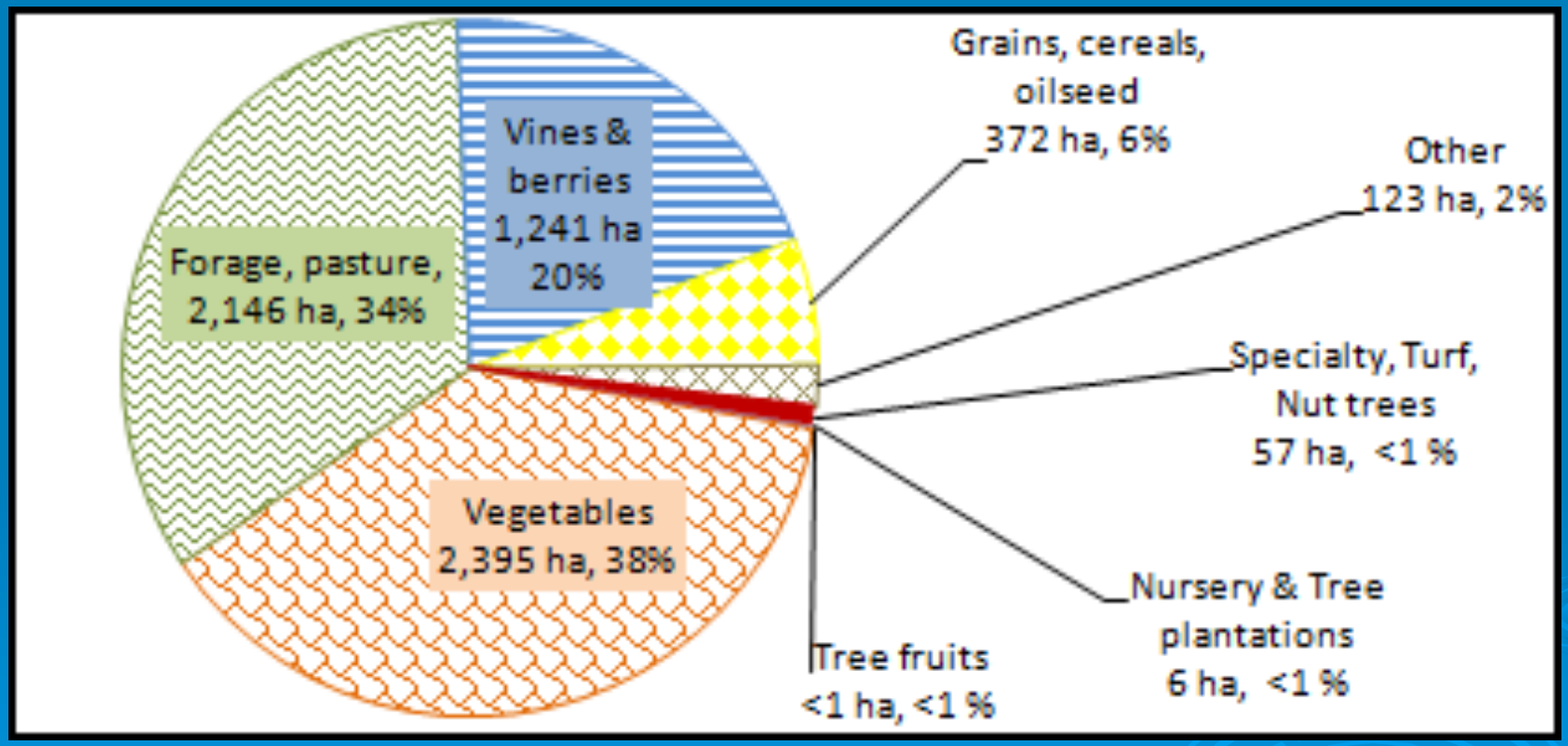
Land Use Inventories: Results



Utilization of Farmed Parcels

Delta Land Use Inventory

Land Use Inventories: Results



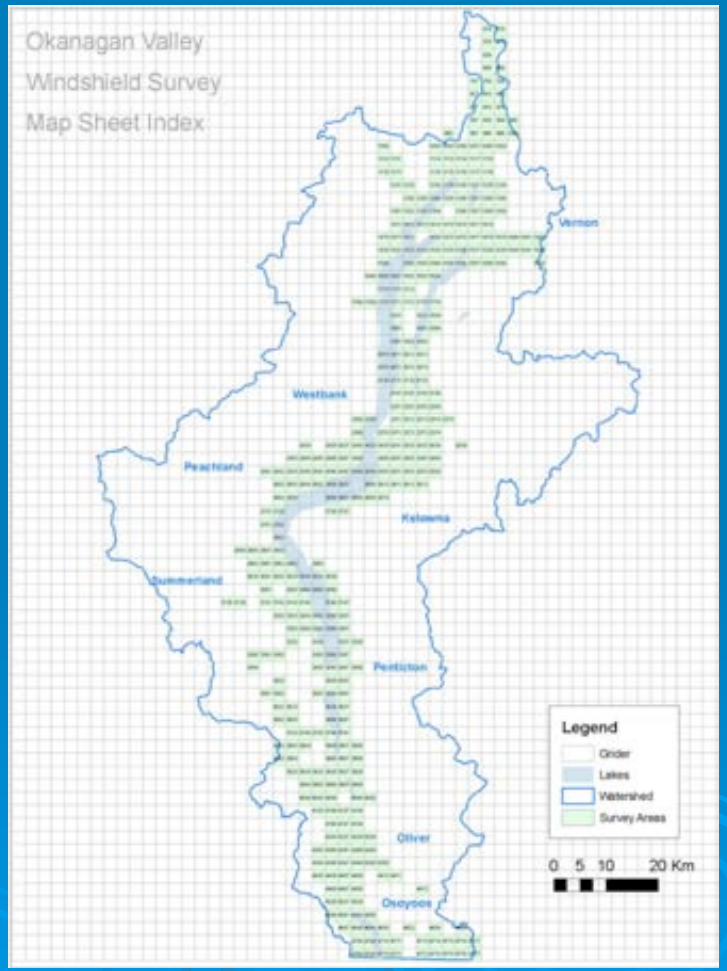
Field crops on ALR Lands

Delta Land Use Inventory

Irrigation Water Demand Model

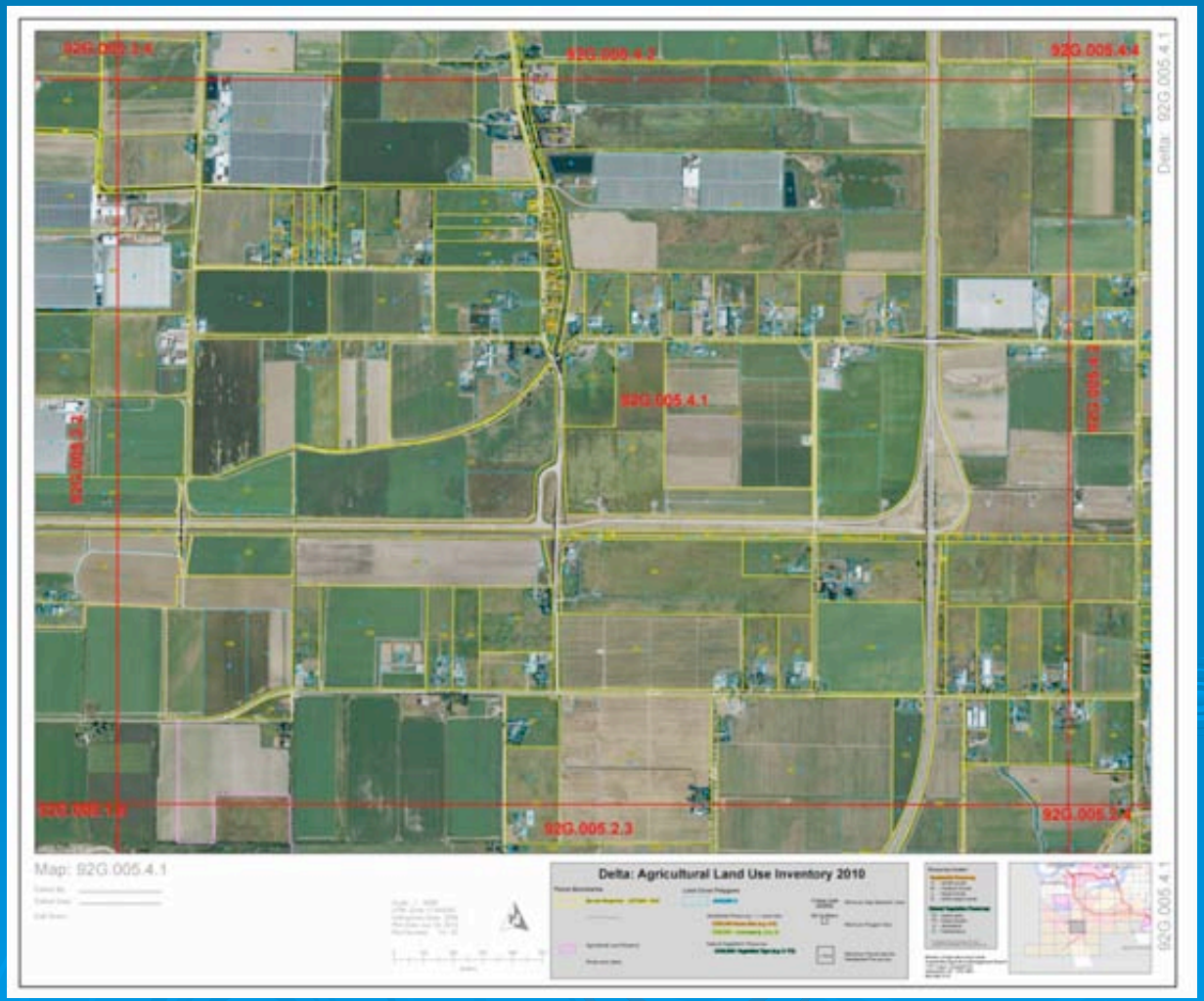
Unified Cadastre

- The agricultural area is divided into 398 map sheets



Land Use Inventories: Methodology

Maps are created using aerial photography and GIS

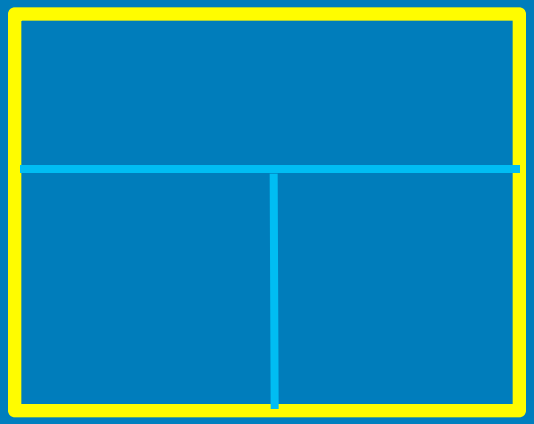


Land Use Inventories: Methodology

Cadastre

Land Use Inventories: Methodology

Cadastre



Land Cover is first digitized in GIS

Land Use Inventories: Methodology

Windshield survey

Each parcel is visited and the land cover and land use is classified and recorded.

Land Use Inventories: Results

Crop Type:

Apple

Pasture

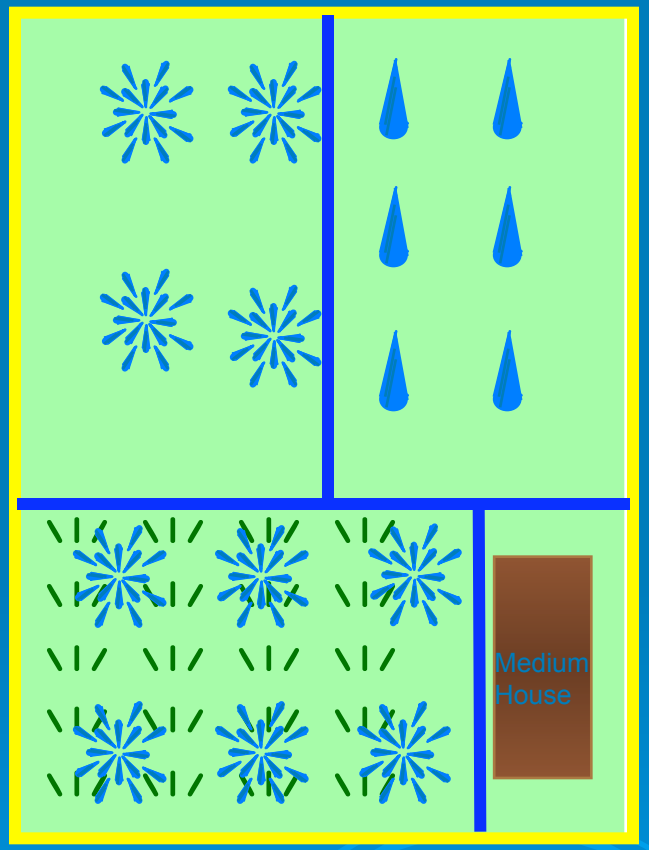
Irrigation System Type:

Sprinkler

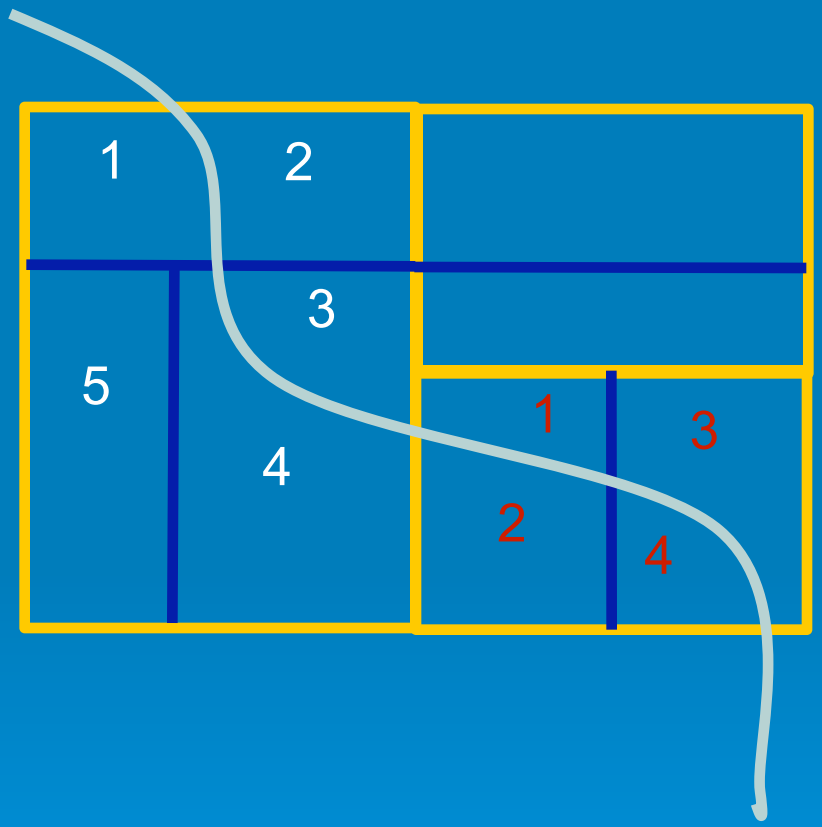
Drip

Building Type:

Medium sized House



Soils Boundary



There are 132,000 polygons generated for the Okanagan in the farming areas

Cadastre

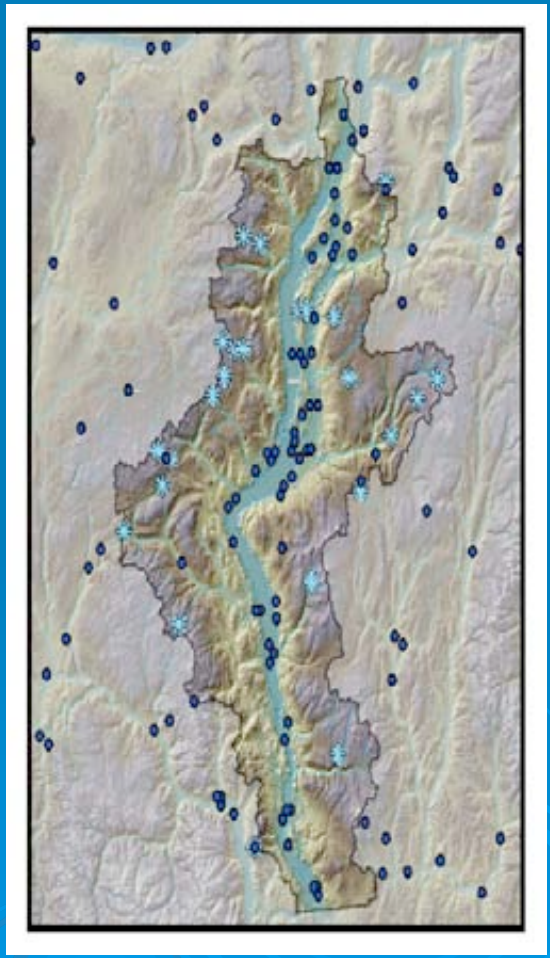
Land and Crop Polygon

Soil Boundary

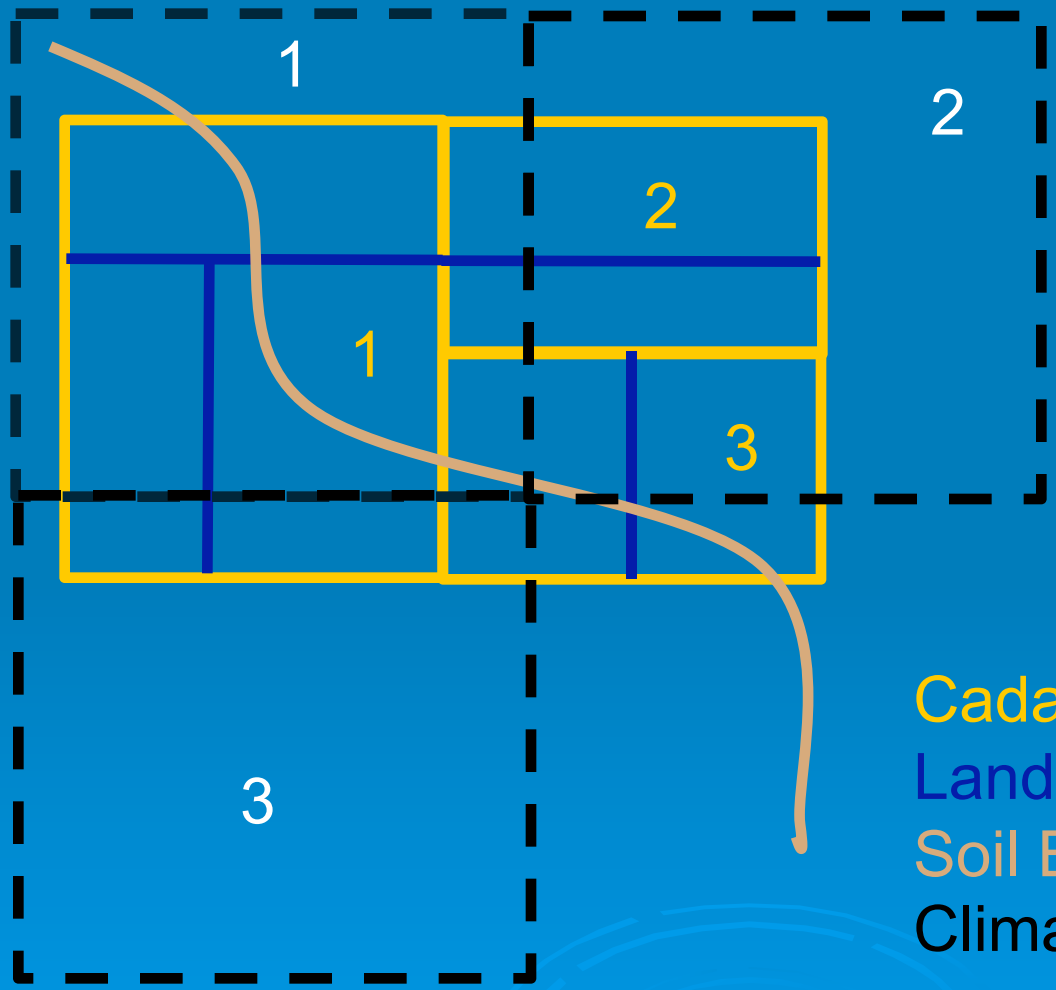
Irrigation Water Demand Model

Climate data:

- A climate model has been developed on a 500 m x 500 m grid
- Provide current climate data based on historical and current information
- Climate change scenarios have been developed



Climate Data

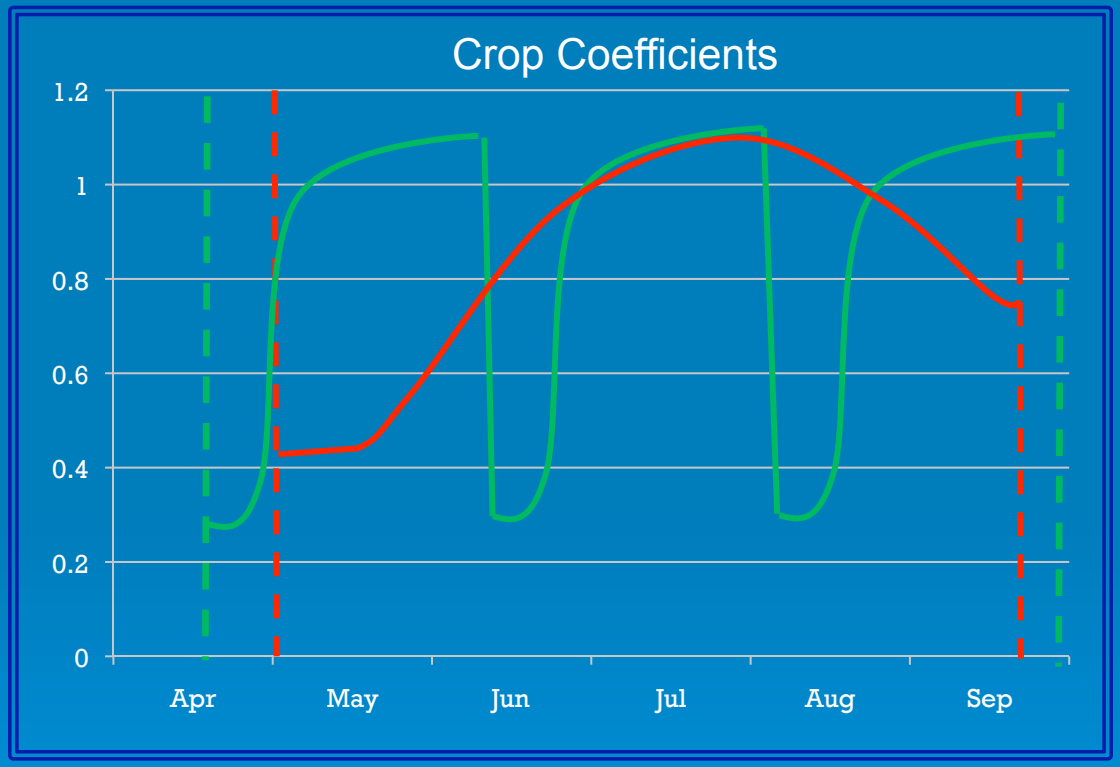


A climate cell gets assigned to each cadastre

Climate grid 1 linked to Cadastre 1
Climate grid 2 linked to Cadastre 2 and 3

Cadastre
Land and Crop Polygon
Soil Boundary
Climate Grid

Model Calculations



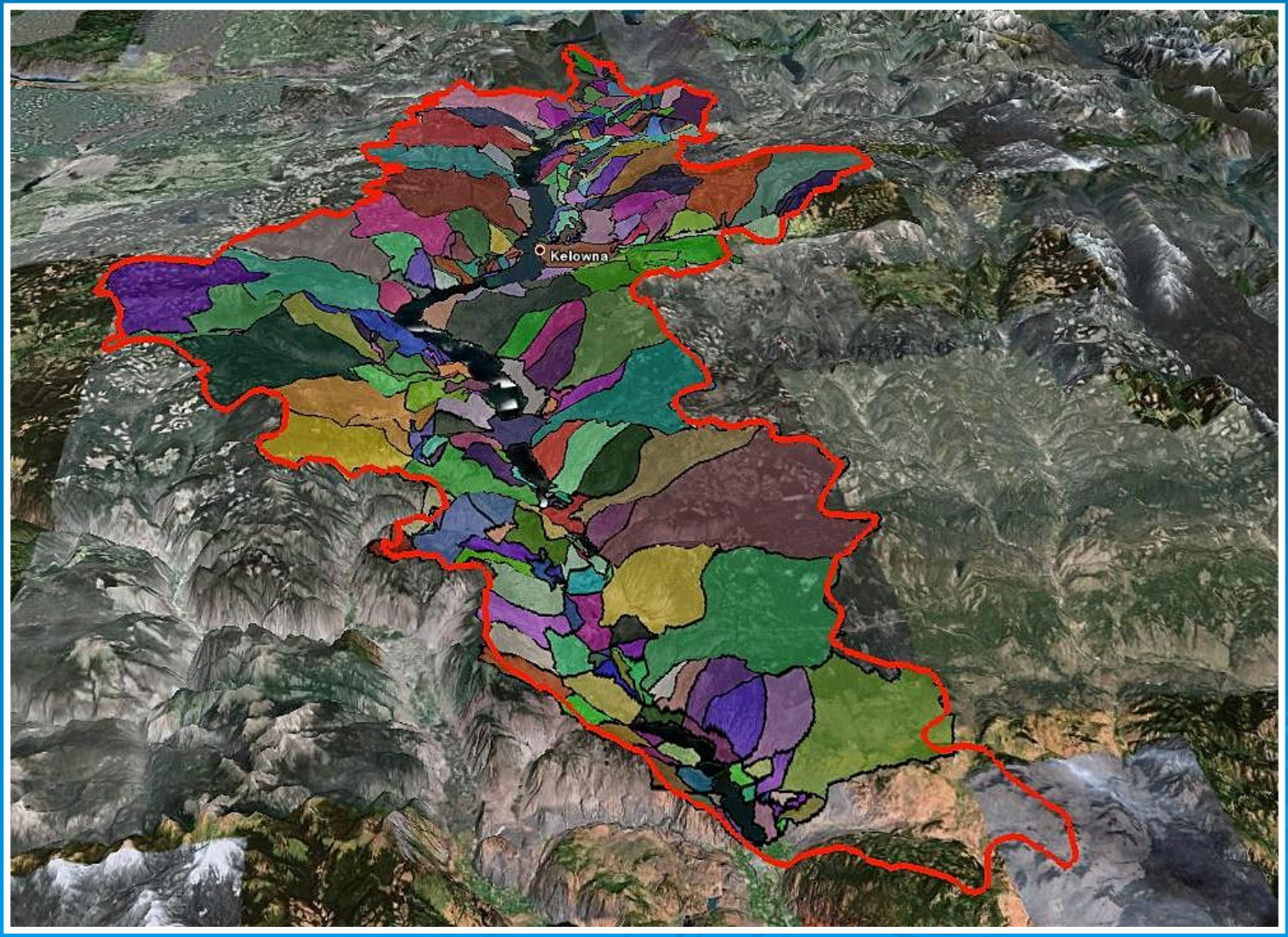
Algorithm calculates water demand from:

- ETo calculated daily from climate data.
- Climate data to determine start and end of growing season.
- Crop coefficients to adjust daily Eto
- Soil and rooting depth information to calculate soil water storage, percolation rates and determine soil factors
- Irrigation system efficiencies

Results by Crop

Crop Group	Irrigated Area (ha)	Irrigation Demand (mm)
Apple	4,292	693
Berry	62	633
Cherry	1,121	733
Forage	8,520	755
Fruit	898	793
Golf	1,048	992
Grape	2,734	413
Landscape Turf	126	1,009
Nursery	385	909
Turf Farm	120	959
Vegetables	531	692
Total =	**20,033**	**704**

Groundwater Layer

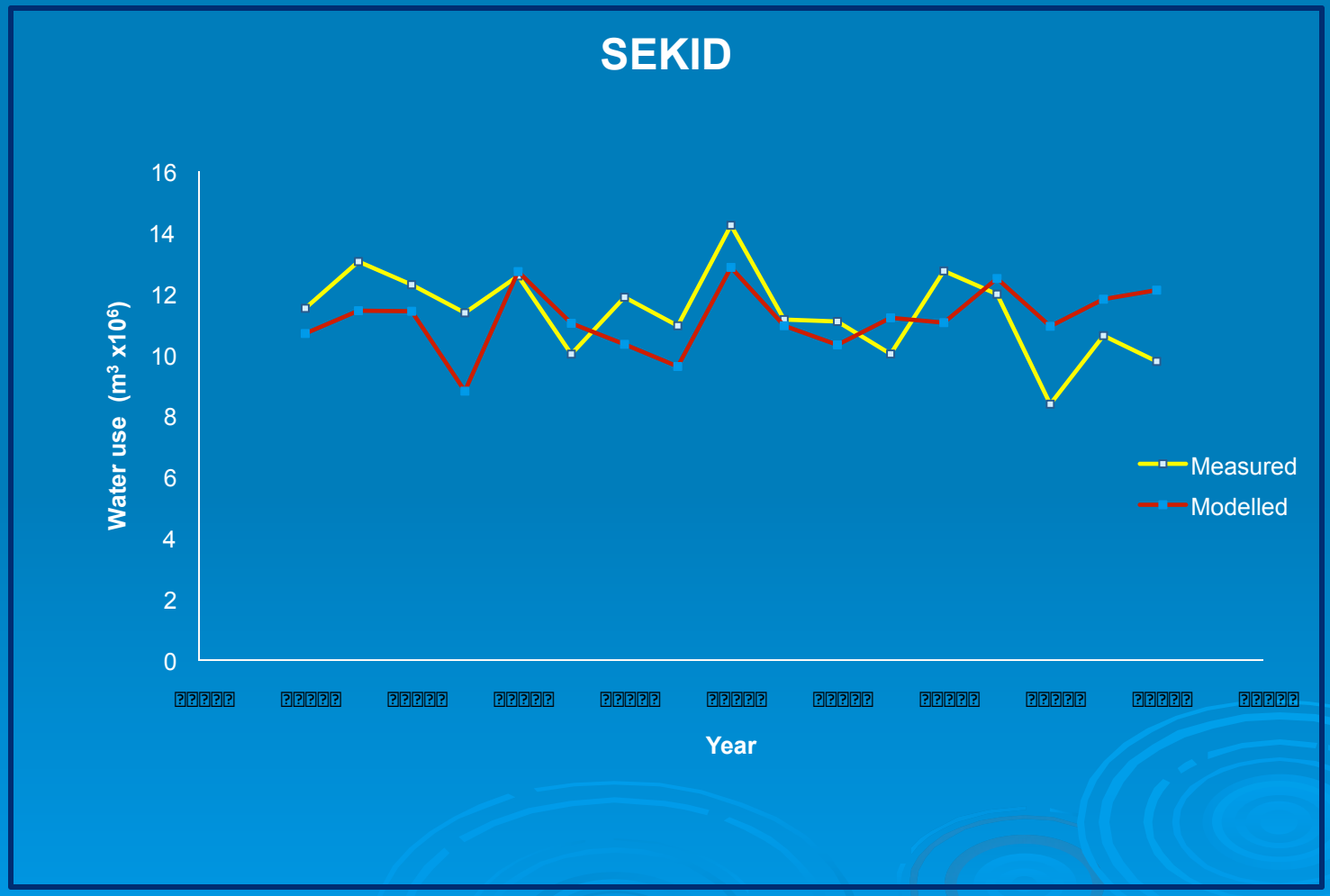


Results by Water Source

Water Source	Irrigated Area (ha)	Irrigation Demand (m^3)
Water License	1,672	11,455,582
Water Purveyor	14,966	107,930,320
Groundwater	3,394	21,695,142
Total	**20,033**	**141,081,043**

Assuming good management

Result Comparison



Irrigation Demand Model - Current

Table A1 Crop Water Demand 2003

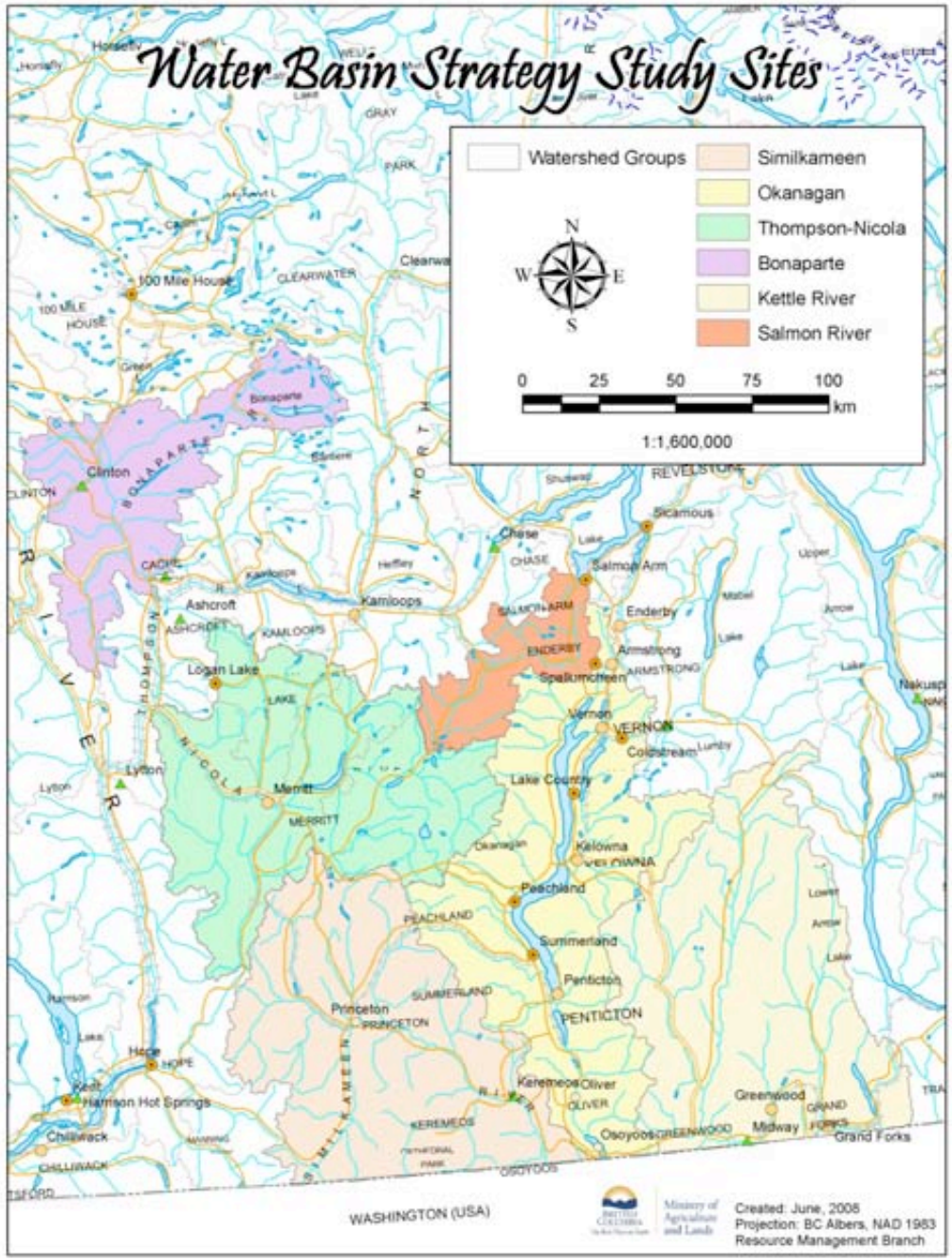
Year: 2003	Okanagan Basin - Average Irrigation Management										
Water Source	**Water Licence**			**Reclaimed Water**			**Groundwater**			**Total**	
Agriculture	**Irrigated**	**Irrigation**	**Average**	**Irrigated**	**Irrigation**	**Average**	**Irrigated**	**Irrigation**	**Average**	**Irrigated**	**Irrigation**
Crop Group	**Area**	**Demand**	**Req.**	**Area**	**Demand**	**Req.**	**Area**	**Demand**	**Req.**	**Area**	**Demand**
	(ha)	**(m3)**	**(mm)**	**(ha)**	**(m3)**	**(mm)**	**(ha)**	**(m3)**	**(mm)**	**(ha)**	**(m3)**
Alfalfa	1,275	9,010,934	707	96	647,964	677	852	5,767,594	677	2,222	15,426,491
Apple	4,070	29,174,202	717	-	-	-	211	1,511,750	717	4,281	30,685,952
Berry	44	291,916	672	-	-	-	18	110,656	603	62	402,572
Cherry	1,074	8,120,474	756	-	-	-	45	367,359	819	1,119	8,487,833
Corn	409	1,956,321	479	23	120,830	525	189	821,606	436	620	2,898,757
Forage	2,964	27,446,657	926	429	4,132,948	964	1,703	13,877,787	815	5,096	45,457,392
Fruit	792	6,576,735	830	-	-	-	102	771,618	759	894	7,348,354
Grape	2,290	9,780,281	427	6	15,923	250	436	1,863,362	427	2,733	11,659,566
Nursery	253	2,543,339	1,006	185	1,263,641	684	127	1,047,376	823	565	4,854,356
Turf Farm	60	606,512	1,008	-	-	-	46	414,190	911	106	1,020,702
Vegetable	370	2,732,012	739	-	-	-	137	845,546	618	507	3,577,558
Inactive	190	-	-	0	-	-	23	-	-	213	-
	13,790	98,239,383		739	6,181,306		3,887	27,398,844		18,416	131,819,533
Turf											
Golf	446	4,471,113	1,002	298	3,095,884	1,041	317	3,095,360	977	1,061	10,662,357
Landscape Turf	488	4,779,235	980	17	172,714	1,004	101	973,438	960	607	5,925,388
Domestic Outdoor	5,169	50,987,109	986	0	1,312	1,006	741	7,578,839	1,023	5,910	58,567,260
	6,104	60,237,457		315	3,269,910		1,159	11,647,637		7,577	75,155,005
Total	19,893	158,476,840	797	1,054	9,451,216	897	5,046	39,046,481	774	25,993	206,974,538

Current Agriculture Irrigated Demand 132,000,000 m3 – 64% of total demand

Irrigation Demand Model - Future

Table A11 Crop Water Demand - Increased Agricultural Acreage and Domestic Buildout to 2040												
Year: 2003	Okanagan Basin - Average Irrigation Management											
Water Source	Water Licence			Reclaimed Water			Groundwater			Total		
Agriculture / Crop Group	Irrigated Area (ha)	Irrigation Demand (m3)	Average Req. (mm)	Irrigated Area (ha)	Irrigation Demand (m3)	Average Req. (mm)	Irrigated Area (ha)	Irrigation Demand (m3)	Average Req. (mm)	Irrigated Area (ha)	Irrigation Demand (m3)	Average Req. (mm)
Alfalfa	4,469	27,733,769	621	94	635,746	679	1,159	7,841,402	676	5,722	36,210,918	633
Apple	7,088	46,353,895	654	42	263,067	625	974	5,907,341	607	8,104	52,524,303	648
Berry	43	291,674	672	-	-	-	18	107,125	604	61	398,799	652
Cherry	1,024	7,730,498	755	-	-	-	54	430,617	802	1,078	8,161,115	757
Corn	411	1,967,680	479	20	105,718	530	182	792,486	435	613	2,865,883	468
Forage	3,446	32,443,771	941	407	3,965,771	974	2,086	17,503,189	839	5,939	53,912,731	908
Fruit	763	6,337,478	831	-	-	-	101	763,842	758	864	7,101,320	822
Grape	2,158	9,257,317	429	6	14,317	252	415	1,777,314	428	2,579	11,048,948	428
Nursery	241	2,442,916	1,015	185	1,263,704	684	127	1,047,811	823	553	4,754,431	860
Turf Farm	52	529,111	1,019	-	-	-	36	330,022	918	88	859,133	978
Vegetable	368	2,723,014	740	-	-	-	136	842,391	619	504	3,565,405	707
	20,062	137,811,123		753	6,248,323		5,288	37,343,540		26,103	181,402,986	
Turf												
Golf	443	4,435,377	1,002	293	3,045,970	1,041	284	2,792,974	985	1,019	10,274,321	1,008
Landscape Turf	471	4,616,938	981	17	172,756	1,004	102	978,823	962	590	5,768,517	978
Domestic Outdoor	4,826	47,618,401	987	156	1,497,405	959	1,266	12,719,155	1,004	6,249	61,834,962	990
	5,740	56,670,716		466	4,716,131		1,652	16,490,952		7,857	77,877,800	
Total	25,802	194,481,839	780	1,219	10,964,454	885	6,939	53,834,492	786	33,961	259,280,786	786

Future Agriculture Irrigated Demand 181,500,000 m3 – 70% of total demand
Total irrigated demand for basin increased by 25% (207 – 260 million m3)



Irrigation Demand Model Applications