Asian Development Bank
TA 4669-CAM

Technical Assistance to the Kingdom of Cambodia
for the Study of the Influence of Built Structures
on the Fisheries of the Tonle Sap
(financed by the Government of Finland)

Database Component

BUILT STRUCTURES DATABASE

TONLE SAP BUILT STRUCTURES STATISTICS
DATABASE DOCUMENTATION
DATABASE USER MANUAL

Prepared by

Hannu LAURI

Environmental Impact Assessment Center of Finland Ltd

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CONTENTS

Introduction 2

1. Statistics by sub-catchment 3

2. Statistics by province 5

3. Number of structures by class 7

4. Structure statistics by subcatchment 7

5. Structure statistics by province 14

INTRODUCTION

This document contains summary statistics of the Tonle Sap Basin built structures database.
Data sets used to identify structures are detailed in the database documentation. In short this census is based on the best available GIS information covering the whole basin, with a specific focus on floodplains and the three project study areas: Stung Chinit, Prek Toal and Pursat. For these study areas, more detailed information has been sought, maps of higher resolution have been used and details of these maps have been digitized (e.g. fishing gear in Prek Toal) to be better quantified.
More than fourteen thousand built structureshave been identified during the studying the Tonle Sap Basin. However counting all existing structures in the Tonle Sap Basin (i.e. over 44 percent of the whole country) is a titanic undertaking; during this project only 3 study areas could be covered in detail. Roads cannot be easily counted (their length, width or design might be more important than their number). Counting structures also relies on automatic mapping (e.g. to identify rice fields), with subsequent uncertainties. Categorizing them into simple, distinct groups is often tricky (e.g. difference between weirs, dykes and embankments). Fishing fences can be identified as long as they are not under vegetation cover nor underwater (which is often the case with extensive nylon barriers). Canals are many but include a large majority of canals from the Khmer Rouge period that are not actually operational. Major pollution sources (mines, factories, etc.) can be counted, but not diffuse pollution sources due to agriculture or human settlements. Last, the influence of many structures depends on how they are designed and operated. For instance a sluice gate in an irrigation scheme counts as one structure, but its role depends whether it is open or closed, and when; similarly a floodplain road that counts as one structure will have a different influence depending upon the number and size of its culverts.

1. STATISTICS BY SUB-CATCHMENT

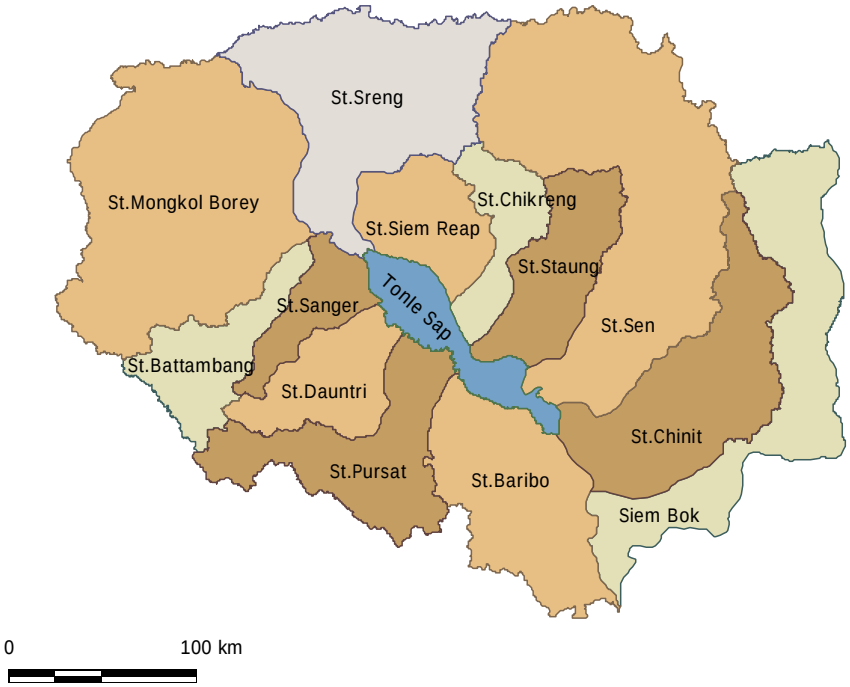

Figure 1: Tonle Sap subcatchments

Tonle Sap subcatchment statistics

Subcatchment	Area (km2)	Flooded (km2) medium flood	Flooded (%) in medium flood
Siem Bok	8851.22	2171.99	24.54
St. Baribo	7153.78	1032.37	14.43
St. Battambang	3708.31	431.79	11.64
St. Chikreng	2713.90	700.19	25.80
St. Chinit	8236.86	1983.23	24.08
St. Dauntri	3695.97	1174.30	31.77
St. Mongkol Borey	14966.42	1834.95	12.26
St. Pursat	5964.77	687.25	11.52
St. Sangker	2344.47	1548.73	66.06
St. Sen	16359.58	1773.03	10.84
St. Siem Reap	3618.98	1017.23	28.11
St. Sreng	9986.27	1430.55	14.33
St. Staung	4357.39	1186.82	27.24
Tonle Sap	2743.80	2743.80	100.00
Sum	94701.70	19716.23	20.82

Lake dry season and medium flood (year 2001) statistics

Dry season lake from MRC shoreline data (50m resolution):

Lake shoreline length	1059	km
Main islands shoreline length	1309	km
Together	2368	km
Lake area (islands subtracted)	2767	km2

Medium flood lake shoreline length from MRC 2001 flood level data (50m resolution):

Total shoreline length	7007.8	km
Area under flood	19718.7	km2

Dry season and medium flood shoreline lengths by catchment area

Catchment	Dry season (km)	Flooded (km)
Siem Bok	0	736.24
St. Baribo	368.1	554.33
St. Battambang	0	267.85
St. Chikreng	298.5	162.42
St. Chinit	181.2	379.19
St. Dauntri	133.9	725.48
St. Mongkol Borey	0	1626.26
St. Pursat	109.7	351.88
St. Sangker	176.5	89.5
St. Sen	106.4	531.38
St. Siem Reap	69.4	449.58
St. Sreng	41.7	814.25
St. Staung	482.8	319.42
Tonle Sap	400.8	0
Sum	2368.1	7007.78

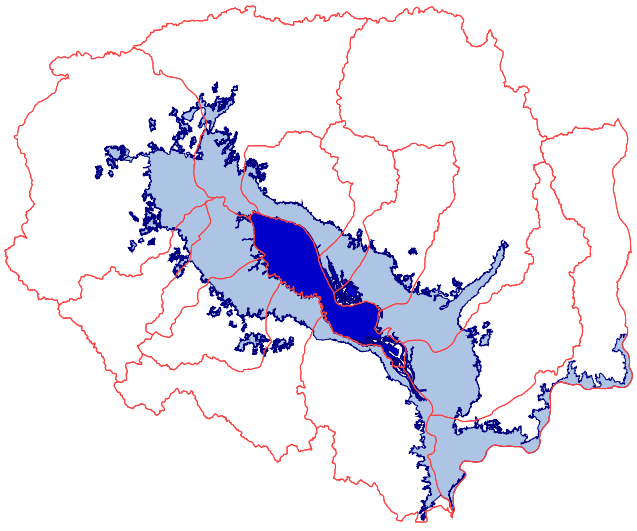

Figure 2: Data used in shoreline length and area computation, dry season lake area in blue, medium flood area in light blue, and catchment boundaries in red.

Dry season lake shoreline length during low water level, computed from subcatchment boundary data:

Catchment	Length (km)
Siem Bok	0
St. Baribo	80.5
St. Battambang	0
St. Chikreng	22.2
St. Chinit	15.5
St. Dauntri	30.0
St. Mongkol Borey	0
St. Pursat	83.7
St. Sangker	33.6
St. Sen	46.6
St. Siem Reap	56.6
St. Sreng	11.9
St. Staung	40.5
Tonle Sap	0
Sum	421.1

2. STATISTICS BY PROVINCE

Figure 3: Cambodian provinces intersecting Tonle Sap catchment area

Area data for provinces in the Tonle Sap catchment, including flooded area of provinces within the Tonle Sap catchment boundary (see Figure 4).

Province	Area (km2)	Flooded (km2) in medium flood and within Tonle Sap catchment
Stung Treng	12016.42	0
Oddar Meancheay	5211.71	30.90
Preah Vihear	14030.75	0
Banteay Meanchey	6148.69	1347.75
Siem Reap	11963.74	2825.36
Thailand	4102.97	0
Battambang	11857.86	3331.61
Kampong Thom	12446.57	3625.73
Kratie	11972.83	268.88
Tonle Sap	2524.603	2524.603
Pailin	1090.97	0
Pursat	11576.90	1612.47
Kampong Chhnang	5327.54	1964.28
Kampong Cham	9482.88	1642.04
Kampong Spe	6964.62	0.2
Kandal	3563.69	506.35
Phnom Penh	373.72	56.06

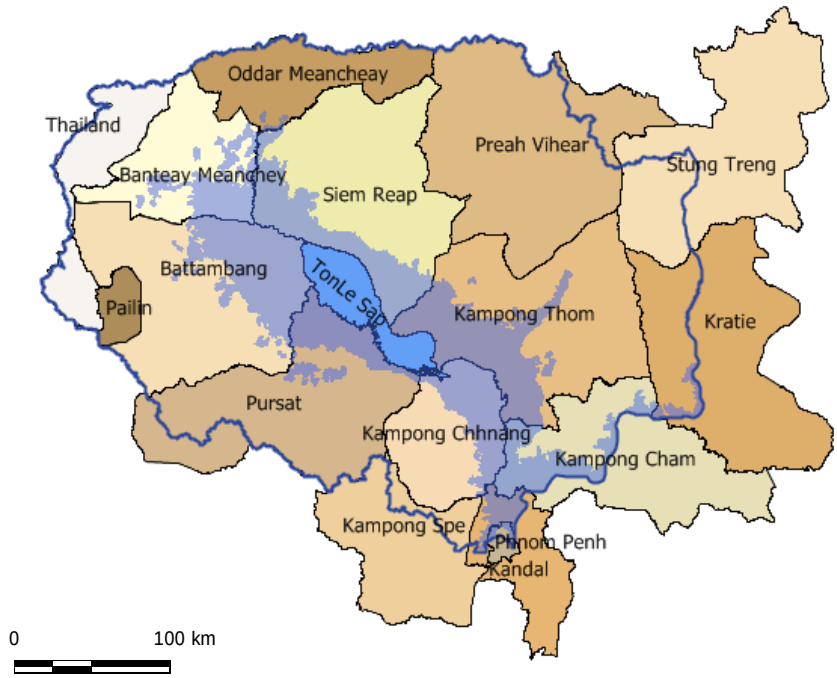

Figure 4: Medium flood area with provinces and Tonle Sap catchment boundary (wide blue line).

3. NUMBER OF STRUCTURES BY CLASS

Class ID	Class name	Count
110	Reservoir	55
211	Irrigation canal	3992
220	Bridge	1311
230	Culvert	323
310	Dam	38
320	Embankment	908
321	Road embankment primary	45
322	Road embankment other	2149
323	Railroad embankment	20
324	Reservoir dike	3
340	Weir	2
371	Hydrological station	44
372	Meteorological station	85
411	Dai fishery	11
413	Fence system	163
414	Fence trap	258
415	Fence pen	51
440	Fishing lot	41
450	Fish sanctuary	7
610	Rice field	1597
620	Field crops	473
630	Plantation	77
640	Other agriculture	2961
650	Irrigated area	159
710	Docks/Harbour	4
730	Ferry	4
814	Mine	62
Sum		14843

4. STRUCTURE STATISTICS BY SUBCATCHMENT

Length of primary roads (km)

Catchment	Count	Length (km)
Siem Bok	8	138.47
St. Baribo	16	188.79
St. Battambang	1	18.89
St. Chikreng	1	19.88
St. Chinit	2	68.72
St. Dauntri	2	51.26
St. Mongkol Borey	5	155.61
St. Pursat	1	29.31
St. Sangker	1	20.63
St. Sen	1	50.32
St. Siem Reap	1	77.83
St. Sreng	2	35.6
St. Staung	2	44.49
Sum	43	899.81

Length of other roads (km)

Catchment	Count	Length (km)
Siem Bok	106	657.27
St. Baribo	225	844.73
St. Battambang	152	443.27
St. Chikreng	8	41.97
St. Chinit	129	600.12
St. Dauntri	85	208.99
St. Mongkol Borey	509	1604.24
St. Pursat	191	588.8
St. Sangker	6	49.73
St. Sen	212	1013.28
St. Siem Reap	228	678.61
St. Sreng	243	1091.97
St. Staung	54	215.56
Sum	2148	8038.54

Length of railroad embankments (km)

Catchment	Count	Length (km)
Siem Bok	0	0
St. Baribo	9	143.07
St. Battambang	1	21.53
St. Chikreng	0	0
St. Chinit	0	0
St. Dauntri	2	51.97
St. Mongkol Borey	3	111.34
St. Pursat	1	31.72
St. Sangker	1	20.15
St. Sen	0	0
St. Siem Reap	0	0
St. Sreng	0	0
St. Staung	0	0
Sum	17	379.78

Length of embankments (km)

Catchment	Count	Length (km)
Siem Bok	232	363.88
St. Baribo	108	197.61
St. Battambang	15	24.72
St. Chikreng	17	57.36
St. Chinit	67	117.92
St. Dauntri	62	168.09
St. Mongkol Borey	124	347.11
St. Pursat	4	8.62
St. Sangker	12	34.86
St. Sen	33	64.82
St. Siem Reap	167	418.73
St. Sreng	44	144.82
St. Staung	23	89.56
Sum	908	2038.11

Length of irrigation channels (km)

Channels selected for a catchment if the channel mid-point is within the catchment.

Catchment	Count	Length (km)
Siem Bok	264	259.49
St. Baribo	133	285.81
St. Battambang	94	108.77
St. Chikreng	30	65.56
St. Chinit	493	626.94
St. Dauntri	282	479.58
St. Mongkol Borey	1622	2039.92
St. Pursat	249	405.84
St. Sangker	86	154.17
St. Sen	161	215.69
St. Siem Reap	63	155.73
St. Sreng	373	429.15
St. Staung	142	187.98
Sum	3992	5414.63

Length of reservoir dikes (km)

Catchment	Count	Length (km)
Siem Bok	0	0
St. Baribo	0	0
St. Battambang	0	0
St. Chikreng	0	0
St. Chinit	3	25.89
St. Dauntri	0	0
St. Mongkol Borey	0	0
St. Pursat	0	0
St. Sangker	0	0
St. Sen	0	0
St. Siem Reap	0	0
St. Sreng	0	0
St. Staung	0	0
Sum	3	25.89

Length of fish fences (km)

Data was available from Preak Toal area only, see figure 5.

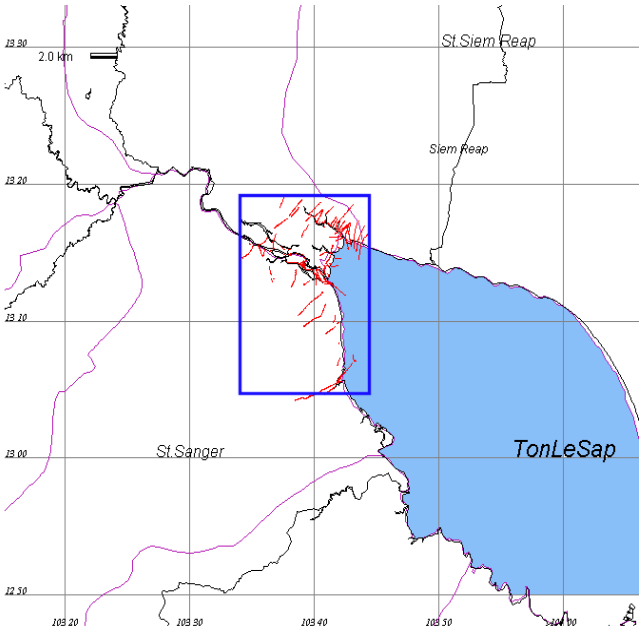

Figure 5: Area from where fishing fences, pens and traps data have been digitized.

Catchment	Count	Length (km)
Siem Bok	0	0
St. Baribo	0	0
St. Battambang	0	0
St. Chikreng	0	0
St. Chinit	0	0
St. Dauntri	0	0
St. Mongkol Borey	0	0
St. Pursat	0	0
St. Sangker	54	55.66
St. Sen	0	0
St. Siem Reap	1	4.1
St. Sreng	74	56.45
St. Staung	34	8.16
Sum	163	124.37

Number of traps (km)

Catchment	Count
Siem Bok	0
St. Baribo	0
St. Battambang	0
St. Chikreng	0
St. Chinit	0
St. Dauntri	0
St. Mongkol Borey	0
St. Pursat	0
St. Sangker	83
St. Sen	0
St. Siem Reap	0
St. Sreng	105
St. Staung	70
Sum	258

Number of pens (km)

Catchment	Count
Siem Bok	0
St. Baribo	0
St. Battambang	0
St. Chikreng	0
St. Chinit	0
St. Dauntri	0
St. Mongkol Borey	0
St. Pursat	0
St. Sangker	17
St. Sen	0
St. Siem Reap	0
St. Sreng	24
St. Staung	10
Sum	51

Area of reservoirs (km2)

Catchment	Count	Area (km2)
Siem Bok	2	1.74
St. Baribo	0	0
St. Battambang	0	0
St. Chikreng	2	3.64
St. Chinit	1	0.85
St. Dauntri	0	0
St. Mongkol Borey	6	27.36
St. Pursat	0	0
St. Sangker	0	0
St. Sen	4	6.83
St. Siem Reap	3	14.27
St. Sreng	5	12.03
St. Staung	32	35.56
Sum	55	102.28

Area of paddy fields (km2)

Catchment	Count	Area (km2)
Siem Bok	206	1196.25
St. Baribo	167	2656.31
St. Battambang	29	539.88
St. Chikreng	51	402.85
St. Chinit	109	1607.71
St. Dauntri	48	1349.02
St. Mongkol Borey	139	4476.1
St. Pursat	45	674.7
St. Sangker	12	427.61
St. Sen	370	1624.11
St. Siem Reap	40	1347.38
St. Sreng	289	1988.98
St. Staung	89	790.19
Sum	1594	19081.11

Area of field crops (km2)

Catchment	Count	Area (km2)
Siem Bok	37	209.43
St. Baribo	46	53.51
St. Battambang	28	70.33
St. Chikreng	3	2.57
St. Chinit	99	387.8
St. Dauntri	1	10.11
St. Mongkol Borey	160	742.31
St. Pursat	2	17.42
St. Sangker	0	0
St. Sen	40	65.51
St. Siem Reap	17	23.31
St. Sreng	27	31.15
St. Staung	13	10.52
Sum	473	1623.98

Area of plantations (km2)

Catchment	Count	Area (km2)
Siem Bok	8	111.92
St. Baribo	0	0
St. Battambang	9	2.52
St. Chikreng	0	0
St. Chinit	37	218.37
St. Dauntri	0	0
St. Mongkol Borey	22	85.54
St. Pursat	0	0
St. Sangker	0	0
St. Sen	1	0.17
St. Siem Reap	0	0
St. Sreng	0	0
St. Staung	1	0.5
Sum	78	418.90

Area of other agriculture (km2)

Catchment	Count	Area (km2)
Siem Bok	450	826.83
St. Baribo	422	362.74
St. Battambang	100	172.51
St. Chikreng	61	123.65
St. Chinit	316	338.2
St. Dauntri	90	96.1
St. Mongkol Borey	325	354.58
St. Pursat	62	83.54
St. Sangker	26	14.2
St. Sen	354	278.09
St. Siem Reap	201	865.59
St. Sreng	391	693.68
St. Staung	159	132.35
Sum	2957	4342.06

Area of irrigation (km2)

Catchment	Count	Area (km2)
Siem Bok	12	186.42
St. Baribo	27	146.01
St. Battambang	0	0
St. Chikreng	2	259.54
St. Chinit	5	48.86
St. Dauntri	17	562.49
St. Mongkol Borey	5	965.03
St. Pursat	14	139.24
St. Sangker	1	356.29
St. Sen	19	141.78
St. Siem Reap	14	297.2
St. Sreng	13	109.84
St. Staung	30	313.37
Sum	159	3526.08

Number of dams

Catchment	Count
Siem Bok	1
St. Baribo	0
St. Battambang	0
St. Chikreng	0
St. Chinit	0
St. Dauntri	0
St. Mongkol Borey	23
St. Pursat	0
St. Sangker	0
St. Sen	11
St. Siem Reap	0
St. Sreng	2
St. Staung	1
Sum	38

Number of bridges

Catchment	All bridges	Bridges on primary roads
Siem Bok	132	39
St. Baribo	147	68
St. Battambang	60	10
St. Chikreng	13	4
St. Chinit	41	23
St. Dauntri	65	24
St. Mongkol Borey	202	67
St. Pursat	164	23
St. Sangker	21	18
St. Sen	204	16
St. Siem Reap	79	30
St. Sreng	162	22
St. Staung	21	10
Sum	1311	354

Number of culverts

Includes only bridges on primary roads (no data on culvers elsewhere)

Catchment	Count
Siem Bok	5
St. Baribo	43
St. Battambang	5
St. Chikreng	2
St. Chinit	9
St. Dauntri	13
St. Mongkol Borey	46
St. Pursat	8
St. Sangker	5
St. Sen	12
St. Siem Reap	78
St. Sreng	56
St. Staung	41
Sum	323

5. STRUCTURE STATISTICS BY PROVINCE

In that section, statistics about built structures are detailed by province. Two special cases are to be mentioned:
- the tables below include a “Tonle Sap” category, that corresponds to the permanent water body that includes structures but does not pertain to any province in particular;
- the tables also include a “Thailand” category; as a matter of fact a small fraction of the Tonle Sap basin lies in Thailand, and this area includes built structures that have also been recorded in the database.

Length of primary roads (km)

Province	Count	Length
Stung Treng	0	0
Oddar Meancheay	0	0
Preah Vihear	0	0
Banteay Meanchey	4	121.36
Siem Reap	4	131.66
Thailand	1	0.94
Battambang	4	111.65
Kampong Thom	3	141.78
Kratie	0	0
Tonle Sap	0	0
Pailin	0	0
Pursat	3	88.04
Kampong Chhnang	1	93.34
Kampong Cham	6	109.76
Kampong Spe	3	1.07
Kandal	16	100.47
Sum	45	900.08

Length of other roads (km)

Province	Count	Length
Stung Treng	4	42.28
Oddar Meancheay	188	799.99
Preah Vihear	118	602.74
Banteay Meanchey	228	848.73
Siem Reap	288	1029.28
Thailand	91	161.03
Battambang	292	1032.8
Kampong Thom	208	960.53
Kratie	49	401.46
Tonle Sap	2	1.08
Pailin	90	148.35
Pursat	308	907.66
Kampong Chhnang	97	449.99
Kampong Cham	93	367.79
Kampong Spe	24	107.55
Kandal	65	171.07
Sum	2145	8032.33

Length of railroad embankments (km)

Province	Count	Length
Stung Treng	0	0
Oddar Meancheay	0	0
Preah Vihear	0	0
Banteay Meanchey	1	70.78
Siem Reap	0	0
Thailand	1	0.73
Battambang	4	113.74
Kampong Thom	0	0
Kratie	0	0
Tonle Sap	0	0
Pailin	0	0
Pursat	3	80.14
Kampong Chhnang	2	75.17
Kampong Cham	0	0
Kampong Spe	1	14.83
Kandal	8	24.39
Sum	20	379.78

Length of irrigation channels (km)

Province	Count	Length
Stung Treng	1	0.55
Oddar Meancheay	13	13.71
Preah Vihear	41	24.91
Banteay Meanchey	964	1255.68
Siem Reap	431	566.49
Thailand	0	0
Battambang	1047	1455.06
Kampong Thom	507	750.74
Kratie	20	14.23
Tonle Sap	0	0
Pailin	0	0
Pursat	403	670.24
Kampong Chhnang	77	147.94
Kampong Cham	452	459.97
Kampong Spe	6	12.27
Kandal	30	42.84
Sum	3992	5414.63

Length of embankments (km)

Province	Count	Length
Stung Treng	0	0
Oddar Meancheay	3	7.3
Preah Vihear	7	25.21
Banteay Meanchey	90	245.04
Siem Reap	224	587.44
Thailand	1	4.2
Battambang	106	300.25
Kampong Thom	56	137.4
Kratie	4	8.08
Tonle Sap	0	0
Pailin	0	0
Pursat	31	80.93
Kampong Chhnang	122	255.12
Kampong Cham	173	265.12
Kampong Spe	11	14.43
Kandal	80	107.58
Sum	908	2038.11

Length of reservoir dikes (km)

Province	Count	Length
Stung Treng	0	0
Oddar Meancheay	0	0
Preah Vihear	0	0
Banteay Meanchey	0	0
Siem Reap	0	0
Thailand	0	0
Battambang	0	0
Kampong Thom	3	25.89
Kratie	0	0
Tonle Sap	0	0
Pailin	0	0
Pursat	0	0
Kampong Chhnang	0	0
Kampong Cham	0	0
Kampong Spe	0	0
Kandal	0	0
Sum	3	25.89

Length of fish fences (km)

Province	Count	Length
Stung Treng	0	0
Oddar Meancheay	0	0
Preah Vihear	0	0
Banteay Meanchey	0	0
Siem Reap	41	45.49
Thailand	0	0
Battambang	115	76.67
Kampong Thom	0	0
Kratie	0	0
Tonle Sap	7	2.2
Pailin	0	0
Pursat	0	0
Kampong Chhnang	0	0
Kampong Cham	0	0
Kampong Spe	0	0
Kandal	0	0
Sum	163	124.37

Number of traps (km)

Province	Count
Stung Treng	0
Oddar Meancheay	0
Preah Vihear	0
Banteay Meanchey	0
Siem Reap	60
Thailand	0
Battambang	171
Kampong Thom	0
Kratie	0
Tonle Sap	27
Pailin	0
Pursat	0
Kampong Chhnang	0
Kampong Cham	0
Kampong Spe	0
Kandal	0
Sum	258

Number of pens (km)

Province	Count
Stung Treng	0
Oddar Meancheay	0
Preah Vihear	0
Banteay Meanchey	0
Siem Reap	12
Thailand	0
Battambang	34
Kampong Thom	0
Kratie	0
Tonle Sap	5
Pailin	0
Pursat	0
Kampong Chhnang	0
Kampong Cham	0
Kampong Spe	0
Kandal	0
Sum	51

Area of reservoirs (km2)

Province	Count	Area
Stung Treng	0	0
Oddar Meancheay	1	8.94
Preah Vihear	1	0.64
Banteay Meanchey	6	16.11
Siem Reap	8	28.27
Thailand	0	0
Battambang	1	12.89
Kampong Thom	36	42.6
Kratie	0	0
Tonle Sap	0	0
Pailin	0	0
Pursat	0	0
Kampong Chhnang	0	0
Kampong Cham	2	1.74
Kampong Spe	0	0
Kandal	0	0
Sum	55	111.2

Area of paddy fields (km2)

Province	Count	Area
Stung Treng	41	28.69
Oddar Meancheay	136	624.76
Preah Vihear	334	369.19
Banteay Meanchey	146	3350.5
Siem Reap	191	2927.83
Thailand	15	38.77
Battambang	102	2983.65
Kampong Thom	174	2841.25
Kratie	57	189.7
Tonle Sap	0	0
Pailin	9	6.85
Pursat	80	1650.73
Kampong Chhnang	124	1592.3
Kampong Cham	113	1498.17
Kampong Spe	21	573.14
Kandal	52	405.51
Sum	1595	19081.02

Area of field crops (km2)

Province	Count	Area
Stung Treng	0	0
Oddar Meancheay	3	4.5
Preah Vihear	14	18
Banteay Meanchey	79	159.93
Siem Reap	35	43.16
Thailand	46	10.29
Battambang	45	509.97
Kampong Thom	90	163.66
Kratie	3	1.04
Tonle Sap	0	0
Pailin	27	144.09
Pursat	3	27.53
Kampong Chhnang	37	34.91
Kampong Cham	76	481.89
Kampong Spe	8	6.74
Kandal	4	18.27
Sum	470	1623.97

Area of plantation (km2)

Province	Count	Area
Stung Treng	0	0
Oddar Meancheay	0	0
Preah Vihear	0	0
Banteay Meanchey	2	24.71
Siem Reap	0	0
Thailand	19	60.71
Battambang	7	1.47
Kampong Thom	6	9.51
Kratie	0	0
Tonle Sap	0	0
Pailin	2	1.05
Pursat	0	0
Kampong Chhnang	1	0.2
Kampong Cham	39	321.26
Kampong Spe	0	0
Kandal	0	0
Sum	76	418.9

Area of other agriculture (km2)

Province	Count	Area
Stung Treng	86	21.23
Oddar Meancheay	97	271.75
Preah Vihear	156	50.8
Banteay Meanchey	237	191.69
Siem Reap	522	1459.43
Thailand	23	7.83
Battambang	295	382.52
Kampong Thom	491	454.24
Kratie	56	78.44
Tonle Sap	16	1.07
Pailin	3	3.83
Pursat	149	162.09
Kampong Chhnang	297	501.55
Kampong Cham	247	509.7
Kampong Spe	85	23.2
Kandal	202	222.7
Sum	2962	4342.06

Area of irrigation (km2)

Province	Count	Area
Stung Treng	0	0
Oddar Meancheay	6	31.53
Preah Vihear	0	0
Banteay Meanchey	2	235.56
Siem Reap	22	614.5
Thailand	0	0
Battambang	10	1507.42
Kampong Thom	50	461.83
Kratie	0	0
Tonle Sap	0	0
Pailin	0	0
Pursat	34	334.23
Kampong Chhnang	10	63.58
Kampong Cham	12	192.95
Kampong Spe	7	24.43
Kandal	6	60.05
Sum	159	3526.08

Number of bridges

Province	All bridges	Bridges on primary roads
Stung Treng	17	0
Oddar Meancheay	106	0
Preah Vihear	138	0
Banteay Meanchey	118	42
Siem Reap	158	51
Thailand	0	0
Battambang	187	77
Kampong Thom	99	40
Kratie	36	0
Tonle Sap	0	0
Pailin	14	0
Pursat	242	52
Kampong Chhnang	87	39
Kampong Cham	53	16
Kampong Spe	6	0
Kandal	50	37
Sum	1311	317

Number of culverts

Province	Count
Stung Treng	0
Oddar Meancheay	0
Preah Vihear	0
Banteay Meanchey	34
Siem Reap	126
Thailand	0
Battambang	42
Kampong Thom	58
Kratie	0
Tonle Sap	0
Pailin	0
Pursat	17
Kampong Chhnang	20
Kampong Cham	9
Kampong Spe	4
Kandal	13
Sum	323

Number of dams

Province	Count
Stung Treng	0
Oddar Meancheay	2
Preah Vihear	10
Banteay Meanchey	23
Siem Reap	0
Thailand	0
Battambang	0
Kampong Thom	2
Kratie	1
Tonle Sap	0
Pailin	0
Pursat	0
Kampong Chhnang	0
Kampong Cham	0
Kampong Spe	0
Kandal	0
Sum	38

Asian Development Bank
TA 4669-CAM

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Database Component

DATABASE DOCUMENTATION

Prepared by:

Hannu LAURI

EIA Ltd, Finland

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CONTENTS

Purpose of the database component 3
Classification of built structures 3
Structure type classification 3
Structure attributes 5
Selection criteria for structures 6
Spatial extent 6
Flow impact classification 6
Database 6
Database tables 7
Class dependent data 10
Area data 30
System components and setup 30
Appendix A: Glossary 34
Appendix B: Tonle Sap catchment statistics 35
Appendix C: Data directory 37

PURPOSE OF THE DATABASE COMPONENT OF THE PROJECT

The main task of the database component of the Built Structures project is to prepare a database of existing surface water and surface water quality related structural works in the Tonle Sap Basin. The database should contain the geographic extent and characteristics of these structures.

The database will be used in the assessment of the consequences of built structures on the environmental and human components of the lake ecosystem.

A built structure is defined here as a structure that

(i) opposes water outflow (e.g. dams, weirs, irrigation schemes, levees, embankments);
(ii) prevents water inflow (e.g. . roads, railways, flood control works, polders, dykes, wharves and quays);
(iii) alters water inflow or outflow (e.g. drainage canals, diversion structures, agricultural works, and flow modifications);
(iv) may degrade water quality (e.g. plants with aqueous effluents, mining and mineral processing facilities, petroleum storage facilities, sewerage systems, and dredges); and
(v) Fishing gears that can alter hydrological flows and obstruct fish movement.

The main emphasis of the database is on structures of type (i), (ii) and (v).

CLASSIFICATION OF BUILT STRUCTURES

The structures are grouped in the database using structure type classification, derived from structure type and usage. The type classification

1. Assigns exactly one type class for each existing structure in the target area,
2. Determines what characteristics of a given structure are stored in the database,
3. Aids database users in searching for structures that have specific impacts,
4. Is easy to understand for the database user.

STRUCTURE TYPE CLASSIFICATION

1 Storage
110 Reservoir
120 Floodwater storage

2 Flow route
210 Canal
211 Irrigation canal
210 Bridge
230 Culvert
240 Spillway

3 Flow control
310 Dam
320 Embankment
321 Road embankment primary road
322 Road embankment other
323 Railroad embankment
324 Reservoir dike
330 Gate
340 Weir
350 Pumping station
360 Hydropower station
370 Measurement station
371 Hydrological station
372 Meteorological station

4 Fish and aquaculture
410 Fishing gear
411 Dai fishery
412 River barrage with bagnet or trap
413 Fence system fence
414 Fence system trap
415 Fence system pen
420 Fishway
430 Aquaculture
431 Fish pond
432 Fish cage
440 Fishing lot
450 Fish sanctuary

5 Erosion prevention
510 Reinforced bank
520 RipRap

6 Agriculture
610 Rice field
620 Field crops
630 Plantation
640 Other agriculture
650 Irrigated area

7 Transportation
710 Docks/Harbour
720 Breakwater
730 Ferry

8 Discharge
810 Point source
811 Sewage treatment plant
812 Sewage outlet
813 Industrial sewage outlet
814 Mine
820 Diffuse source
821 Scattered population

STRUCTURE ATTRIBUTES

Structure attributes are values that describe a given structure and are stored in the database. The following data is stored:

- Structure name
- Structure position (mid-point position), UTM (Universal Transverse Mercator, zone 48N with false easting of 500000, and WGS84 datum)
- Structure outline, mid-line or point location, coordinate system as above
- Structure creation (and demolition) date
- Database diary data; entry date and user ID
- Main physical dimensions of the structure
- Main hydrological characteristics of the structure
- Photographs of the structure

Below is a table of attributes based on the above structure classification.

Attributes for all classes

Field	Type	Unit	Explanation
id	Int	-	Structure identifier
class_id	Int	-	Structure class identifier
name	String	-	Name of structure
info	String	-	Additional information in text format
xpos	Real	m	x-coordinate of mid-point (UTM)
ypos	Real	m	y-coordinate of mid-point (UTM)
boundary	Geom	-	Boundary/mid-line/mid-point data
constructed	Date	-	Construction date (when taken to use)
demolished	Date	-	Demolition date (when taken out of use)
entrydate	Date	-	Date when entered into database
entryby	String	-	Userid of user who created this entry
datasource	String	-	Datasource acronym
srid	Int	-	Coordinate system identifier
boundary	Geom	-	Mid-point/boundary/mid-line geometry data

Class-dependent attributes

Field	Type	Unit	Explanation
width	Real	m	Width of structure
height	Real	m	Height of structure
length	Real	m	Length of structure
area	Real	m^2	Area or structure (at the maximum water level)
activestorage	Real	m^3	Storage volume between minimum and maximum water levels
minlevel	Real	m	Water level at which flow out or through a structure stops
maxdepth	Real	m	Maximum water level for a structure
crestlevel	Real	m	Minimum water level for flow to occur over structure
maxflow	Real	m^3/s	Maximum flow on maximum water level
crsection	Real	m^2	Channel/opening cross section area at maximum water level
wldrop	Real	m	Water level drop over structure
material	String	-	Construction material, e.g. timber/earth/stones/concrete/metal

production	Real	kg/a	Approximate production per year

SELECTION CRITERIA FOR STRUCTURES

SPATIAL EXTENT

The database contains structures in the Tonle Sap Basin as defined by the watershed boundary. Spatial emphasis is on the areas through which water flows to the Tonle Sap, and more generally on areas that are or have been under water during the flood season. The Tonle Sap flooded area is shown in Figure 1 and is mostly limited by National Roads nº 5 and 6. The project target sites in Preak Toal, Pursat and Chinit are included in the database with some more detail.

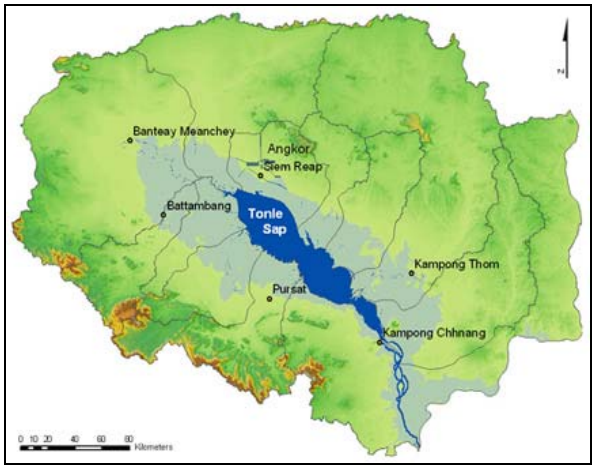

Figure 1: Geographic boundary for database contents

FLOW IMPACT CLASSIFICATION

Structures in the area are divided roughly into three categories according the impact of the structure on water flow. The classes are large, mid-size and small structure. Large structures may have catchment scale impacts, mid-size structures have regional scale impacts, and small-scale structures have only local impacts.

A limit for large structures is here defined as a structure that can store at least 2.5 million m^3 water (in a year), or modify existing flows for at least 1 m^3/s on average, or 4 m^3/s during peak flow time.

A limit for mid-size structures is defined as a structure that can store at least 0.5 million m^3 water (in a year), or modify existing flows for at least 0.5 m^3/s on average, or 2 m^3/s during peak flow time.

Structures that store water modify flows less than mid-size structures that belong to the small category.

The database mainly contains large and mid-size structures. Structures classified as small may also be included in the database in some cases, for example, if the impact of a structure is not known or the attributes required for assessing the structure size are not available.

DATABASE

The data is put into a relational database with the capability to store geometry types MySQL database version 5.0.21 is used here. The MySQL database is free, and contains user friendly tools for installation, database management, and queries. Also, tools for data import from shapefile to the database are available.

A map-based data viewer Java applet was constructed to allow remote access to the database data using an Internet browser.

Export of data to and from the database to GIS programs can be done by writing selected database contents to an ESRI shapefile. The shapefile attribute table will contain selected structure properties.

DATABASE TABLES

The database contains the following tables:

- Structure table – table for storing structure attributes
- Class table – table for storing structure classification data
- Photo table – table for storing photographs of structures
- Contact table – table for storing contact information for structure managers, database users and data sources
- Validation table – table for storing validation data
- Discharge table – table for storing point load data
- Area table – geographic data that can be used to geographically select structure data, for example, catchment boundaries, main rivers, districts and province boundaries, and main settlement locations.

Structure table

Since many types of structures have common attributes, all structures are put in to a single table that has a set of attributes shown below. The list of attributes can be extended if required. Not all attributes are relevant to all structures, so only the relevant attributes, defined by the structure class, will be set for each structure. The irrelevant attributes will have undefined (null) values.

Field	Type	Unit	Explanation
id	Int	-	Structure identifier
class_id	Int	-	Structure class identifier
name	String	-	Name of structure
info	String	-	Additional information in text format
xpos	Real	m	x-coordinate of mid-point (UTM)
ypos	Real	m	y-coordinate of mid-point (UTM)
boundary	Geom	-	Boundary/mid-line/mid-point data
constructed	Date	-	Construction date (when put into use)
demolished	Date	-	Demolition date (when taken out of use)
entrydate	Date	-	Date when entered into database
entryby	String	-	Userid of user who created this entry
datasource	String	-	Datasource acronym
srid	Int	-	Coordinate system identifier
boundary	Geom	-	Mid-point/boundary/mid-line geometry data
width	Real	m	Width of structure
height	Real	m	Height of structure
length	Real	m	Length of structure

area	Real	m^2	Area of structure (at the maximum water level)
activestorage	Real	m^3	Storage volume between minimum and maximum water levels
minlevel	Real	m	Water level at which flow out or through a structure stops
maxdepth	Real	m	Maximum water level for a structure
crestlevel	Real	m	Minimum water level for flow to occur over structure
maxflow	Real	m^3/s	Maximum flow on maximum water level
crsection	Real	m^2	Channel/opening cross section area at maximum water level
wldrop	Real	m	Water level drop over structure
material	String	-	Construction material, e.g. timber/earth/stone/concrete/metal
production	Real	kg/a	Approximate production per year

Class table

The class table contains data on structure classes.

Field	Type	Unit	Explanation
id	Int	-	Structure class identifier
name	String	-	Name of class
parent	Int	-	Identifier of parent class
description	String	-	Description of the class
shapetype	tinyint	-	Shape type point/polyline/polygone
linecolor	Integer	-	RGB linecolor (256*R+256*(G+B))
linestyle	tinyint	-	Line style: 0=thin, 1=medium, 2=thick, 3=dashed
fillcolor	integer	-	RGB fillcolor (256*R+256*(G+B))
fillstyle	tinyint	-	Fill style, 0=solid, 1-28 hatch: 1: ' ' , 4: '\\\', 7: '///', 10: '|||', 13:'xx' , 16:'++'; +0=dense, +1=medium, +2=sparse

Photo table

The photo table contains photos that can be added to structure descriptions. Photos are stored using a maximum size of 1600x1200 pixels and in .jpeg format.

Field	Type	Unit	Explanation
id	Int	-	Photo identifier
structure_id	Int	-	Structure identifier
image	BLOB	-	Photograph data (.jpeg 1600x1200)
description	String	-	Photo description
priority	Int	-	Photo presentation order, smaller first
date	date	-	Date photo was taken
ypos	Real	m	Photo position X-coordinate (UTM)
ypos	Real	m	Photo position Y-coordinate (UTM)
direction	Int	degr.	Direction from structure to photographer, 0=from north, 90=from east side
distance	Real	m	Distance from structure to photographer

Contact table

Table for contact information of database users, data sources and structure managers.

Field	Type	Unit	Explanation
id	Int	-	Contact identifier
acronym	String	-	Acronym
firstname	String	-	Firstname
lastname	String	-	Lastname
userid	String	-	Database userid, if exist
institute	String		Institute
department	String		Department
address1	String	-	Street address
address2	String	-	Post number and city
phone1	String		Phone number
phone2	String	-	Mobile phone number
fax	String	-	Fax number
email	String	-	Email address
date	Date	-	Date of last update

Validation table

Table for structure validation data.

Field	Type	Unit	Explanation
id	Int	-	Validation identifier
structure_id	Int	-	Structure identifier
contact_id	Int	-	Validator identifier
validated	Date	-	Date of validation
method	String	-	Validation method; visit/indirect
description	String	-	If anything was changed

Discharge table

Table for discharge data.

Field	Type	Unit	Explanation
id	Int	-	Load identifier
structure_id	Int	-	Associated structure
substance	String	-	Load variable, e.g. PTOT, NTOT
amount	Real	kg/d	Amount of load per day
dyear	Int	-	Year for discharge

Area table

Table for selection data.

Field	Type	Unit	Explanation
id	Int	-	Area identifier
name	String	-	Area name
type	String	-	Catchment/district/river/settlement/road
area	Double	m^2	Area of boundary
boundary	Geometry	-	Area boundary

CLASS DEPENDENT DATA

110 Reservoir

Class-dependent attributes

Attribute	Type	Unit	Explanation
*info	String	-	Reservoir owner (owner: name)
width	Real	m	Reservoir extent (bounding box width) in east-west direction
length	Real	m	Reservoir extent (bounding box height) in north-south direction
area	Real	km2	Area of reservoir at the maximum water level
activestorage	Real	m3	Active storage of the reservoir
minlevel	Real	m	Water level at which outflow from the storage stops
maxdepth	Real	m	Difference from minlevel to activestorage level

Selection criteria

Large: Reservoirs with a volume larger than 2.5 million m^3. For typical reservoirs in the area with a water depth of 0-2 meters, this would mean an area of at least 2.5 km^2 when 1 m average water depth is used in volume computation.
Midsize: Reservoirs with a volume 0.5-2.5 million m^3. For typical reservoirs in the area with a water depth of 0-2 meters, this would mean an area of at least 0.5 km^2 when 1 m average active depth is used in volume computation.

Reservoirs that are next to each other are included in the database if the combined estimated volume exceeds the above criteria.

Source data

- source data JICA reservoirs (ts_reservoir2.shp),
    - attributes: boundary, name and area

Data processing

- reservoirs with area smaller than 0.5 km^2 dropped out
- selection criteria applied to original data

120 Floodwater_storage

Class-dependent attributes

Attribute	Type	Unit	Explanation
*info	String		Storage owner (owner: name)
width	Real	m	Storage extent (bounding box width) in east-west direction
length	Real	m	Storage extent (bounding box height) in north-south direction
area	Real	km2	Area of storage at the maximum water level
activestorage	Real	m3	active storage of the reservoir
minlevel	Real	m	Water level at which flow to/from the storage stops
maxdepth	Real	m	Difference from minlevel to water level at activestorage volume

Selection criteria

- same as for reservoirs (class 110)

Source data

- source data Kampong Thom private reservoirs, Agriculture Office Kampong Thom Province (kt_reservoir.shp)
    - attributes: boundary, owner, area

Data processing

- no addition processing

210 Canal

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Channel/opening width perpendicular to flow direction
length	Real	m	Channel/opening length along flow
minlevel	Real	m	Channel bottom level
maxdepth	Real	m	Channel depth from minlevel to bank level
crsection	Real	m2	Channel cross section area at maxlevel
material	String		

Selection criteria

Large: Canals with an average flow larger than $1m^3/s$, or a peak flow larger than $10m^3/s$. Channels with high water cross section larger than 10 m^2
Midsize: All channels wider than 2 meters

Source data

- no data

Data processing

- no addition processing

211 Irrigation canal

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Channel width perpendicular to flow direction
length	Real	m	Channel length along flow
minlevel	Real	m	Channel bottom level
maxdepth	Real	m	Channel depth from minlevel to bank level
crsection	Real	m2	Channel cross section area at maxlevel
material	String	-	Bank material, if not earth

Selection criteria

- same as canal (class 210)

Source data

- source data JICA irrigation channel data (ts_irr_canal2.shp)
    - all data included
    - attributes: mid-line, small/large size classification
- source data Chinit irrigation project channel data (added ts_reservoir2.shp)
    - all data included
    - attributes: mid-line, size: main/secondary/tertiary canal/drain

Data processing

- simplified data to 10 meter resolution
- split with catchment boundaries

220 Bridge

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Channel/opening width perpendicular to flow direction
height	Real	m	Height of bridge bottom from dry-season water level
length	Real	m	Channel/opening length along flow
minlevel	Real	m	Bridge opening bottom level
maxdepth	Real	m	Typical maximum water depth under bridge
crsection	Real	m2	Channel/opening cross section area at maxlevel
material	String	-	Material

Selection criteria

Large: Bridges longer than 30 meters
Midsize: Bridges longer than 5 meters

Source data

- source data JICA map road bridges (ts_rd_bridge.shp)
    - all bridges included
    - attributes: location

- source data JICA map railroad bridges (ts_rr_bridge.shp)
    - all bridges included
    - attributes: location

Data processing

- no additional processing

230 Culvert

Class-dependent attributes

Attribute	Type	Unit	Explanation
*info	String		Culvert type, pipe/box
width	Real	m	Width perpendicular to flow direction
height	Real	m	Height of culvert opening
length	Real	m	Length along flow
minlevel	Real	m	Culvert bottom level
maxdepth	Real	m	Culvert maximum water depth
crsection	Real	m2	Cross section area at maxdepth
wldrop	Real	m	Difference of height from start to end of culvert
material	String		Material, if not earth

Selection criteria

- all culverts included

Source data

- source data (ts_culvert2.shp)
    - attributes: location, culvert type box/pipe, construction year

Data processing

- Culverts with no completion year dropped out

240 Spillway

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Channel/opening width perpendicular to flow direction
length	Real	m	Channel/opening length along flow
minlevel	Real	m2	Minimum water level for flow to occur over structure
maxdepth	Real	m2	Typical maximum water depth
crsection	Real	m2	Cross-section area
wldrop	Real	m	Water level drop over the length of structure
material	String		Bank material, if not earth

Selection criteria

- all data included

Source data

- field visit data from Chinit
    - attributes: width, length, wldrop

Data processing

- no additional processing

310 Dam

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Width of structure/opening perpendicular to flow direction
height	Real	m	Largest height of dam
length	Real	m	Length of flow path in structure along flow direction
crestlevel	Real	m	Minimum water level for flow to occur over structure
material	String	-	Timber/earth/stone/concrete/metal

Selection criteria

Large: Dams with active reservoir volume larger than 2.5 million m3
Midsize: Dams with active reservoir volume between 0.5-2.5 million m3

Source data

- source data JICA map (ts_dam_earth2.shp)
    - attributes: boundary, material

Data processing

- all data included
- joined lines
- simplified to 10 m resolution

320 Embankment

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Width of structure
height	Real	m	Average height of embankment from ground level
length	Real	m	Length of embankment
crestlevel	Real	m	Minimum water level for flow to occur over structure
material	String	-	Timber/soil/concrete/metal

Selection criteria

Large: Any embankment potentially catching water for more than 2.5 million m^3, or, an embankment longer that 10 km.
*Midsize***:** Embankments higher than 1 m if longer than 2 km. Also, other embankments that potentially trap more than 0.5 million m^3 of water.

Source data

- source data JICA embankments (ts_levee3.shp)
    - attributes: boundary, material, length

Data processing

- joined lines
- dropped out embankments shorter than 0.8 km, and not within distance of 0.5 km of a selected embankment
- simplified to 10 m resolution
- split with catchment boundaries

321 Road embankment (primary)

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Width of structure
height	Real	m	Average height of embankment from ground level
length	Real	m	Length of embankment
crestlevel	Real	m	Minimum water level for flow to occur over structure
material	String	-	Timber/soil/concrete/metal

Selection criteria

- all data included

Source data

- source data JICA primary roads (ts_rdprimary2.shp)
    - attributes: boundary, length

Data processing

- split with catchment boundaries
- set the crestlevel to 12 meters (equal to above flood)

322 Road embankment (other)

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Width of structure
height	Real	m	Average height of embankment from ground level
length	Real	m	Length of embankment
crestlevel	Real	m	Minimum water level for flow to occur over structure
material	String	-	Timber/soil/concrete/metal

Selection criteria

- all data included (no knowledge on embankment heights available)

Source data

- source data JICA secondary roads (ts_rdsecondary2.shp)
    - attributes: boundary, length

Data processing

- simplified data to 25 meter resolution
- split with catchment boundaries

323 Railroad embankment

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Width of structure
height	Real	m	Average height of embankment from ground level
length	Real	m	Length of embankment
crestlevel	Real	m	Minimum water level for flow to occur over structure
material	String	-	Timber/soil/concrete/metal

Selection criteria

- all data included

Source data

- source data JICA railroads (ts_railway2.shp)
    - attributes: boundary, length

Data processing

- joined lines
- simplified data to 25 meter resolution
- split with catchment boundaries
- set crestlevel to 12 (above flood)

324 Reservoir dike

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Width of structure
height	Real	m	Largest height of dike from ground level
length	Real	m	Length of dike
crestlevel	Real	m	Minimum water level for flow to occur over structure
material	String	-	Timber/earth/stone/concrete/metal

Selection criteria

- see reservoir

Source data

- source data Chinit irrigation project data (chinit_embankment.shp)
    - attribute: boundary, width, length

Data processing

- no additional processing

330 Gate

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Width of gate perpendicular to flow direction
height	Real	m	Height of gate from bottom to max water level
length	Real	m	Length of flow path in gate along flow direction
minlevel	Real	m	Min water level on which flow can occur through the gate
maxdepth	Real	m	Typical maximum water depth for gate
crsection	Real	m2	Cross section though which water can flow at maxdepth
material	String	-	Timber/earth/stone/concrete/metal

Selection criteria

Large: Gate with width of at least 3.0 meters
Midsize: Gate with width of 1.0 to 3.0 meters

Source data

- field survey data

Data processing

- no additional processing

340 Weir

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Width of weir perpendicular to flow direction
height	Real	m	Height of weir
length	Real	m	Length of weir flow path in flow direction
crestlevel	Real	m	Minimum water level for flow to occur over structure
wldrop	Real	m	Water level drop (typical)
material	String	-	Timber/earth/stone/concrete/metal

Selection criteria

Large: Weir with width of at least 30 meters
Midsize: Weir with width of 2.0 to 30 meters

Source data

- source data Chinit irrigation project data (chinit_weir.shp)
    - attributes: length, wldrop, material

Data processing

- no additional processing

350 Pumping station

Class-dependent attributes

Attribute	Type	Unit	Explanation
minlevel	Real	m	Minimum water level where the station can work
production	Real	m3/s	Maximum pumping capacity

Selection criteria

Large: Station with capacity of at least 2 m3/s
Midsize: Station with capacity over 0.5 m3/s

Source data

- no data

Data processing

- no additional processing

360 Hydropower station

Class-dependent attributes

Attribute	Type	Unit	Explanation
minlevel	Real	m	Min water level on which flow can occur through the structure
maxdepth	Real	m	Typical maximum water depth from minlevel
maxflow	Real	m3	Maximum flow though structure on maximum water level
wldrop	Real	m	Water level drop (maxlevel to bottom of structure)
production	Real	Gwh	Annual hydropower production

Selection criteria

Large: Station with production over 50 Gwh
Midsize: Station with production less than 50 Gwh

Data processing

- no additional processing

370 Measurement station

Class-dependent attributes

Attribute	Type	Unit	Explanation
*info	Real	m	Type of station: automatic/manual, measured variable(s)

Selection criteria

- all data stations included

Data processing

- no additional processing

371 Hydrological station

Class-dependent attributes

Attribute	Type	Unit	Explanation
*info	Real	m	Type of station: automatic/manual, measured variable(s)

Selection criteria

- all data stations included

Source data

- source data MOWRAM water level stations (river_station.shp)
    - attributes: location, station id code, measured variables

Data processing

- no additional processing

372 Meteorological station

Class-dependent attributes

Attribute	Type	Unit	Explanation
*info	Real	m	Type of station: automatic/manual, measured variable(s)

Selection criteria

- all data stations included

Source data

- source data MPWT rainfall stations (rainfall_st.shp)
    - attributes: location, station id, measured variables

Data processing

- no additional processing

410 Fishing gear

Class-dependent attributes

Attribute	Type	Unit	Explanation
production	Real	kg/a	Approximate production in one year

Selection criteria

- stationary gears included

Data processing

- no additional processing

411 Dai fishery

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Number of nets
production	Real	kg/a	Approximate production in one year

Selection criteria

- all known dai fisheries included

Source data

- satellite picture from Google Earth
    - attributes: boundary, number of nets

Data processing

- no additional processing

412 River barrage with bagnet or trap

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Width of barrage
production	Real	kg/a	Approximate production in one year

Selection criteria

Large: Barrages longer than 50 meters
Midsize: Barrages between 10-50 meters

Data processing

- no additional processing

413 Fence system fence

Class-dependent attributes

Attribute	Type	Unit	Explanation
length	Real	m	Length of associated fence system (main fence part only)
production	Real	kg/a	Approximate production in one year

Selection criteria

- all fences, traps and pens

Source data

- digitized from aerial photos (fence_pen.shp, fence_trap.shp, fish_fence.shp), Preak Toal area only
    - attributes: boundary, length

Data processing

- no additional processing

414 Fence system pen

Class-dependent attributes

Attribute	Type	Unit	Explanation
length	Real	m	Length of associated fence system (main fence part only)
production	Real	kg/a	Approximate production in one year

Selection criteria

- all fences, traps and pens

Source data

- digitized from aerial photos (fence_pen.shp, fence_trap.shp, fish_fence.shp), Preak Toal area only
    - attributes: boundary, length

Data processing

- no additional processing

413 Fence system rap

Class-dependent attributes

Attribute	Type	Unit	Explanation
length	Real	m	Length of associated fence system (main fence part only)
production	Real	kg/a	Approximate production in one year

Selection criteria

- all fences, traps and pens

Source data

- digitized from aerial photos (fence_pen.shp, fence_trap.shp, fish_fence.shp), Preak Toal area only
    - attributes: boundary, length

Data processing

- no additional processing

420 Fishway

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Channel width perpendicular to flow direction
length	Real	m	Channel length along flow (measured along bank)

crestlevel	Real	m	Minimum water level for flow to occur
crsection	Real	m2	Channel cross section
wldrop	Real	m	Water level drop over the length of structure
material	String		Bank material, if not earth

Selection criteria

- all fishways

Source data

- field trip data from Chinit area
    - attributes: boundary, width, length, wldrop

Data processing

- no additional processing

430 Aquaculture

Class-dependent attributes

Attribute	Type	Unit	Explanation
area	Real	m2	Aquaculture area
production	Real	kg/a	Approximate production in year

Selection criteria

- farms with annual production more than 10 tons per year

Source data

- no data

Data processing

- no additional processing

431 Pond fish farm

Class-dependent attributes

Attribute	Type	Unit	Explanation
area	Real	m2	Aquaculture area
production	Real	kg/a	Approximate production in year

Selection criteria

- same as for aquaculture (class 430)

Source data

- no data

Data processing

- no additional processing

432 Cage fish farm

Class-dependent attributes

Attribute	Type	Unit	Explanation
area	Real	m2	Aquaculture area
production	Real	kg/a	Approximate production in year

Selection criteria

- same as for aquaculture (class 430)

Source data

- no data

Data processing

- no additional processing

440 Fishing lot area

Class-dependent attributes

Attribute	Type	Unit	Explanation
*name	String		Province and number
area	Real	m2	Lot area
production	Real	kg/a	Approximate production in year

Selection criteria

- all fishing lots included

Source data

- source data MRC fishing lots from year 2001 (c_lot2001_commercial_3.shp)
    - attributes: boundary, lot number, area code

Data processing

- extracted commercial lots (type 2) from c_lot2001.shp
- union of lots with same region code and lot number
- simplified to 50 m resolution

450 Fish sanctuary

Class-dependent attributes

Attribute	Type	Unit	Explanation
*name	String		Province and number
area	Real	m2	Lot area

Selection criteria

- all fish sanctuaries included

Source data

- source data MRC fish sanctuaries from year 2001 (c_lot2001_sanctuary.shp)
    - attributes: boundary

Data processing

- extracted sanctuaries (type 3) from c_lot2001.shp
- simplified to 50 m resolution

510 Reinforced bank

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	
length	Real	m	
material	String	-	Description of material used

Data processing

- no additional processing

520 RipRap

Class-dependent attributes

Attribute	Type	Unit	Explanation
width	Real	m	Width across flow direction
length	Real	m	Length along flow direction
material	String	-	Description of material used

Selection criteria

- ripraps associated with a structure already in the database

Source data

- field trip data from Chinit area
    - attributes: boundary, width, length, wldrop

Data processing

- no additional processing

610 Rice field

Class-dependent attributes

Attribute	Type	Unit	Explanation
area	Real	km2	Area of structure

Source data

- source data JICA paddy field areas (ts_paddyfield5.shp)
    - attributes: boundary, area

Data processing

- simplified to 50 m resolution
- split to catchment areas
- areas smaller than 0.1 km2 removed

620 Field crops

Class-dependent attributes

Attribute	Type	Unit	Explanation
area	Real	km2	Area of structure

Source data

- source data JICA plantation areas (ts_fieldcrop2.shp)
    - attributes: boundary, area

Data processing

- simplified to 50 m resolution
- areas smaller than 0.1 km2 removed
- split to catchment areas

630 Plantation

Class-dependent attributes

Attribute	Type	Unit	Explanation
area	Real	km2	Area of structure

Source data

- source data JICA plantation areas (ts_plantation2.shp)
    - attributes: boundary, area

Data processing

- simplified to 50 m resolution
- areas smaller than 0.1 km2 removed
- split to catchment areas

640 Other agriculture

Class-dependent attributes

Attribute	Type	Unit	Explanation
area	Real	km2	Area of structure

Source data

- source data JICA agricultural areas (ts_otheragri2.shp)
    - attributes: boundary, area

Data processing

- simplified to 50 m resolution
- areas smaller than 0.1 km2 removed
- split to catchment areas

650 Irrigated area

Class-dependent attributes

Attribute	Type	Unit	Explanation
area	Real	km2	Area of structure

Selection criteria

- Irrigated areas with field area larger than 2.5 km^2

Source data

- source data MRC irrigated areas (ts_irriarea.shp)
    - attributes: boundary, project name, area
- source data Kampong Thom private reservoir areas (kt_irriarea.shp)
    - attributes: boundary, area, owner name

Data processing

- no additional processing

710 Dock/Harbour

Class-dependent attributes

Attribute	Type	Unit	Explanation
length	Real	m	Length of structure

Selection criteria

- all data included

Source data

- no data

Data processing

- no additional processing

720 Breakwater

Class-dependent attributes

Attribute	Type	Unit	Explanation
length	Real	m	Length of structure

Selection criteria

- breakwaters with length of at least 100 meters

Source data

- no data

Data processing

- no additional processing

730 Ferry

Class-dependent attributes

Attribute	Type	Unit	Explanation
length	Real	m	Length of structure

Selection criteria

- all data included

Source data

- source data JICA ferry lines (ts_ferry_line.shp)

Data processing

- no additional processing

810 Point source

Class-dependent attributes

Attribute	Type	Unit	Explanation
production	Real	m3/d	Volume of water coming from outlet

Selection criteria

- waste water flow of at least 100 m3/d, or P load of at least 0.1 kg/d, or N load of at least 1 kg/d, or otherwise non-negligible point source.

Source data

- no data

Data processing

- no additional processing

811 Sewage treatment plant

Class-dependent attributes

Attribute	Type	Unit	Explanation
production	Real	m3/d	Volume of water coming from outlet

Selection criteria

- with waste water flow of at least 100 m3/d

Source data

- no data

Data processing

- no additional processing

812 Sewage outlet

Class-dependent attributes

Attribute	Type	Unit	Explanation
production	Real	m3/d	Volume of water coming from outlet

Selection criteria

- with waste water flow of at least 50 m3/d

Source data

- no data

Data processing

- no additional processing

813 Industrial sewage outlet

Class-dependent attributes

Attribute	Type	Unit	Explanation
production	Real	m3/d	Volume of water coming from outlet

Selection criteria

- with waste water flow of at least 50 m3/d

Source data

- no data

Data processing

- no additional processing

814 Mine

Class-dependent attributes

Attribute	Type	Unit	Explanation
*info	String		Mineral/material, type open-pit/placer/quarry/sub-surface
production	Real	tn	Production of material processed/taken out yearly

Selection criteria

- all data included

Source data

- source data MIME mine data (mine_mime2.shp)

Data processing

- removed points outside Tonle Sap catchment areas

820 Diffuse source

Class-dependent attributes

Attribute	Type	Unit	Explanation
*info	String		Type of source
area	Real	km2	Area of source
width	Real	-	Number of units
height	Real	kg	Production per unit per year
production	Real	units	Total production per year

Source data

- no data

Data processing

- no additional processing

821 Scattered population

Class-dependent attributes

Attribute	Type	Unit	Explanation
*info	String		Type of source, waste produced
area	Real	km2	Area of source
width	Real	-	Number of people
height	Real	kg	Production per person per year
production	Real	units	Total production per year

Selection criteria

- Village (“phum”) level division

Source data

- population data from year 1998 (ts_phum2.shp)

- attributes: village position, number of persons

Data processing

- no additional processing

AREA DATA

The area table contains the following data:

- Tonle Sap catchment and subcatchment boundaries
    - Data source: MRC (tls_catchments.shp)
    - Attributes: boundary, name, area
- Medium flood extent boundaries
    - Data source: MRC (tls_catchments.shp)
    - Attributes: boundary, name, area
- Cambodian province boundaries (the provinces intesecting Tonle Sap catchment area)
    - Data source: MRC (tls_provicnes.shp)
    - Attributes: boundary, name, area

SYSTEM COMPONENTS AND SETUP

The database system is based on the following MySQL standard software components

- MySQL database server (version 5.0. community edition)
- MySQL Query browser (version 1.1.20)
- MySQL Administrator (version 1.1.9)

Additional tools were created in the project to enable transfer of GIS file data to and from the database server, and to allow data to be shared in internet. These are:

- BSViv tool to access database locally, and to import and export data from ESRI shapefile format
- BSMap tool (a java applet) to view data in internet
- BSConn program (a www-server cgi-program) to retrieve data from database server to BSMap applet

The MySQL database server stores the database data and provides database services to client applications. The MySQL Query browser is an interactive tool that can be used to view and modify the data in the database in the computer that contains the database. Use of the tool requires knowledge of SQL. The Administrator tool is used to manage the database server, for example, create new users and create data backups. The programs are available at the MySQL www-site www.mysql.com free of charge.

The Local database access tool "BSViv" can be used to view, add, and modify structure data on map-based windows application. Also import and export of data to ESRI shape file is possible. This feature can be used, for example, when larger amounts of structure data need to be moved to GIS system. The BSViv program utilizes an open-source GIS tool package called FWTools (version 1.0.7), which can be downloaded from http://fwtools.maptools.org.

The Internet access interface "BSApp" can be used to view database data remotely using an internet browser. To use BSApp a www-server with system html pages and bsconn- cgi-program needs to be setup.

Installation of the system for local and internet access is described in the chapter 2 of the Built Structures Database User Manual.

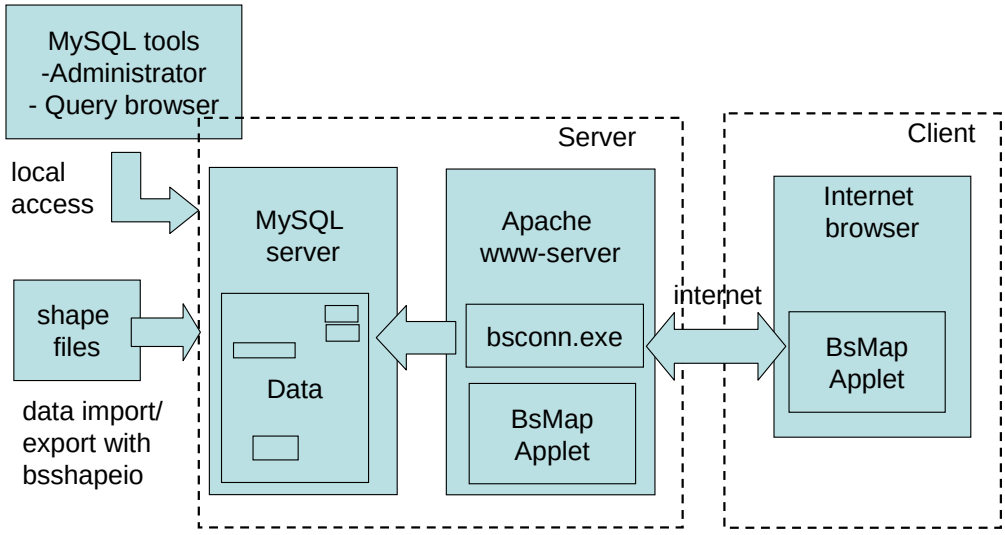

Figure 1: System components and connections

BSViv APPLICATION FILES

The BSViv application is implemented using a viv-language interpreter, that is developed in EIA Ltd. for simple graphical user interface implementation. The installation will setup the BSViv application under the installation directory to several subdirectories listed below with contents. Starting the program is done by running the "viv.exe" program with the "bs.ip"-file as a parameter.

The viv (=program) subdirectory contains following files:

bs.ip	- program statup file
bsmain.ip	- main program file
common.ip, rl*.ip	- application program files
viv.exe	- ip-file interpreter
vivres.dll, vivbmp.dll	- viv.exe resources and bitmaps, required by viv.exe
rlgis.bmp	- about dialog bitmap file

The map-subdirectory contains following files:

tls_lake.*	- lake and river data for BSViv application
tls_subcatch_utm.*	- subcatchment boundaries for BSViv application

The doc-subdirectory contains following files:

BSApp-help.doc	- BSApp help file
BSDB_manual.doc	- Built structure database system user manual
bsdb_techdoc.doc	- this document

The bsdb-subdirectory contains following files:

bs0.sql	- sql macro to create bs-database tables

bs0create.sql	- sql macro to create bs-database
bs0dump.sql	- database dump file
bs0users.sql	- sql macro to setup default database users
classdata.sql	- sql macro to populate structure class data to database

WWW-SITE FILES

To access the bs-database using internet, the files listed below need to be setup in a www-server directory. The built structures – site contains BSApp java applet, composed of several jar-files, a bsconn – cgi-bin program, and some html pages.
By defatul user authentication is setup using as in the Apache www-server basic authenication using .htaccess file. The bs-www site countains the following files

Main directory: www/bs

.htaccess	- Apache access control file
index.html	- startup page
tlsstart.jpg	- picture in the startup page
bsapp.shtml	- applet window
bsapp.jar	- applet code
openmap.jar	- applet code library
swingset.jar	- applet code library
bsapp_help.html	- help window
exitwindow.html	- file used to exit applet

Help pictures : www/bs/bsapp_help_files

.	- bsapp_help.html pictures

cgi-bin programs: www/bs/cgi-bin

bsconn.exe	- cgi-bin program to connect bsapp to MySQL database
libmysql.dll	- mysql dll-library, used by bsconn

Documentation: www/bs/doc

bsdb_manual.doc	- bsdb user manual
bsdb_techdoc.doc	- this documentation

Apache configuration: wwwconf

.htpasswd	- password file
htpasswd.exe	- password generator program
httpd.conf	- example Apache configuration file

DATABASE AND WWW-SITE USER AUTHENTICATION

The user authentication is setup by default for the Apache www-server using basic authentication. Entering the www/bs directory requires giving a user identification and password, after this no more passwords are asked.

The "bsconn" cgi-bin program uses defult username and password (see user manual/Installation) hard coded in the program for accessing MySQL database server. Therefore, it is necessary to setup the default user to the database server if it is to be used via BSApp – applet. If required, the username and password can be easily changed in the bsconn source code.

SOURCE CODE FILES

The bsconn c++ source files and BSApp java source files are included in the "BSSourceSetup.exe" installation package. The bsconn is compiled with Borland C++ builder 6, and the BsApp with Java 1.5.0_08.

APPENDIX A: GLOSSARY

(Reference: http://www.nalms.org/glossary/glossary.htm)

Channel

A course, such as a trench or aqueduct, through which water is moved or directed; the bed of a river or stream.

Conduit

Any channel or pipe used for conducting the flow of water.

Culvert

A hydraulically short conduit which conveys water e.g. through a roadway embankment or through some other type of flow obstruction below ground level.

Dam

A barrier built across a valley or river for storing water.

Detention basin

A basin or reservoir where water is stored for regulating a flood. It has outlets for releasing the flows during the floods.

Embankment

A man-made earth structure constructed for the purpose of impounding water and/or carrying a roadway.

Fish ladder

An inclined trough which carries water from above to below a dam so that fish can easily swim upstream.

Fishway

A structure allowing fish to pass over vertical impediments. It may include special attraction devices, entrances, collection and transportation channels, a fish ladder, and an exit.

Gauge (gauging station)

Specific locations on a stream where systematic observations of hydrologic data are obtained through mechanical or electrical means.

Intake

A hydraulic structure built at the upstream end of the diversion canal; a tunnel or power plant for controlling the flow and preventing silt and debris from entering the diversion.

Levee

A natural or man-made earthen barrier along the edge of a stream, river, or lake to prevent the flow of water out of its channel.

Reservoir

An artificial lake, pond, tank, or basin (natural or man-made) into which water flows and is stored for future use.

Riprap

A layer of large stones, broken rock, boulders, or precast blocks placed in random fashion on the upstream and downstream faces of embankment dams, on stream banks, on reservoir shores, on the sides of a channel, or on other land surfaces to protect them from erosion caused by current, wind, wave, and/or ice action.

Sluice

An artificial channel for conducting water, with a valve or gate to regulate the flow.

Sluice gate

A valve or gate used in a channel to regulate flow.

Spillway

Section of a dam designed to permit water to pass over its crest; a weir or channel taking overflow from the dam; serves as a safety channel to prevent erosion of the dam.

Weir

A dam, usually small, in a stream to raise the water level or divert its flow.

Weir (measurement)

A notch or depression in a levee, dam, embankment, or other barrier across or bordering a stream, through which the flow of water is measured or regulated.

Weir (fish)

A barrier constructed across a stream to divert fish into a trap.

APPENDIX B: TONLE SAP CATCHMENT STATISTICS

(references. MRC hydrology report, 2005, WUP-FIN Tonle Sap modelling project, www.eia.fi/wup-fin)

Catchment area ~ 95000 km^2
Dry season lake ~ volume 1-2 km^3, depth minimum 0.5 m, area 2500 km^2
Rainy season lake ~ volume 50-80 km^3, depth 6-9 m, area 13000-14500 km^2
Lake retention capacity ~ 80 km^3
80 % of sediments brought to lake by flood retained

Average leaching from lake catchment area ~ 30 km^3/a = 10 $l/s/km^2$
Average volume flowing to lake outside catchment 40 km^3/a

Outflow from lake 7.5-8.5 months, 70.4 km^3, or 3375 m^3/s average for 8 months

Inflow to lake from outside catchment area 40.7 km^3, starting mid-May to mid-June, duration 3.5-4.5 months, 3860 m^3/s average for 4 months

Precipitation ~ 1300 mm/a, typically no rain from December to February
For rainy season, peak precipitation per month is typically over 300 mm/a, or about ¼ of the total yearly precipitation, three times the average precipitation.

Pan evaporation ~ 2100 mm/a = 5.8 mm/d
1 cm water level change in dry season lake level is 2.5 km^3

APPENDIX C: DATA DIRECTORY

JICA data point data

- ts_rr_bridge.shp
- ts_rd_bridge.shp
- ts_culvert.shp
- mine_mime.shp
- ts_hystation.shp

JICA line data

- ts_ferry_line.shp
- ts_railway2.shp
- ts_canal.shp
- ts_levee.shp
- ts_rdprimary2.shp
- ts_dam_earth.shp
- ts_rdsecondary_aw.shp
- ts_rdsecondary_dw.shp

JICA polygon data

- ts_reservoir.shp

MRC data

- Tonle Sap catchment boundary
- Tonle Sap subcatcment boundaries

Asian Development Bank
TA 4669-CAM

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on the Fisheries of the Tonle Sap
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Database Component

BUILT STRUCTURES DATABASE USERS MANUAL

Prepared by

Hannu LAURI

EIA Ltd., Finland

April 2006

Contents

1. Introduction 2

Classification of structures 3
Database access 3

2. Setting up the BSData database 4

Running environment 4
Setting up database for local use 4
Setting up database remote access 5

3. Using BSViv to access BSData locally 6

Installation and starting the program 6
Main window, tools and main menu 6
Viewing and updating database data 8
Importing data from ESRI shapefile to the BSData database 9
Exporting data from BSData database to shapefile 10
Adding and removing single structures from the database 10
Importing photos to the database 11
Modifying class related database data 11
Creating database dump file and importing all data from an existing dump file. 11
Creating a database report 11

4. Using BSApp to access BSData remotely 12

Installation and starting the program 12
Main window, tools and main menu 12
Querying database data 14
Viewing structure data 14
Other functionality 15

1. INTRODUCTION

The Built Structures database "BSData" contains data on man-made hydraulic structures on the Tonle Sap catchment. The structures are classified according to the intended use. For each structure position, extent and structure attributes such as structure height and construction material are stored.

Classification of structures

The structures are classified for eight higher level classes that may have one or more subclasses. The detailed classification can be found in the technical documentation. The main classes are:

1. Storages (e.g. reservoirs)
2. Flow routes (e.g. canals)
3. Flow controls (e.g. dams, gates)
4. Fish and aquaculture (e.g. dai fisheries)
5. Erosion prevention (e.g. ripraps)
6. Agriculture (e.g. irrigated areas)
7. Transportation (e.g. docs and harbours)
8. Discharge (e.g. sewage outlets, mines)

Database access

The database can be accessed using three methods (see Figure 1.1):

1. Standard SQL tools (MySQL)
2. Local database access
3. Internet access interface

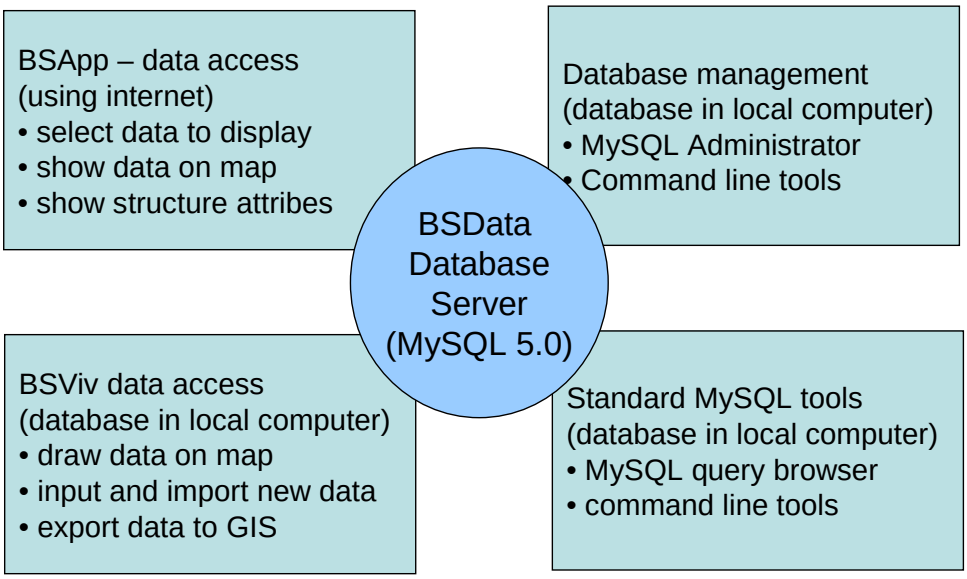


Figure 1.1: Database access and management tools

The standard MySQL tools are:

a. MySQL database server (version 5.0. community edition)
b. MySQL Query browser (version 1.1.20)
c. MySQL Administrator (version 1.1.9)

The MySQL database server stores the database data and provides database services to client applications. The Query browser is an interactive tool that can be used to view and modify the data in the database in the computer that contains the database. Remote access is also possible. Use of the tool requires knowledge of SQL. The Administrator tool is used to manage the database server, for example, create new users and create data backups. The programs are available at the MySQL www-site www.mysql.com free of charge.

Please see the technical documentation on database structure. Chapter 1, "Setting up the database"", explains how to set up the database and access it using Query Browser.

The Local database access tool "BSViv" can be used to view, add, and modify structure data on map-based windows applications. Also, importing and exporting to and from ESRI shape files is possible if larger amounts of structure data need to be moved to or from a GIS system. See Chapter 3 below on how to set up and use this application.

The Internet access interface "BSApp" can be used to view database data remotely using an Internet browser. In order to use this access method, a www-browser installation of the database system needs to be set up. See Chapter 4 below on how to setup and use this system.

Database management, such as adding users and backing up data, can be done using Database standard tools. Some tasks can be done using the "BSViv" applications. See Chapter 5 on database administration and updating.

2. SETTING UP THE BSDATA DATABASE

Running environment

The database system works on PC computers using Windows 2000/XP operating systems. About 150 Mb of disk space is needed to set up the system. Software installation packages can be found on the distribution CD.

Setting up database for local use

To set up the BSData database the following software needs to be installed:

1. MySQL database server (version 5.0.21)
2. MySQL Query Browser (version 1.1.20)
3. BSViv application (version 1.0)
4. FWTools toolset (version 1.1.0)

Detailed installation instructions for the MySQL database server can be found on the MySQL www-site (www.mysql.com). The following instance configuration options seem to work quite well:

- Developer machine
- Multifunctional database
- Tablespace in C: disk and "Installation Path"
- Number of concurrent connections 15 (Manual setting)
- Enable TCP/IP networking (also configure your Firewall, so that access to port 3306 is allowed from localhost ip-address 127.0.0.1 only)
- Standard character set

- Set password to 'tietoa'. If you change this the password in the BSViv application must be changed as well. See below.

To install the Query Browser, BSViv application and FWTools just run the corresponding installation files "mysql-query-browser-1.1.20-win.msi", "BSVivSetup.exe" and "FWTools100.exe". Please use the default installation directories. The database data is in the BSViv setup.

After the database server is installed and working, the database data needs to be imported. This can be done using the BSViv application, or by using MySQL command line client.

If you are using the BSViv, do the following:

- Start the BSViv application (Windows “Start” menu)
- If you changed the database root password, select the Database/Connection setup from the main menu and type in the new password to dbpasswd-field.
- To create to database select the "Database/Create bs0 database" menu item. If the database already exists, this will return an error.
- To import data to the database select the "Database/Import dump file" menu item, then select "bs0dump.sql" from the file list, and click "Open". The dump file is located in "C:\Program Files\BS\bsdb directory".

If you like to use MySQL command line, do as follows:

- Start MySQL command line (from Windows “Start” menu)
- create the database by typing "create database bs0;", then press <Enter>
- import data by typing "source C:/Program Files/BS/bsdb/bs0dump.sql;".

Setting up database remote access

There are two possibilities for accessing the database remotely:

- Access through IP-port 3306, using BSViv and Query Browser.
- Access using www-browser and BSApp

First, access to the database server can be opened to selected remote computers, by configuring the firewall of the server computer to allow access to IP-port 3306 from the remote computers. Note that access to port 3306 should be allowed for friendly ip-addresses only. In this case the BSViv and Query Browser can be used to access the database. Just configure the database server to the remote server computer.

The second way is to set up remote access using a www-server and the BSApp data browsing program. This configuration allows access to anyone with an Internet browser, and knowledge of the correct userid and password.

To setup remote intenet access the following software needs to be installed (in addition to the local database installation):

- Apache 2.2.2 www-server
- BSApp www-pages and cgi-program.

The Apache www-server setup is on the distribution CD. The latest version can be downloaded from http://www.apache.org.

The BSApp system setup can be done by running the BSAppSetup program from the distribution disk. The setup program will put the BSApp www-pages to directory c:\bs\www by default. In addition to running the setup program following task need to be done:

- Set up network access userid's for the MySQL database by running the "bsdb/bs0users.sql" macro using the BSViv "Run SQL macro" command.
- Modify Apache configuration file so that it works with BSApp. After installing the BSApp, an example configuration file "httpd.conf" can be found from the wwwconf-directory. To setup the default configuration for Apache, with local www-server access only, copy the provided example configuration file to Apache configuration directory (typically "C:\Program files\Apache Group\Apache2\conf"). Note that Apache must be restarted after the configuration has been changed. To modify the file by hand, "Includes" must be allowed for bs directory, and "bs/cgi-bin" directory must be defined to contain script files. See the provided "httpd.conf" file for details.

3. USING BSVIV TO ACCESS BSDATA LOCALLY

The BSViv program is used to access BSData locally; that is, the database server containing the data is in the same computer. The program can be configured to access data in remote servers as well.

The BSViv can be used for the following tasks:

- querying database data by class, and showing the results on the map
- moving data from an ESRI shapefile to the BSData database
- exporting data from the BSData database to a shapefile
- modifying single structure attributes
- adding and removing single structures from the database
- importing photos to the database
- modifying class related database data
- creating a database dump file and importing all data from an existing dump file
- creating a database report of the number of structures in each class.

Installation and starting the program

To install the BSViv application, see chapter 2, Setting up the database for local use. The installation program creates a start-menu item "BSViv", that is used to start the program. To start the system from command line, move to the installation directory ("C:\Program Files\BS\viv") and give command "C:\Program Files\BS\viv\viv bs.ip".

Main window, tools and main menu

The BSViv main window displays a menu, toolbar, data layer list, and map window workspace typically containing a single map window.

The top part of the window holds the main menu and toolbar. Main menu commands are used to initiate actions such as querying of the database. Toolbar tools are used to zoom and pan the map window, and select, add and remove structures from the data layers.

The map window displays some base map data (catchment boundaries and main rivers) from which database structure data is drawn. The data in the map window is divided into layers that are listed in the layer list. The map window can be zoomed and panned using the toolbar tools. The UTM coordinates of the current mouse location are shown on the toolbar as well.

On the left side of the window is the layer list containing a list of data layers shown in the map window. A data layer can hold data for one class of structures only. Many

data layers can be shown at the same time. Some actions require selecting a data layer from the layer list. This can be done simply by clicking the layer name in the layer list. Clicking a layer name with the right mouse button causes a popup menu to appear. By using this menu the layers can be rearranged or completely removed.

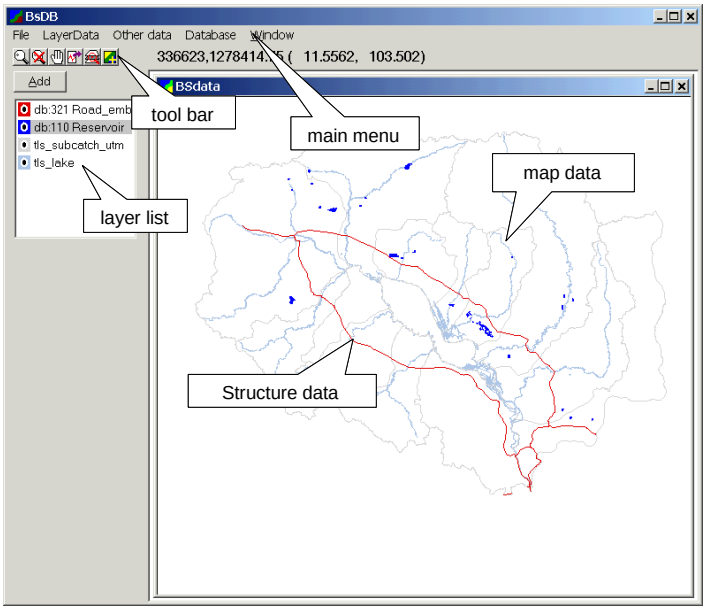


Figure 3.1: BSViv main window

The toolbar has the following tools:

	Zoom in by dragging a rectangle to a model window
	Zoom back to previous zoom setting
	Pan by dragging the mouse
	Copy window contents to the clipboard as a Metafile
	Zoom to selected layer boundaries
	Add a new structure to the selected data layer
X,Y (Lat,Lon)	Current mouse position coordinates: UTM-East,UTM-North, (latitude, longitude) Units: meters and decimal degrees

The main menu has the following commands:

File menu	
New	Create a new map window
Run SQL command	Run a SQL command
Run SQL macro	Select a SQL macro file and run it
Show cmd window	Display viv command window
Exit	Exit program

LayerData menu	
New layer	Create a new empty structure data layer
Query by class	Query data from the database and create a new data layer
Read shapefile	Import graphics and attributes from a shapefile to a structure data layer
Write to shapefile	Write structure graphics and attributes to a shapefile
Import to database	Write structure data from a structure data layer to the database

Other data menu	
Import photo	Read a .jpeg photo to database, convert to standard size and also create an icon file
Edit class data	Select class and edit related data, such as line and fill color

Database menu	
Connection setup	Set database location and userid information
Program path setup	Set MySQL command line and FWTools paths
Report by class	Count and report the number of items in each class
Dump to file	Dump all database data to a SQL-script file
Create bs0 database	Create a database, used when setting up the database
Reset tables	Create database tables, used when setting up the database
Import dump file	Used to import all database data and tables from a SQL dump file

Viewing and updating database data

To view and edit database data, a database query must first be made. The query will then fetch data from the database and create a new data layer in the map window. To perform a query use the "LayerData/Query by class" command from the main menu, select structure class and click OK. After the query is completed a new data layer is added to the layer list, and the structure data is drawn to the window.

To view or modify single structure attributes zoom in on the area of the map where the structure is located, and click the structure graphic with the mouse. This action will create a popup menu showing a list of nearby structures, where the preferred structure can be selected. A dialog box containing the structure data then opens in the window, shown in Figure 3.2 below.

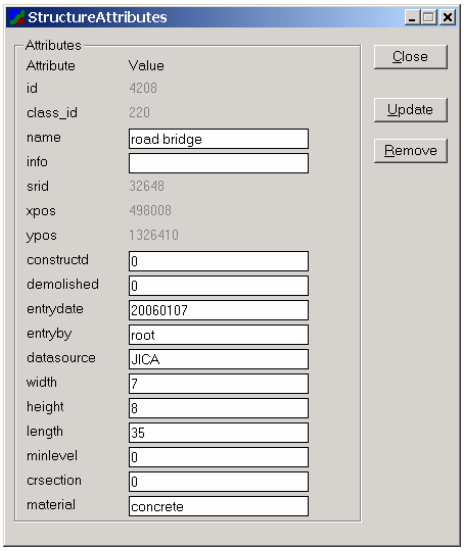


Figure 3.2: Structure data dialog box

The dialog box allows editing of structure attribute data. Attribute fields visible in the window depend on the structure class. To modify and update the data to the database first modify the desired fields, and then click the "Update" button. To close the window with no update click "Close". To remove the structure from the database click "Remove".

Graphical structure data cannot for now be modified in the BSViv application. If graphical data needs to be modified, the old structure must be removed, and a new structure with the modified data must then be created.

Importing data from ESRI shapefile to the BSData database

To move data from the ESRI shapefile to the database, first the shapefile must be imported to BSViv, and then from BSViv to the database.

To import shapefile contents to BSViv, use the "LayerData/Read shapefile" menu command. After giving the command two things need to be selected. First the shapefile to import, and then the structure class for the objects in the shapefile. Each shapefile may contain only structures belonging to same structure class. After selecting these an attribute selection window opens, in which the shapefile attribute data can be mapped to BS database structure attributes. (See Figure 3.3 below).

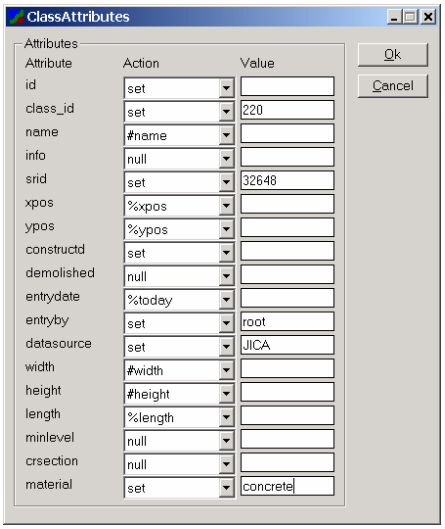


Figure 3.3: Setting class attributes during shapefile import

For each structure attribute there are the following options: “set to given value”, “use attribute from shapefile”, or “compute from geographic data”. The dialog box "Action" column pull-down menus define how to set the field value. Items staring with “%” are values that are computed from geographical data ("%length", "%xpos", "%ypos"). The items starting with "#" are attributes from the shapefile. If the action column value is "set" then the value in the "Value" column is set for all imported structures.

After pressing OK the shapefile data is imported to BSViv and displayed on the map. The structures are, however, not yet in the database, (structure “id” values are set to zero to show that the structures are not yet in the database). To copy the data from the new shapefile layer to the database, first select the new layer from the layer list, and then use the "LayerData/Import to database" command.

Exporting data from BSData database to shapefile

To export data from the database to a shapefile, first query the preferred structure from the database using the "LayerData/Query by class" command. After the query is done and a new data layer is created in the map window, select the data layer from the layer list and select the "LayerData/Write to shapefile" command from the main menu. Select a new name for the new shapefile and press OK:

Adding and removing single structures from the database

Adding new structures to the database can be done by importing shapefile data as described above, or by creating new structures manually.

To create a new structure, a data layer for the structure data must first be created using the "LayerData/New Layer" command. The command asks for the structure class of the new layer, after which it creates a new empty layer in the layer list.

To add a new structure to the created data layer, click the "Add new structure" tool from the toolbar, and the use the mouse to click a location on the map for the new structure. If the structure is a point, one mouse click is sufficient. If the structure is a line-type of polygon, draw the structure on the map with a sufficient number of mouse clicks, and finish the drawing by double clicking. After the geographic data is clicked to the map, a dialog box asking for structure attributes opens. Fill the structure data and press "Create" to create the structure in the database.

Importing photos to the database

Photos can be put into the database and associated with structures that are already in the database. The imported photos must be in .jpeg format. Photos can be imported using the "Other data/Import photo" command, which will open a dialog box asking for the photo file name, photo location and associated structure id. After the information is given, the command creates a 800x600 pixel size version of the photo and copies it to the database. Also, a 80x60 pixel size icon is made and put into the database as well. The www-interface is able to show the photos along with structure data. The BSViv cannot display photos.

Modifying class related database data

Class related data, such as drawing line color and fill color, can be modified using "Other data/Edit class data". After selecting the class to edit, a class data edit dialog box opens. The drawing attributes and class description can be changed. Class identifiers and shapetype cannot be changed, since other applications use the defined values.

Creating database dump file and importing all data from an existing dump file

Database dump files can be used to move the whole database to another computer, or to backup the database before making changes to the data content. To create a database dump use the menu command "Database/Dump to file", select a new name for the database dump, and click OK.

To restore the database from a dump file, use the menu command "Database/Import dump file", select the database dump file from the file window, and click OK.

Creating a database report

A simple report listing number of items in each structure class can be created using the menu command "Database/Report by Class". The command will create a new text window containing the generated report.

class	items	class name
110	55	Reservoir
211	3732	Irrigation canal
220	1278	Bridge
230	323	Culvert
310	38	Dam
320	892	Embankment
321	28	Road embankment primary
322	1848	Road embankment other
323	14	Railroad embankment
324	3	Reservoir dike
340	2	Weir
371	44	Hydrological station
372	85	Meteorological station
411	11	Dai fishery
413	472	Fence system
440	41	Fishing lot
450	7	Fish sanctuary
610	1323	Rice field
620	372	Field crops
630	77	Plantation
640	2708	Other agriculture
650	157	Irrigated area
710	4	Docks/Harbour
730	4	Ferry
814	62	Mine

Figure 3.4: Database Report by class

4. USING BSAPP TO ACCESS BSDATA REMOTELY

The BSApp interface can be used to connect to the BSData database using an Internet browser, such as IE 6.0 or Firefox 1.5. The Internet server should have BSData database installed for remote access.

The BSApp can be used for the following tasks:

- querying database data by class and geographical area, and showing the results on the map
- Viewing structure attribute data for selected structures
- Viewing structure attribute data in table format

Installation and starting the program

The BSApp runs in any modern Internet browser that can run Java applets. To run the program an Internet browser should be installed. The BSApp also uses Java Runtime Environment 5 or later, which should be installed on the client computer (JRE download: http://java.sun.com/javase/downloads/index.jsp).

To start the BSApp, start your browser program and type the address of the BSData server into the address bar of the browser. A test version of the database is available during 2007 at http://www.eia.fi/bs, userid "bsclient" and password "gh4ntx89". On the welcome page there is a button where the BSApp can be started.

After clicking the start button the application downloads from the www-server, which can take some time, since a few megabytes of data program code need to be downloaded. The application code is cached to the accessing computer, so next time the program is started the start time will be shorter.

Main window, tools and main menu

The main window of the BSApp applet is shown in Figure 4.1. The window displays a base map with main rivers and catchment boundaries, a coordinate grid and a scale bar. On the right side of the window is a data layer list displaying all data layers shown in the window. The top part of the window contains the menu and toolbar.

The map window can be zoomed and panned using the toolbar tools. Also, the Zoom, Query, Classes and Areas commands are located on the toolbar for fast access. The geographic coordinates of the current mouse location are shown on the toolbar as well.

On the right side of the window the layer list containing a list of maps and data layers in shown in the window. A data layer holds data that results from one database query. Many data layers can be shown at the same time. Some actions require selecting data layers from the layer list. This is done simply by clicking the layer name in the layer list. By clicking a layer name with the right mouse button, a popup menu appears. Using this menu the layers can be rearranged or completely removed.

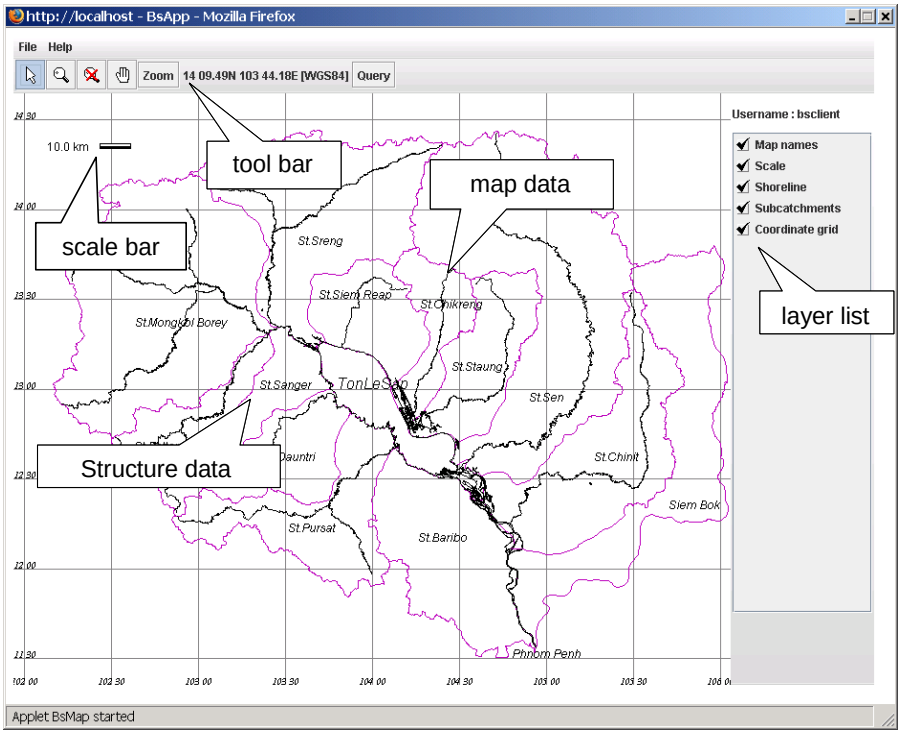


Figure 4.1: BSApp main window

The toolbar has the following tools and buttons:

	Arrow tool: Show structure data (point and click), Zoom (drag) and Pan (Shift+drag)
	Zoom in by dragging a rectangle to model window
	Zoom back to previous zoom setting
	Pan by dragging with the mouse
Zoom	Zoom to preset area
Lat N, Lon E	Mouse position geographical coordinates in degrees and decimal minutes
Query	Query data from the database

The window menu contains the following commands:

File menu	
Print	Print window contents
Exit	Exit program

Help menu	
Help	Open up a help window
About	Application version etc. information

Querying database data

To view database data a database query must be made. The query will then fetch data from the database and create a new data layer in the map window. To perform a query click the "Query" button on the toolbar, which opens a query dialog box (Figure 4.2). In the query dialog box select a structure class and area and click OK. After the query is completed a new data layer is added to the layer list, and the structure data is drawn in the window.

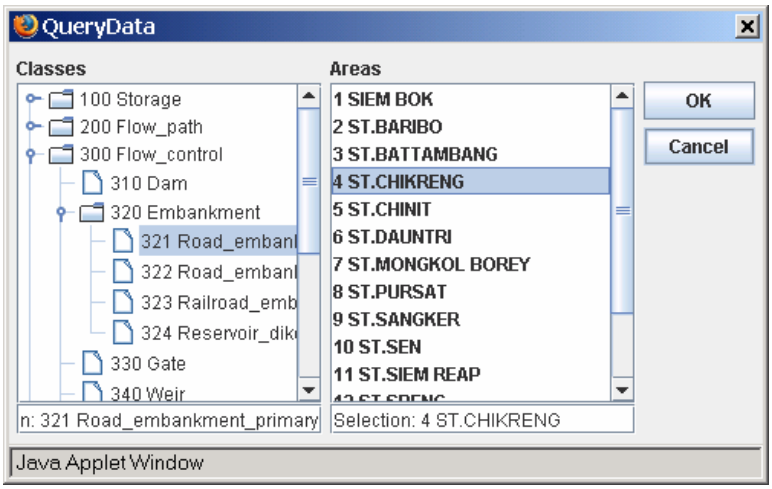


Figure 4.2 Query data window

Viewing structure data

To view structure attribute data zoom the map to the area where the preferred structure is located and click the structure graphic with the mouse (when the Arrow tool is active). This will open a dialog window showing the structure data (Figure 4.3). The displayed attributes depend on structure class.

To view all the attribute data of a data layer in table format, click the layer title in the layer list with the right button, and select "Show table" from the popup menu. This will open a table view of all structure attribute data (Figure 4.4). The table rows can be selected using the mouse and copied to Clipboard by pressing Ctrl-C on the keyboard.

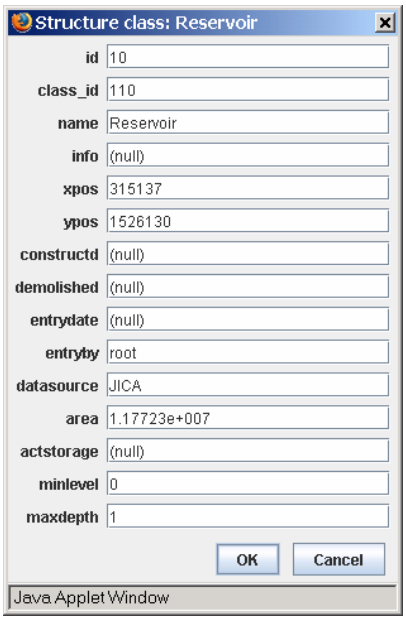
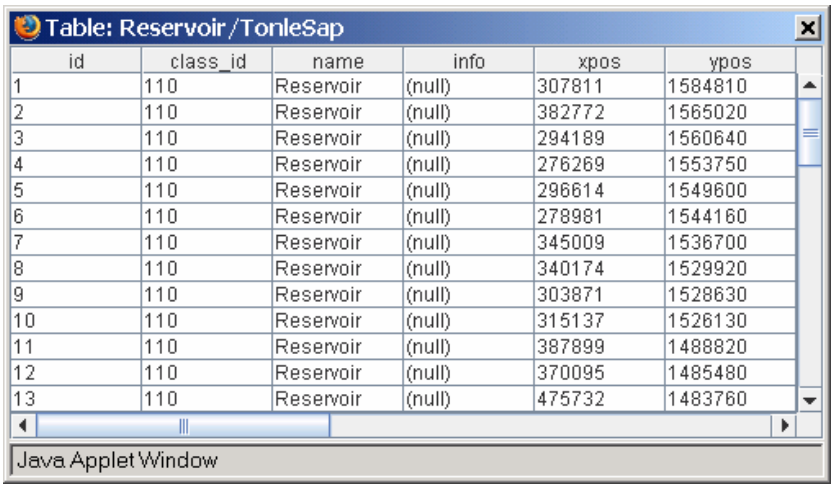


Figure 4.3 Structure data dialog box



id	class_id	name	info	xpos	ypos
1	110	Reservoir	(null)	307811	1584810
2	110	Reservoir	(null)	382772	1565020
3	110	Reservoir	(null)	294189	1560640
4	110	Reservoir	(null)	276269	1553750
5	110	Reservoir	(null)	296614	1549600
6	110	Reservoir	(null)	278981	1544160
7	110	Reservoir	(null)	345009	1536700
8	110	Reservoir	(null)	340174	1529920
9	110	Reservoir	(null)	303871	1528630
10	110	Reservoir	(null)	315137	1526130
11	110	Reservoir	(null)	387899	1488820
12	110	Reservoir	(null)	370095	1485480
13	110	Reservoir	(null)	475732	1483760

Figure 4.4 Table view of layer attribute data

Other functionality

"Zoom" – toolbar button has some zoom shortcuts, including, "TonleSap river", "TonleSap lake" and "Full extent".
"Areas" – toobar button can be used to draw selection areas to map window. This includes subcatchments, provinces and mediumflood boundary