CHAPTER 3

ISWM TECHNICAL SYSTEM

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3.1 Field Surveys

3.1.1 Factories' Survey

a. Objectives of the Factory Survey

The objectives of the survey are:

i. to identify the present generation and disposal of ISW on-site in order to formulate a Master Plan in 2010 and a short term improvement plan;

ii. to understand the actual conditions of the following aspects of ISW generating factories:

- generation, management and reutilization of wastes for the formulation of waste disposal and minimization plan ; and
- environmental management system in factories including their waste management (i.e. production process, installation of pollution control facilities, water/energy demands, etc.) ; and

iii. to gain an insight into the possible behavior and consciousness on environmental protection of generators.

b. Scope of Industries for the Study

ba. Bases for Discussion

According to the S/W (Scope of the Work) the wastes to be studied in this study shall cover industrial and medical solid wastes; construction and agricultural wastes were excluded from the study. However, the composition of ISWs was not clearly defined.

On the other hand, target factories mentioned in the S/W for factory surveys are those reporting under the present declaration system, although the S/W was amended to include some factories not reporting following the M/M on IC/R.

bb. Criteria of Scoping of Industries for the Study

There is no clear definition and/or regulations to distinguish industrial and municipal solid wastes in the current SWM within the Metropolitan Region. The following criteria were, therefore, set up through the discussion with Chilean counterpart personnel for scoping of industries for the Study.

i. Scope of industries for this Master Plan Study shall be, in principal, those industries in the list which is presently supervised and managed by SESMA-PROCEFF through the manifest system (Act 5081).

ii. However, any industry which is expected to considerably count for total quantity of waste to be generated and/or magnitude of hazardousness of waste to be generated at present and/or in future (related to the enforcement of pollution regulations) should be included in the scope of the Study.

bc. Finalization of Scope of Industries

Based on the above criteria, the following industries were included for the study following the discussion with the counterpart personnel:

- manufacturing industries (CIIU code 31111 to 39099);
- mining industries (CIIU code 21001 to 29090);
- electricity generators (CIIU code 41011);
- fuel stations (CIIU code 62536); and
- laundries and dry cleaners (CIIU code 95201).

The list of the industries for the Study can be found in section C.2 of the Annex.

c. Classification of Wastes for the Study

ca. Determination of Waste Classification

The method of criteria determination of ISW for the Factories' Survey was the principle issue. The Study Team carried out an examination with regard to this issue, its outcome was materialized for the following discussions between the Team and the Chilean counterpart.

i. 24 classification of ISW

Following the examination of the criteria used by Japan, EU and the World Bank, the Team found that the EU's classification of industrial waste is based upon physico-chemical characteristics, however, the capacity to conduct detailed laboratory analysis is required. Meanwhile, initially in building the framework of management system of ISW, it is important that field staff of both industrial waste generators and relevant governmental authorities could visually identify waste characteristics. In view of this, waste classifications of the World Bank and Japan were examined and the 24 classification of ISW was proposed below.

Table 3.1.1a ISW Classification (24 Categories) Used for Factories' Survey

ISW Code	ISW category
C-1	Ash including from incinerator
C-2	Dust and APC products
C-3	Inorganic sludge
C-4	Organic sludge
C-5	Asbestos
C-6	Acids
C-7	Alkalis
C-8	Solvents
C-9	Oily waste
C-10	Inorganic chemical residues
C-11	Organic chemical residues
C-12	Other liquid waste
C-13	Waste from food production
C-14	Glass and ceramics
C-15	Metal and scrap
C-16	Paper and cardboard
C-17	Plastics
C-18	Rubber
C-19	Textile and leather
C-20	Waste similar to domestic waste
C-21	Wood
C-22	Slag from melting
C-23	Construction waste
C-24	Other solid waste

ii. EWI's 333 classification of ISW

The counterpart approved the classification proposed. However, at the same time requested that attentions should be drawn to the 333 classification (which had been proposed through EWI's RISNOR study and is being incorporated into

SESMA-PROCEFF's control system of the declaration system) and the compatibility of 24 classification and 333 classification with each other.

iii. Matrix-table for 24 and 333 classifications

The Study Team confirmed the request and formulated a matrix-table which indicates the correspondence between both the 24-classification and the 333 classification. Furthermore, this matrix-table is incorporated into the Team's Factories' Survey. Meanwhile, the Team proposed that some items of ISW which were classified into non-hazardous waste according to SESMA-PROCE-FF's current waste categories should be changed into categories of hazardous waste; this was confirmed by SESMA-PROCEFF.

cb. Priority Waste for the Study

As a consequence of the above discussions, it was confirmed that the Team's survey of "Actual Condition of Industrial Solid Waste" should employ a matrix-table in which principal 24 classifications are vertically listed and correspondence with waste codes being employed by SESMA-PROCEFF are maintained.

On the other hand, EWI's RISNOR investigation considerably clarified the status-quo of non-hazardous industrial waste. Both the Team and Chilean counterpart mutually understood that the ISWM in the Metropolitan Region had to be mainly targeted to "Hazardous Waste" including "Liquid waste" and the Study's survey should mainly focus on these wastes.

cc. Format of Survey Questionnaire Form

In relation to the main objectives of the survey, a draft survey form was produced by the Team. As a consequence of discussions between the Chilean counterpart and the Team and after several pilot surveys were conducted and re-examination of the draft survey form, final survey form was produced.

d. Selection of Factories for the Survey

In relation to the selection criteria of factories to be surveyed, manufacturing industries were classified into "industries with high potentiality of generating hazardous waste " and "industries with low potentiality of generating hazardous waste". In relation to this classification (into 2 categories), a table indicating sizes (represented by number of employees) of all companies with no less than 10 employees in the Metropolitan

Region as well as a table which indicates the same with regard to the factories surveyed through EWI's previous "non-hazardous" study, were formulated. Factories to be surveyed in this Study were determined as follows as a result of the comparative examination of those tables:

i. Industries with high potentiality of hazardous waste generation

Industries with high potentiality of hazardous waste generation should mainly be selected to be surveyed, while information of EWI's "non-hazardous industrial waste" should be usefully incorporated.

ii. Total number of factories to be surveyed

In order for the total number of factories to be surveyed should be about 200 and assuming that about 25% of attempted surveys would be rejected by companies, about 270 companies had to be selected for the survey.

iii. Selection of factories to be surveyed

270 factories comprised:

- All 55 major factories with 500 or more employees
- All 114 major factories from industries with high potentiality of hazardous waste generation with 200 to 499 employees
- 80 factories from industries with high potentiality of hazardous waste generation with 100 to 199 employees (in case that such industry does not have companies with more than 199 employees, at least 2 factories should be chosen respectively from such industries.). 80 factories might cover 40% of factories in this category.
- About 21 factories should be selected from industries (such as fertilizer/pesticide manufacturers, laundries, fuel filling stations) employing less than 100.

iv. Reliability of data and information

With regard to all companies with no less than 10 employees, information of ISW from 200 factories of this survey together with information from previous EWI's RISNOR survey would cover about 14% of the of factories but about one-third of total employees. Significant reliability was expected from the data and information for the identification and understanding of the status-quo of the

industrial solid waste in the Metropolitan Region.

e. Outcome

ea. Database

Data obtained from questionnaires (both the Team's Factory Survey and EWI's RISNOR study) and processed in this Study are compiled in a "database". The "database" contains data from a total of 425 factories (189 out of 199 factories surveyed by the Team, and 236 out of 265 factories surveyed by EWI's RISNOR study.).

i. The data summarized from both studies are compiled in two files (i.e. JEWI_IND.DBF and JEWI_DB.DBF).

ii. The data summarized exclusively from Team's Factory Survey are compiled in another set of two files (i.e. JICA_IND.DBF and JICA_DB.DBF).

This "database" is submitted to the Chilean counterpart in form of a floppy disk (2HD, 1.44MB formatted, 3.5").

"Identification of present SW generation amount" and "estimation of future SW generation amount" is indispensable to initiate planning of SWM (either municipal, industrial or medical) and to revise the plan based on its monitoring.

The Team strongly wishes that the Chilean side fully utilizes the data base submitted for their reviewing current ISW generation in certain intervals, subsequently it would like to enable the Chilean authorities to review the Master Plan periodically and revise and refine their policies regarding the ISWM.

eb. List of Factories Surveyed

From a total 267 factories contacted, the Study Team carried out an interview survey of 199 factories (the remaining factories in general were not willing to answer, claiming how repetitive this practice was) mainly from manufacturing industries, and some from mining, electricity generation, retail trade and personal and household services (e.g. gas stations and laundries).

ec. Effective Samples

Numbers of effective samples for the respective data analysis are listed below.

Table 3.1.1b Effective Samples for Each Items

Items	Sub-Items	Effective Answers	Unit	Total
Rut Number		199		
Name of Company		199		
Address	Provincia	199		
	Comuna	199		
	Address	199		
Category of Industry	Proceff Code	199		
Main Product	Production	167	(tn/year)	3,509,304.20
		7	(m3/year)	4,876,811.00
	Input of Raw Material	171	(tn/year)	2,734,616.78
		6	(m3/year)	621,164.20
Share Capital		109	(mill. Pesos)	1,521,885.40
Number of Employees		189	(People)	64,784.00
Anual Sales Amount		118	(mill. Pesos)	1,063,274.56
Use of Raw Material		199		
Production Process		199		
Pollution Control Facilities		199		
Water Consumption		178	(m3/year)	51,146,795.00
Power Consumption		183	(kw/year)	913,791,383.00
Fuel Consumption		42	(tn/year)	2,638,664.37
		136	(kl/year)	17,168,137.52
Present Managment of Hazardous Waste	6.1	148		
	6.2	121		
	6.3	148		
	7.1	132		
	7.2	131		
	7.3	154		
	7.4	160		
	7.5	147		
	7.6	128		

ed. General Data

The effective answers corresponding to the number of employees covered 189 factories, with a total of 64,784 employees.

Regarding the location of the factories, 88% of them are in Santiago Province and 8% in Maipo Province.

ee. Production

i. Use of raw materials

With regard to the use of raw materials which may either be hazardous and/or contain such materials when it becomes a by-product, there are significant differences among HPI (High Potential Industries), PI (Potential Industries) and LPI (Less Potential Industries), except for heavy metals which HPI uses more than PI and LPI.

ii. Production process

Thermic processes, such as boilers, furnaces, heating, incineration etc., are used by 82% of the surveyed sample and 81% use water in its productive processes.

iii. Pollution control facilities

The installation rate of the flue gas treatment facilities among those which have thermic processes (i.e. boilers, incinerator, etc.) is 38%; 62 among 164 factories. Although the installation rate of the waste water treatment facilities is 52 % (83 factories), only 5 factories generate C-3 (Inorganic sludge) and C-4 (Organic sludge) is produced by 21. The remaining 57 factories have only primary treatment facilities (e.g. simple ponds, screen, etc.) which do not generate sludge. Consequently the installation rate of waste water treatment facilities which generate sludge is 16% (26/161 x 100 = 16%).

ef. Treatment and Final Disposal in Factories

i. Internal treatment methods

According to the results of the survey (see Table 3.1.1c), most of ISW (82.6%) generated on-site are not treated. Among the treated ISW (17.4%), 10.1% of them are recycled on-site. Thus, only 7.3% of ISW generated are treated on-site

(at the factory). Popular treatment methods on-site are neutralization (2.8%), sorting (1.8%) and drying/evaporation (1.7%), in order, and the other methods are negligible. Regarding treatment methods on-site by factories, there are no significant difference observed in the industrial category of HPI (Highly Potential Industries), PI (Potential Industries) and LPI (Less Potential) Industries.

ii. Disposal methods

The results of the survey according to the 24 ISW categories are summarized in Table 3.1.1d. According to the results, it is significant that 56.2% of ISW generated are recycled and 25.5% of ISW are transported to the municipal landfills. It is surprising that 95.6% of C-13 (Waste from food production) and 94.4% of C-21 (Wood) are recycled. It indicates that some of HW, i.e. 78.2% of C-10 (Inorganic chemical residues), 71.9% of C-7 (Alkalis) and 22.9% of C-8 (Solvents), are discharged into sewer or watercourse. In addition, while rate of long-term storage on-site is very limited including some of HW (0.8%), considerable portion of HW, i.e. 100% of C-5 (Asbestos), 96.9% of C-4 (Organic sludge) and 78.0% of C-11 (Organic chemical residues), are disposed of at municipal landfills.

Referring to the results by industrial category (see Tables 3.1.1e), it is quite reasonable that recycling rates according to the HPI, PI and LPI are 29.8%, 53.8% and 73.9% respectively. The fact is also supported by the result that disposal rate at municipal landfills of ISW from LPI is only 8.7% while the rate from HPI and PI is about 36%. On the other hand, 12.4% of ISW generated in HPI are discharged into sewer or watercourse, while rates of ISW discharged from PI and LPI are only 0.1% and 4.1% respectively. This is a critical issue to be solved urgently.

Table 3.1.1c Treatment Methods On-site by 24 ISW Categories (Rate obtained)

Unit: %

ISW Category		E												
		1	2	3	4	5	6	7	8	9	10	11	(blank)	Grand Total
C-1	Ash including from incinerator	-	20.2%	-	-	-	-	44.5%	-	-	-	-	35.3%	100%
C-2	Dust and APC products	-	8.9%	0.2%	-	0.4%	-	-	-	-	70.6%	4.4%	15.4%	100%
C-3	Inorganic sludge	-	48.6%	-	-	-	-	-	-	-	-	-	51.4%	100%
C-4	Organic sludge	0.3%	-	0.6%	-	-	-	-	-	-	36.9%	3.2%	59.0%	100%
C-5	Asbestos	-	-	-	-	-	-	-	-	-	-	-	100.0%	100%
C-6	Acids	-	-	8.9%	-	-	-	-	-	-	-	-	91.1%	100%
C-7	Alkalis	-	-	77.7%	-	-	-	-	-	-	-	10.4%	11.9%	100%
C-8	Solvents	-	-	-	-	-	-	-	-	-	46.8%	0.4%	52.7%	100%
C-9	Oily waste	-	-	-	-	2.3%	-	-	0.3%	0.1%	-	5.8%	91.5%	100%
C-10	Inorganic chemical residues	-	-	48.4%	-	-	-	-	-	-	0.0%	-	51.6%	100%
C-11	Organic chemical residues	4.0%	-	1.7%	-	-	-	-	-	-	20.0%	-	74.4%	100%
C-12	Other liquid waste	-	-	-	-	-	-	-	-	-	100.0%	-	-	100%
C-13	Waste from food production	-	-	-	-	-	-	0.9%	-	-	-	0.1%	99.0%	100%
C-14	Glass and ceramics	-	-	-	-	-	0.0%	3.4%	-	-	47.1%	-	49.5%	100%
C-15	Metal and scrap	-	-	-	-	-	0.0%	2.5%	-	-	2.2%	0.4%	95.0%	100%
C-16	Paper and cardboard	-	-	-	0.0%	-	0.0%	0.4%	-	-	0.7%	0.3%	98.6%	100%
C-17	Plastics	-	-	-	-	-	0.8%	15.7%	-	-	4.9%	13.8%	64.9%	100%
C-18	Rubber	-	-	-	-	-	1.9%	-	-	-	3.0%	-	95.2%	100%
C-19	Textile and leather	-	-	-	-	-	4.0%	1.7%	-	-	-	-	94.3%	100%
C-20	Waste similar to domestic waste	-	-	0.1%	-	0.0%	-	0.0%	-	-	-	0.1%	99.7%	100%
C-21	Wood	-	-	-	-	-	-	2.8%	-	-	0.0%	-	97.2%	100%
C-22	Slag form melting	-	-	-	-	-	-	-	-	2.2%	16.3%	-	81.6%	100%
C-23	Construction Waste	-	-	-	-	-	-	0.7%	-	-	3.4%	-	95.9%	100%
C-24	Other solid waste	-	-	-	-	-	-	-	-	-	100.0%	-	0.0%	100%
Grand Total		0.1%	1.7%	2.8%	0.0%	0.0%	0.1%	1.8%	0.0%	0.1%	10.1%	0.8%	82.6%	100%

Note:
1. Dewatering
2. Drying and /or Evaportion
3. Neutralization
4. Reduction
5. Incineration
6. Crushing
7. Sorting
8. Oil Separation
9. Solidification
10. Reutilization
11. Other

Table 3.1.1d Disposal Methods On-Site by 24 ISW Categories (Rate obtained)

Unit: %

ISW Category		Disposal Methods									Grand Total
		1	2	3	4	5	6	7	8	No Answer	
C-1	Ash including from incinerator	6.5%	3.0%	-	-	-	25.9%	64.7%	-	-	100%
C-2	Dust and APC products	0.1%	15.8%	-	64.2%	3.1%	1.1%	8.9%	-	6.8%	100%
C-3	Inorganic sludge	-	51.4%	-	-	-	-	-	48.6%	-	100%
C-4	Organic sludge	0.4%	96.9%	0.1%	-	-	1.4%	0.4%	0.9%	-	100%
C-5	Asbestos	-	100.0%	-	-	-	-	-	-	-	100%
C-6	Acids	-	0.2%	2.9%	0.9%	5.9%	0.1%	79.5%	10.6%	0.0%	100%
C-7	Alkalis	-	-	-	4.9%	71.9%	-	12.8%	-	10.5%	100%
C-8	Solvents	-	0.1%	-	0.5%	22.9%	3.6%	37.0%	35.4%	0.4%	100%
C-9	Oily waste	-	18.6%	-	-	2.4%	4.2%	71.1%	1.3%	2.3%	100%
C-10	Inorganic chemical residues	-	21.8%	-	-	78.2%	-	0.0%	-	-	100%
C-11	Organic chemical residues	-	78.0%	-	-	1.0%	-	-	1.0%	20.0%	100%
C-12	Other liquid waste	-	-	-	-	34.6%	-	65.4%	-	-	100%
C-13	Waste from food production	-	2.9%	-	-	0.7%	0.9%	95.6%	0.0%	-	100%
C-14	Glass and ceramics	-	22.5%	-	-	-	29.9%	14.6%	-	33.0%	100%
C-15	Metal and scrap	0.4%	3.3%	-	-	-	0.1%	74.1%	20.1%	2.0%	100%
C-16	Paper and cardboard	0.6%	14.8%	-	0.1%	-	3.8%	79.8%	0.6%	0.4%	100%
C-17	Plastics	4.1%	49.8%	-	0.0%	-	1.7%	35.5%	4.7%	4.1%	100%
C-18	Rubber	92.7%	0.2%	0.2%	-	-	1.9%	1.1%	-	3.9%	100%
C-19	Textile and leather	0.2%	59.1%	-	-	-	4.0%	32.9%	-	4.0%	100%
C-20	Waste similar to domestic waste	4.4%	90.5%	0.0%	0.4%	-	0.5%	2.5%	0.8%	0.9%	100%
C-21	Wood	-	4.0%	-	0.1%	-	0.4%	94.4%	0.2%	0.9%	100%
C-22	Slag form melting	41.0%	40.8%	-	8.7%	-	3.5%	3.9%	-	2.2%	100%
C-23	Construction Waste	-	96.6%	-	-	-	-	-	-	3.4%	100%
C-24	Other solid waste	-	-	100.0%	-	0.0%	-	-	-	-	100%
Grand Total		2.9%	22.6%	2.9%	0.8%	4.4%	3.3%	56.2%	3.7%	3.2%	100%

Note:

1. Transport and final disposal at municipal landfill by own means of transportation.
2. Transport and final disposal at municipal landfill by consignment of private contractor.
3. Final disposal at factory's compound and/or its property land.
4. Long-time storage at factory's compound awaiting external treatment/disposal.
5. Discharge to sewer or watercourse
6. Disposal consigned to private contractor - treatment and disposal is not known.
7. Reutilization by other parties, e.g. use at other factory as raw material.
8. Others.

Table 3.1.1e Disposal Methods On-Site Surveyed by Industrial Category (Rate obtained)

Unit: %

Industrial Category		Disposal Methods									
		1	2	3	4	5	6	7	8	No Answer	Grand Total
Highly Potential Industries	351	0.4%	8.6%	-	-	0.1%	0.1%	90.7%	0.1%	0.1%	100.0%
	352	0.0%	11.7%	0.0%	0.0%	15.7%	0.4%	67.2%	3.2%	1.7%	100.0%
	354	2.5%	96.0%	-	-	-	-	-	1.5%	-	100.0%
	356	31.2%	34.8%	-	-	0.0%	0.8%	29.6%	1.6%	2.0%	100.0%
	371	15.9%	55.6%	-	3.1%	-	23.5%	-	-	1.9%	100.0%
	372	-	65.9%	-	-	1.6%	-	15.9%	-	16.6%	100.0%
	381	1.2%	17.4%	0.7%	0.8%	22.0%	4.7%	34.5%	18.2%	0.5%	100.0%
Total Highly Potential Industries		6.3%	30.1%	0.3%	1.3%	12.4%	9.4%	29.8%	8.8%	1.6%	100.0%
Potential Industries	3211	1.3%	50.2%	0.7%	-	0.9%	30.3%	13.3%	3.2%	0.2%	100.0%
	3231	0.9%	74.5%	-	-	-	-	24.6%	-	-	100.0%
	3319	-	-	-	-	-	-	100.0%	-	-	100.0%
	341	0.2%	58.2%	-	-	-	-	39.1%	-	2.5%	100.0%
	3420	-	3.1%	-	-	0.0%	6.7%	89.3%	0.1%	0.7%	100.0%
	355	98.1%	0.2%	0.2%	-	-	-	1.5%	-	-	100.0%
	362	-	61.8%	-	15.3%	-	-	6.8%	0.6%	15.5%	100.0%
	3699	-	97.3%	-	-	-	-	-	-	2.7%	100.0%
	382	2.8%	39.4%	-	-	-	-	57.3%	-	0.6%	100.0%
	383	1.4%	14.2%	-	-	0.3%	0.3%	41.9%	1.1%	40.8%	100.0%
	384	-	14.8%	-	-	-	-	85.2%	-	-	100.0%
	385	-	4.9%	-	-	-	-	94.7%	0.4%	-	100.0%
	390	-	-	-	-	-	-	100.0%	-	-	100.0%
	625	-	51.3%	-	-	-	-	38.5%	10.3%	-	100.0%
	952	0.2%	86.5%	-	-	13.1%	-	-	0.2%	-	100.0%
Total Potential Industries		3.9%	32.4%	0.0%	1.3%	0.1%	1.8%	53.8%	0.3%	6.5%	100.0%
Less Potential Industries	311	0.2%	11.7%	-	-	0.0%	3.6%	83.3%	-	1.3%	100.0%
	313	-	8.6%	-	-	6.4%	-	84.4%	0.4%	0.2%	100.0%
	322	-	35.4%	-	-	7.2%	-	57.4%	-	-	100.0%
	324	-	-	-	-	-	43.4%	-	-	56.6%	100.0%
	3691 - 3696	-	-	64.8%	-	-	-	-	35.2%	-	100.0%
	410	-	-	-	-	-	-	100.0%	-	-	100.0%
Total Less Potential Industries		0.0%	8.7%	7.2%	-	4.1%	1.1%	73.9%	4.2%	0.8%	100.0%
Grand Total		2.9%	22.6%	2.9%	0.8%	4.4%	3.3%	56.2%	3.7%	3.2%	100.0%

Note:
1. Transport and final disposal at municipal landfill by own means of transprtation.
2. Transport and final disposal at municipal landfill by consignment of private contractor.
3. Final disposal at factory's compound and/or its property land.
4. Long-time storage at factory's compound awaiting external treatment/disposal.
5. Discharge to sewer or watercourse
6. Disposal consigned to private contractor - treatment and disposal is not known.
7. Reutilization by other parties, e.g. use at other factory as raw material.
8. Others.

eg. Hazardous Substances

It is only a few among the 199 factories that identified and reported hazardous substances; i.e. the number of factories identified Pb, Cr, As, organic phosphorous compounds and solvents/pigments are; 2 (non-ferrous metal), 4 (ferrous, tannery and electric parts), 1 (metal plating), 1 (electric parts) and 10 (others).

eh. Hazardous Waste Management

i. General

Factories in general consider that in their productive process HWs are not generated. This statement is almost constant. The responses were in a framework such that, the raw materials or hazardous components that are used were always in small quantities and in low concentrations, which do not imply a risk associated to the management and manipulation of HW and materials. Therefore, it presents a high percentage of positive answers to the current management system of materials and wastes, that is to say, the current existence of people responsible for management and control, the existence of established procedures for management and storage.

ii. Current HWM

In relation to the current system for management of hazardous materials and wastes, 80% of the surveyed industry samples have people responsible for the management and control of hazardous materials and wastes, which are clearly defined, marked and stored separately.

The problems that are presented for the management of HW are:

- Lack of knowledge and information to identify what is hazardous waste, which corresponds to 49% of the sample factories.
- 45% currently expresses having problems with the lack of regulations and norms that define what is to be done.

iii. Future HWM

The future tendency regarding HW and intention of factories on management of HW are that:

- The 50% of the respondents believe that the generation of

hazardous wastes will not increase greatly. In addition, 42% responded that there will be a decrease of HW due to improvement of manufacturing process and change of raw materials.

- 53% of factories intend to improve their on-site HWM system in accordance with the reinforcement of environmental regulations, while 41% wish to ameliorate the HWM system independently.
- Concerning future reduction and recycling of wastes in the industries, 47% of the sample said they would not alter their current management and 49% of factories intend to improve the present system.
- 51% of the respondents have the intention of improving the present system of treatment and final disposal of ISW while 46% will basically apply the present system.
- In the case of the necessity to treat hazardous wastes, 53% of the sample will consign waste to other companies, considering it a lower cost than if the treatment is carried out inside the factory. On the contrary, only 25% will install their own treatment facilities.
- In relation to the cost of disposal of hazardous wastes, 32% of the sample consider that costs will not be significant and their increase will not be important and 29% answered an improved ISWM is necessary to obtain an "environmentally friendly" image of products - regardless of costs. However, an equal proportion of factories consider that the disposal costs are significant and considerably higher costs would affect the price of products (30%).

f. Findings

Based on the outcome presented in the previous section, the following aspects are found and described in the respective sections in this report :

i.	ISWM on-site :	section 3.2
ii.	ISWM outside (factories) :	section 3.3
iii.	Present ISW generation :	section 3.4.3
iv.	Present ISW flow :	section 3.4.4

In addition to the above, general findings obtained by the factories' survey are prepared overleaf.

fa. Large-scale Hazardous Wastes Generation Sources

It was found that there are no outstanding large-scale hazardous waste generation sources, which may emit enormous amounts of hazardous wastes, even by a sole factory (such as copper smelting refinery, blast furnace, petroleum refinery or pulp digesting and bleaching), in the Metropolitan Region (MR). Only one thermoelectric power station (100MW capacity, fuel: heavy oil 80% and coal 20%) located in the MR, operates only when hydroelectric power cannot cover the demand in the water shortage season (i.e. rate of operation (days in a year) is just about 10%) and furthermore fuel conversion to gas is planned. Therefore, large-scale hazardous wastes generators do not seem to exist in the MR.

fb. On-site ISWM

Significant number of factories newly built or renovated recently operate in the north industrial zones along the North Pan-American Highway. Those factories are located in larger sites. Most interviewees from these factories, who are responsible for production or management, showed their consciousness of environmental protection. Provision of facilities viewing environmental protection and work site cleanliness were well observed.

On the contrary, where several industrial zones are found in the south central section of the urbanized area, many older factories which have been in operation for a few decades (mainly small and medium industries), are located in modest sites. They tended to face difficulties in renovating facilities and most waste water was discharged directly to the sewers. It is envisaged that substantial improvement in environmental protection could not be easily expected from these small and medium factories. However, it is appreciated that resource recovery by separate storage (for recyclers' internal collection) and work site cleanliness were pursued within the limited area of the production site.

As for Cleaner Production (CP), only several modernized factories, mainly from multinational enterprises, were observed to be endeavoring CP. Whereas in general, resource recovery and waste minimization *(in terms of visible wastes)* seemed to be well organized and practiced. However, present resource recovery and waste minimization were mainly accomplished by recuperation of resources from wastes, utilizing abundant and cheap labor forces (employees and recyclers). In future, when economic growth and rise in income level affects the availability of the low cost labor force, countermeasures regarding resource recovery and waste minimization will be a set of critical issues for industries. On the other hand, the timing and methods of treatment for "invisible" pollutants in effluent gas and waste water, as suspended and

dissolved solid will be another set of critical issues.

fc. Waste Water Treatment

Almost all the waste water from industries, without any treatment, together with domestic waste water infiltrates rivers of Mapocho, Zanjon de la Aguada or Maipo. The river water is utilized as irrigation water downstream. Among these rivers, Zanjon de la Aguada, the smallest and receiving considerable amount of untreated industrial waste water, seems heavily contaminated with industrial waste water. It is distressing that contamination (with some hazardous substances) of agricultural lands which receive irrigation water from Zanjon de la Aguada is intensifying. Water quality should be urgently checked and whether and how soon regulations for industrial waste water discharge should be established shall be examined. Zanjon de la Aguada merges with Mapocho which converges with Maipo. The river water is used not only for irrigation but also for potable water down stream. Some data of raw water at the potable water treatment plant of Agua-quinta serving San Antonio (located most downstream of Maipo) does not indicate serious deterioration of water quality. It could be deemed due to the large volume of water leading to natural dilution of pollutants.

fd. ISW Generated in the Mining Industries

As for the mining industries (CIIU code 21001 to 29090), there are several in the MR and they produce considerable amount of ISW. However, all of generated ISW in the mining industries are disposed of at their own landfills at present and in future (i.e. closed system). Therefore, ISW generated in mining industries are excluded from the estimation of ISW generation.

3.1.2 Public Opinion Survey

a. Objective of the Survey

The objective of the public opinion survey (POS) is to identify:

i. the awareness and intention of citizens on environmental protection, which includes:

- inclination to use environmentally friendly products (e.g. willingness to pay for environmentally friendly products with higher prices than conventional products);

- impression of enterprises which produce environmentally friendly products; and
- roles and duties of governmental authorities, industries and citizens for environmental protection.

ii. the awareness and possible reaction of citizens to the construction of treatment and disposal facilities for industrial/medical solid waste, which include:

- awareness of the necessity of facilities;
- conditioning for proceeding to construction of facilities;
- citizens' reaction regarding procedures and construction; and
- prerequisite for neighborhood consensus for construction of facilities (e.g. transparency in procedures, completeness of environmental protection measures of facilities, consolidation of local infrastructure as compensation. etc.).

b. Selection of the Samples for POS

ba. Target Citizens and Area for POS

Since the mass can not answer questionnaires to be prepared for the objectives mentioned above, this was discussed with the Chilean side at the meetings of the Inception Report. It was agreed at the meeting that the target citizens and areas for the "Public Opinion Survey" were to be selected from the following groups:

- Environmental NGOs;
- University students;
- Governmental officials and politicians;
- Citizens who live nearby the present municipal landfills (i.e. Lo Errazuriz, Cerros de Renca and Lepanto) according to the distance from the landfill sites; and
- Citizens who live nearby the candidate municipal landfills (i.e. Batuco and Runge).

bb. Time Schedule of the POS

Based on the above-mentioned target citizens and areas, a questionnaire was prepared by the Team. The content of questionnaire was discussed with counterpart personnel and finalized, then the survey work was consigned to a local consultant (Adimark

Ltda.) through a tendering procedure. The work was completed in the beginning of May 1995. The reports were prepared both in English and Spanish. The reports produced by Adimark were submitted to the counterpart.

bc. Sample Interviewed

The final samples interviewed are categorized into i. Homes and ii. Institutions. As for Homes, citizens, 18 years and over, living nearby the present municipal landfills (Lo Errázuriz, Cerros de Renca and Lepanto) and the candidate municipal landfills (Batuco and Rungue) were selected at random.

In terms of Institutions, people with responsibilities in the following institutions were interviewed.

- NGOs: NGOs related to environmental issues.
- Students: 6 in each of the following universities: Chile, Católica, Santiago, Diego Portales, Blas Cañas y La Republica.
- Politicians: Belonging to the various existing parties; a representative sample was taken.
- Central Gov.: Officials in the different ministries and dependent institutions.
- Local Gov.: Officials in the different municipalities.

Finally, the samples shown in Table 3.1.2a were interviewed.

Table 3.1.2a Samples for POS

Category of Sample		Number of Samples
Home	Lo Errázuriz	31
	Cerros de Renca	31
	Lepanto	31
	Batuco	30
	Rungue	31
Sub Total		154
Institutions	NGOs	30
	Students	30
	Central Gov.	31
	Local Gov.	30
	Politicians	33
Sub Total		154
TOTAL		308

c. Findings

Before giving the main findings of the survey, it is important to keep in mind the type of sample chosen: people living next to present landfills, people living in candidate landfill sites, and people belonging to different institutions, some of them very related to environmental issues. This is essential, in order to make a correct analysis of the results.

ca. General Perception

The people interviewed say that the problems that most affect their daily life, are: lack of green areas, lack of environmental education, air pollution and waste. For the people belonging to institutions, the main problems are air pollution and lack of environmental education, while the people living next to the present landfills and candidate landfills, consider as their biggest problem the lack of green areas and waste. It is surely an interesting finding that the high importance placed on environmental education.

When asked about the ones responsible for the existence of these various problems, the municipalities are mentioned as the ones most responsible, specially as regards to waste, insects, inundations, and lack of green areas. The traffic/ transport is thought to be most responsible for air pollution and noise, the industries for water pollution, and the government for the lack of environmental education.

As far as the solution of the different problems is concerned, the interviewees thought that the government and the municipalities have to cope with all of them except noise, which has to be solved by the polluters themselves, the traffic. It is clear that the majority believe that the authorities have to cope with the various problems, but not so much the citizens themselves. Of course, the interviewees belonging to governmental institutions show more inclination towards community responsibility and citizens participation in the solutions.

cb. Environmentally Conscious Products

The knowledge about environmentally conscious products is quite good among the institutions, most of them being highly educated, but in the homes interviewed there is a lack of consciousness, as regards to the existence of these sort of products and companies which produce them. There seems to be a big gap between what people know and what they actually do in their daily lives, since very few, also among the institutions, buy environmentally conscious products.

There is not a great enthusiasm about these products, since they are more expensive and the people are generally not willing to pay extra. Many also feel that these are not really environmentally conscious products. Nonetheless the majority believe that the companies which produce these products, are correct companies and should be imitated, but quite a few say that these companies gain profits and use environmental issues as a tactic to develop their business, selling more. There is definitely a lack of confidence in the existing environmental products and in the companies which produce them.

The information about beer consumption, reveal that in Chile the majority buy bottled beer, specially because it is cheaper and more in quantity. Some also say that bottled beer is more environmentally friendly and the bottles can be reused. As regards soft drinks, in Chile practically only plastic bottled drinks exist, thus the great majority simply consume them because of this reason. The detergents mostly used are conventional phosphate ones. This is partly due to the fact that only a small number know the difference between no-phosphate and phosphate detergents, especially in the homes interviewed.

In general, there is a great lack of environmental consciousness among the people interviewed, in terms of knowledge and of daily practice. The group with the best knowledge are the NGO'S, since the ones chosen to be interviewed work very closely to environmental issues.

As a conclusion, a lot of education is required, in order to achieve a greater environmental consciousness.

cc. Public Co-operation

It is interesting to see that people are very willing to co-operate in a municipality waste separation system, if a neighborhood association would organize a collection system, in maintaining a clean city, because they think that public co-operation is essential in solving the waste problem. One can conclude that the attitude towards recycling is very positive, although people don't know much about it.

It is important to mention that the people living in Batuco and Rungue (potential landfill sites) show greater awareness than the ones living next the present landfills, which is probably due to the fact that there has been a lot of movement within the last year (meetings, organization, talks) in the candidate areas.

Most of the interviewed think that the public education (campaigns) are necessary for maintaining a clean city. It is thought that the municipalities, the government and

the schools should principally take such action.

cd. Opinion about Industry and Hospital Waste

It is strongly felt, that industry and hospital waste create environmental problems for the country, and that this waste type is a risk for the workers in the treatment/disposal facilities.

In general, there is an agreement that the industries should introduce treatment facilities, and this should be promoted by the government. It is thought that the two most efficient policies would be: reinforcement of regulations and legislation standards, and incentives to move outside the metropolitan area. It is concluded that the people prefer the imposing solutions: laws and rules, and control.

The homes interviewed assign more importance than the institutions to the problems created by these waste types. Residents think that industries should treat all their waste as hazardous and apply high security standards, while the institutions affirm that the industries should separate hazardous and non hazardous waste.

ce. Reaction on Waste Treatment/Disposal Facilities

The answers given to questions related to treatment facilities, shows that people seem to have a certain confusion, not knowing what one is actually talking about when referring to this concept, since they only know about the present landfills. When talking about waste treatment facilities, people think , in the first place about recycling, and then about landfills, incineration and composting. Recycling plants are best accepted, followed by a biological plant. People would be most willing to accept them in their area.

But in general, the reaction of people towards a possible construction of a treatment/disposal facility near their home, is very negative, since the majority (54.5%) express a strong objection without exception. The objection is very high in the homes interviewed, specially those living near the candidate landfills, i.e. Batuco and Runge 76.7% and 87.1% respectively. Constructing a treatment facility further from their home, but rather in the commune, without any negative impact, is better accepted, but there is still a high percentage of rejection.

The main reasons of objection are related to the deterioration of the quality of life, caused by the presence of a treatment/disposal facility: pollution of the environment, infections, bad smell, flies, rats, insects. These answers are mainly based on the present experience with the landfills. And people do not easily believe in promises and

technological solutions, because their experience has been negative in these aspects.

Thus it will not be easy to convince people that the promises made are kept and effectively, a treatment/disposal facility will not cause a major environmental impact. This is definitely one of the biggest obstacles.

Those (25.4%) who would accept the construction of a treatment facility in their area under certain conditions (which is an important percentage), mention: taking the necessary security measures and being quite distant from their home.

When we presented a list of possible measures that can be taken, people say that the most important ones would be: previous survey about site aptitude and impact assessment, and in depth clarification of the facilities construction procedures. Great importance is also given to: clarification of responsible party in case of pollution, reliability of technology and financial ability of facilities operation sector, contract about suspension of operation in case of breach of agreement. It can also be concluded that a compensation system is not seen as very important.

cf. Final Conclusions

Finally, it is concluded that people are very against the construction of waste treatment/disposal facilities in their residence area, because they are very aware of the negative influences, these places have in the quality of life. This is supported by the fact that the people with a strong rejection to the facilities were asked under what conditions they would accept the construction of facilities and that a very high number (49.1% in total and 61.3% of residents) insisted that they would never accept the facilities. They are against, but they are not capable of proposing any reasonable solution either, the only thing they propose is that they are built as far away from where people live.

d. Follow-up Research of the POS

da. Background, Objectives and Methodologies of Follow-up Research

i. Background

It is found as an outcome of the POS that majority of interviewees who live near candidate sites and present sites of municipal landfill showed "objection without exception and/or strong objection" against construction of SW treatment/disposal facilities in their community, i.e.:

- 68.8% showed strong objection to the construction in their neighborhood,
- 49.4% showed strong objection to the construction in their community but which is quite far away from their residence.

Furthermore surprisingly, objection to construction of incineration facilities surpassed the objection to construction of a sanitary landfill. Previous surveys conducted by the Chilean side also revealed similar public reactions.

ii. Objectives and methods

In order to investigate and understand "true reasons" deeply-rooted in the people's "strong rejection without exception" and in order to seek keys to the solution (i.e. prerequisite for neighborhood consensus), the "Follow-up Research of the POS" was programmed.

A sociological approach was employed in the following researches to seek "true reasons" of the objections: i.e., free discussion of more or less 8 persons who strongly objected in the questionnaire, moderated by a neutral chairperson.

Session-1: Assemblies for "people living near the present landfills (Lo Errazuriz, Renca, Lepanto)"

After the free discussion, "video footage of an incineration plant in Japan" was shown to the participants. Dr. Arellano, as an expert in SWM, participated in explaining the video and facilities and answered related questions from the participants. Free discussions were held after seeing the video.

Session-2: Assemblies for "people living near the candidate landfills (Runge, Batuco)"

After the free discussion, the participants visited an illegal un-controlled dumping site and a legal controlled landfill (e.g. Lo Errazuriz). Dr. Arellano, as an expert in SWM, participated in the visit and explained about facilities and answered related questions posed by the participants. Free discussions were held after the visit.

db. Outcome of the Follow-up Research

The main objections expressed by the people in the follow-up research can be categorized into two in general, i.e., "objection related to the procedures" and "objection related to the adverse impacts (of landfill projects)".

i. Objection to the communication procedures

The people involved suffer a strong feeling of social exclusion that marks their rationale at the time of evaluating this kind of subjects: "As we are the waste of society, it does not matter to the authorities that we live near waste". For this reason, the issues of institutional transparency and popular participation deserve very sensible and special care.

The group sessions clearly revealed the people's resentments, all of which are addressed to the authorities:

- Lack of direct/official spokesmen
- Evasion of responsibility
- Lack of social participation
- Lack of transparency and honesty

The steps that summarize the institutional procedure requested by the people are these:

- Identify all institutions involved
- Involve the community through all its representative organizations
- Debate and reach an agreement ("contract") on the responsibilities and commitments of all parts

One further consideration must be noted. It is widely accepted that rumors on such sensitive issues must be avoided: they quickly evolve into misconceptions that make people's disposition difficult to overturn.

ii. Objection to the adverse impacts of the projects

The idea of people objecting to the location of a final disposal/treatment site near their homes is not in itself revealing. The importance lies in understanding how their fear and concern towards such situation are manifested and which perceptions are the main sources of objection towards these type of facilities. In this regard, the group sessions provided valuable results that identified the

following as the main concerns associated to the proximity to final disposal/treatment sites:

- Health

Cause of illnesses and headaches; the perception that waste is not treated but simply dumped contributes to strengthen this concern.

- Living standard

The visual effects, pests and bad smell all contribute to lower the standard of living.

- Safety

The gas issue conveys a strong sense of fear and safety concern; it was revealed as one of the main anxieties.

- Delinquency

Fear exists that migration of scavengers will bring about higher crime rates.

- Nuisance caused by increasing traffic

It is expected that a large number of trucks will transit the area creating a serious dust problem, etc..

It is important to point out that, in many cases, all the listed concerns were directly or indirectly linked to the children and measured on the basis of the effects they would have to suffer. Another interesting observation was that, even though people agreed that final disposal/treatment facilities should be built as far as possible from the city, fear existed that such remote location from news and opinion centers would eliminate the authorities' incentive to provide appropriate safety conditions.

More specific actions to be implemented by the authorities' as mitigation measures were suggested by the participants themselves:

- waste should be processed and efforts should be made to exploit all its recycling possibilities;
- adequate investment should be made for the safety measures surrounding the operation of the facilities; and
- the chosen comuna should receive some degree of economic compensation as well as other indirect benefits resulting from the facility.

dc. Conclusions

As for keys for solutions with regard to "neighborhood consensus", POS and Follow-up Research at least suggested that the following three aspects (namely: **improvement of communication, sufficient environmental protection and fulfillment of the agreement (exchanged between promoting sector and neighbor) to be secured by authorities)** should be taken into consideration both for private sectors' preparing projects and for authorities' permission procedures.

i. Improvement of communication

Poor communication in the past of both public authorities and SWM promoting sectors towards neighborhood community (such as, lack of public hearing, project implementation without notification, broken promises', information concealment, etc.) worsened the situation and induced stronger objections by neighbors.

Meanwhile, since neither information were disclosed nor advance campaigns conducted, there are quite a few objections which are mainly based upon their prejudice and mis-conception. It is found that most objections against "incineration facilities" were based upon the prejudice that "incineration means source of smog". Therefore, it is observed that sufficient campaigns and education by promoting sectors are indispensable for establishing "neighborhood consensus" for construction of SWM facilities.

Since the reason why they make "objection without exception and/or strong objection" are considerably attributable to poor and insufficient communication in the past; it is needless to say that improvement of communication is indispensable as one of main prerequisites for the formulation of neighborhood consensus.

ii. Sufficient environmental protection

Although communication is substantially improved, people's fear and anxiety regarding environmental deterioration to be caused by SWM facilities can not be eliminated. In this regard:

- authorities, at the time of a project EIA appraisal, should examine at length whether environmental protection measures proposed in a project is sufficient or not;
- a promoting sector should be obligated to hold public hearings,

explain their environmental protection measures to the public fully, and review and/or improve their protection measures reflecting neighbor's opinions;

- authorities, in case where necessary, should call an advisory committee of independent and neutral experts to further examine sufficiency of environmental protection measures; and
- as preconditions of ISWM facilities' planning permission and operation permission, the promoting sector should be obligated to reach an agreement with neighbors regarding environmental protection measures promised by them.

iii. Fulfillment of the agreement (exchanged by promoting sector and neighbor) to be secured by authorities

Although sufficient environmental protection measures are presented in the planning stage by a promoting sector, neighbors are doubtful and worried whether actual ISWM facilities to be constructed fully comply with what was proposed at the planning stage and whether proposed protection measures will actually be taken place or not. Neighborhood consensus can not be realized without removing neighbors' doubt and worries. For this purpose, the authority should establish a system to ensure that promoting sector complies with the environmental protection measures proposed. Namely, the authority needs to strengthen monitoring and administrative guidance capabilities including on-site inspections to secure the agreement.

It is suggested in practices of authorities' administrative measures that it should be obligated that promoting sector contract environmental risk insurances and/or funds to provide for contingencies such as accidents.

3.1.3 Survey to Private SWM Enterprises

a. Objectives of the Survey

In order to understand the actual status of ISWM, a survey was conducted to the private SWM enterprises that are presently registered in the manifest system data base. Upon examining the data presently available regarding the waste amount discharged by the 510 factories, several equivocal points were observed which are now described:

- according to the information from producers, there are many other

destinations than the present municipal landfills, which should be examined.
- there are also many final destinations for waste subject to recycling.
- there are 12 landfills registered in the manifest system. However, only 7 of them reported amount of waste received.
- there is substantial disparity between the amount of waste reported by producers and that from final receivers.

The survey aimed at clearing these questions and at providing further insight into the actual waste flow after generation at the industries.

b. Number of Samples

A total of 59 samples were executed for this survey. The survey samples were distributed in the following manner among the three types of private enterprises registered in the manifest system:

- transporters: 21 samples
- landfill sites: 12 samples
- recyclers: 25 samples

Three different types of survey sheets (one for each category) were designed in order to accurately target the questions and organize the information received.

c. Major Findings

The following opinions and facts were obtained through the interview/reconnaissance surveys.

ca. Survey to Solid Waste Transportation Enterprises

i. Quantitative analysis

The gathered numbers of "capital" and "number of employees" describe an average profile of 477 million pesos in capital and 169 employees. This figure, however, is a misrepresentative as few transporters fall under the "middle size" category: the top 4 transporters have over 800 million pesos in capital, while the bottom 4 have less than 40 million pesos. At the same time, the market share is even further polarized with the top 4 companies sharing 95% of the total annual

sales. It is therefore clear that competition takes place at two different levels, that is, at both extremes of the company size scale.

With regard to this financial data, it is unavoidable to notice a 33% rate of unwillingness to provide the requested information, even when interviewees were always assured full confidentiality. Such caution may be explained by a highly competitive market where information is regarded as very valuable or by the existence of unauthorized activities (e.g. illegal dumping) which require certain degree of concealment. As the mentioned 33% of transporters belong to the "small size" category, where competition is stronger, a combination of both seems to be the appropriate interpretation.

A total of 20,298 ton/month of ISW is collected by transporters and the figure accounts for only 16.2 % of total waste collected by the transporters surveyed (see Table F.2d of Annex F). According to the ISW flow identified by the Team through the factory surveys, the amount of ISW disposed of at the municipal landfills is 20,348 ton/month (see Figure 3.4.4a). The figure (20,298 ton/month) informed by the transporters corresponds to the ISW flow estimated by the Team.

ii. Qualitative analysis

The lack of appropriately trained and knowledgeable personnel that could carry out monitoring activities was pointed out as a major flaw of the environmental authorities. At the same level of importance, transporters referred to the need for a more severe enforcement in general, and specifically in the implementation of the manifest system. The system is perceived as an unfinished policy for which insufficient effort is made to enforce compliance from the industries. Also, more is expected from the environmental authorities regarding its advisory and educating role.

The subject of illegal dumping was inevitably addressed and the following were proposed as means to prevent its occurrence:

- implement a more stringent enforcement over waste generators;
- devote more human resources towards controlling final disposal practices (both inspectors and police).

cb. Survey to Solid Waste Landfills

i. Quantitative analysis

The most noteworthy figure is the long-standing existence of most unauthorized sites, ranging from 5 to 21 years into the past. The establishment of some of this sites, therefore, dates back to a period where no authorized landfills existed. However, the appearance of unauthorized landfills continued well into the late '80s, even when the first final disposal site (Cerros de Renca) had been inaugurated for more than a decade.

Regarding disposed quantities the total of 170,000 ton/month are received by authorized landfills including 17,870 ton/month of ISW, which again roughly reconciles the figure found from the survey to transporters (20,298 ton/month) with relation to this type of waste. Finally the declared tipping fees range from 1,051 Peso/ton to 6,000 Peso/ton (see Table F.3d of Annex F).

ii. Qualitative analysis

From the visits to all three authorized landfills a critical piece of data was obtained. As a result of the closing down of two of these landfills, an increase in final disposal fees is envisaged in the near future due to the distant location of the new landfill. The implications of this are of key importance as industries will then have a renewed incentive for engaging in illegal dumping.

The expected future scenario acquires even further relevance when we consider the present situation regarding unauthorized landfills: in many cases their existence was due to the unwillingness or inability to bear the disposal costs of the authorized landfills. Furthermore, indulgence or impotence on the government side also accounts for the prevalence of such unacceptable sites.

Upon the visits to the unauthorized landfills it was observed that almost 50% of them entailed some kind of recycling activity. This provided a valuable insight regarding the informal conditions under which many recycling activities are still carried out.

cc. Survey to Solid Waste Recyclers

i. Quantitative analysis

Individual Collectors :

As the initial recycling stage, where collection takes place at an informal level, the figures for individual collectors are correspondingly small: 1.3 million pesos of average annual sales and on average 2.06 ton/month collected. Furthermore, collectors have been on the business for an average of 9.83 years and use tricycles as the main equipment for transporting the waste, which they find mainly on the street.

Middlemen :
Although middlemen are almost as old participants as individual collectors (8.6 years in average), their role as measured by average annual sales and number of employees is much more significant: 216.25 million pesos and 12 persons. This is also reflected in the type and number of equipment owned, where the light tricycles have now become trucks, containers and vans.

Final Users :
At this stage, average annual sales have grown to 756.75 million pesos with 178 employees on average providing for such large business volume. The year of establishment of some final users is surprising as most of their recycling activities can be traced back to 1960. Final users obtain their recyclable materials overwhelmingly from factories and middlemen. In all, we are dealing with volumes that must justify the significant investment in fixed equipment required by this stage of recycling.

ii. Qualitative analysis

It must be noted that the CDSI database entries corresponding to recyclers do not provide specific information identifying the recycler to which the waste is entrusted. The sample was therefore selected on the basis of personal knowledge by the counterpart, and it included individual collectors, middlemen and final users as the three participants involved in the waste recycling flow.

The significance of individual collectors lies in the large number of them currently existing, rather than in their quantitative contribution towards the total amount of waste collected for recycling. As is the case with smaller middlemen, individual collectors are expected to become marginal participants in the waste recycling flow. On the other hand, larger middlemen are fulfilling important tasks such as education campaigns and human resources investments to obtain uncontaminated recyclable materials. Both of these strategies avoid the generation of additional waste from separation procedures.

The most relevant finding in the survey to final users, it was observed that

factories are clearly their main source of recyclable materials (except for the paper and cardboard sector). This is proof that industrial consciousness and organization towards recycling are becoming increasingly important.

3.1.4 Other Field Surveys

a. Field Survey on Industrial/medical SWM in Brazil

Since Brazil is one of the most industrialized countries in Latin America, certain advanced industrial/medical SWM have been established. In order to examine the applicability of their management and/or systems to Chile, a field survey on industrial/medical SWM in Brazil was conducted.

aa. Actual Condition of Industrial/medical SWM in Brazil

The actual conditions of industrial/medical SWM in Brazil which are included G.1 in Annex G are outlined as follows:

i. Industrial/medical SWM in Brazil which contains:

- hierarchy of the government policies;
- important federal regulations;
- nationally recommended standards selected from ABNT (National Association for Technical Standards); and
- Industrial and medical SWM in Brazil - a general view.

ii. Industrial and medical SWM in the State of Sao Paulo that describes:

- general information;
- ISW generation in Sao Paulo;
- ISW control program; and
- medical SWM.

iii. Industrial SWM in the State of Rio de Janeiro that includes:

- general information; and
- selected aspects of related documents.

ab. Cost of Industrial/medical SW Treatment/disposal in Brazil

There are no special facilities and/or sites for industrial/medical SW treatment/disposal in the MR at present moment. In this regard, the following treatment/disposal costs in Brazil were investigated in order to present a reference for tipping fees to be charged in the MR when facilities and/or sites for industrial/medical SW treatment/disposal are established in future.

Table 3.1.4a Cost of industrial/medical SW treatment/disposal in the Sao Paulo state

Treatment/Disposal Facilities	Category of Waste	Treatment/ Disposal Cost	Remarks
ECOSISTEMA Disposal Site	Hazardous Waste	US$ 140/Ton	Including transportation cost of 50 km
	Non-hazardous Waste	US$ 16-20/Ton	Including transportation cost of 50 km
San Jose Campos Medical Waste Incinerator	Medical Waste	US$ 1,500/Ton	Including collection and transportation cost
San Jose Campos Municipal Landfill	Municipal SW	US$ 27/Ton	Collection/transportation costs (US$ 17/ton) are not included
	Industrial SW	US$ 38/Ton	Collection/transportation costs are not included

b. Regulations on Localization of Facilities for SW Treatment/disposal

ba. Background

Of special interest for the Study are the provisions included in the Metropolitan Regulatory Plan regarding "Sanitary Infrastructure" (Title 7, Chapter 2), and specifically those regarding "Final Disposal of Solid Waste". These provisions require that final disposal facilities of ISW include, within their premises, a minimum buffer zone of 600m to the neighboring land. In view of such stringent requirement, the Counterpart requested the Study Team to provide information on similar regulations in other countries (e.g. Japan and Denmark). Such regulations are then summarized in the following section.

bb. Japan

Although the City Planning Law in Japan regulates areas where final disposal sites are not allowed to be located (i.e. residential areas, etc.), for where such localization is allowed there is no specific legislative regulation which specifies e.g. mininum distance from houses to facilities.

However, the local authority which has the power of granting permission for localization and construction of ISW treatment/disposal facilities; i.e. prefectural governors establish related regulations (e.g. minimum percentage of green area to be retained in the project area, buffer distance to the adjacent areas, etc.) respectively (by each prefecture), and require ISWM sectors to refer and reflect those requirements into their proposals. In effect, proposals which do not meet these requirements will not receive permit for localization and/or construction.

Among those requirements in regulations that Japanese prefectural governors require, following requisites might be in similar nature, as that which the Chilean authority requires:

- "Percentage of green area in the project area": In general, **25% to 40% of the project area** (except area occupied by facilities) **should be maintained as a green area.** Where the green area does not exist originally, afforestation is necessary.
- "Buffer distance": It defines the distance from the ISWM facilities themselves to the periphery of the project area. In general it requires a few tens of meters. **50 meters might be the maximum required in Japan.**

Apart from the above-mentioned requirements, local governments generally require the ISWM sector to include attainment of neighborhood consensus (of about 70% to 100%) from habitants in 100 meters to 500 meter distance in his proposal. As a consequence of difficulties in obtaining neighborhood consensus, ISWM sectors generally select less populated area as their facility candidate site. In effect, majority of ISWM facilities are located in less populated area.

On the other hand, since municipalities are responsible for domestic SWM, domestic SWM facilities located in populated area are quite common in Japan.

bc. Denmark

In Denmark the procedures for localization and the localization requirements are the same whether they deal with a treatment or a disposal facility. There are two

procedures: The Physical Planning procedures and the procedures related to EIA/Environmental Permits.

i. Physical planning procedures

No treatment or disposal facility can be established without a proper planning procedure, which involves Regional Planning and Municipal and Local Planning.

Draft plans of all three types are made public and the population may comment on them in an 8-week period, but there is no tie on the Regional or Local Governments as to comply with the observations made by individuals or interest groups.

It should be noted that no planning document dealing with a waste treatment or disposal facility will have provisions related to the minimum distance to other activities, for example that there must be a buffer zone around a proposed landfill site. In practice there will, however, be limitations, as no one will think of building houses or conduct other sensitive activities close to a planned landfill.

In day-to-day administration waste incineration plants will normally be located in areas for heavy industry, but relatively close to the populated areas to make good account of the generated energy (like power plants). Waste transfer stations may be located similarly for practical reasons, but not in odor-sensitive surroundings. Landfills and composting plants will be located in open land as far from housing as possible to avoid public nuisances, mainly noise and odor problems.

ii. Environmental impact assessment/environmental permit procedure

In the EIA/EA documents the applicant must make a full statement of plant localization, planned production/operation, expected emissions, emission reduction measures, expected environmental impact, and initiatives to reduce impact from dangerous operations.

For landfills the requirements related to localization will normally be:

- Access roads. These should not take the traffic through small villages on small roads. In some cases the landfill owner has been requested to build a new access road.
- Noise level. The landfill owner will normally have to construct sound-absorbing banks around the site. If the noise level at the

nearest residents cannot be reduced sufficiently - but the location is otherwise suitable - the landfill owner may have to buy the houses.

- Odors and rodent/bird control. This is normally done through requirements related to cleanliness and daily cover of the waste, and rat extermination if necessary.

It should be noted that there are no requirements as to neighborhood concession. Neighbors dissatisfied with the landfill may complain to the Ministry of the Environment which may alter the decision of the Regional Authority.

There is legislative background for public acquisition of privately owned land if necessary for the construction of a waste treatment and disposal facility. This option is often applied.

c. Leachate Quality Survey

ca. Background of the Leachate Quality Survey

Responding to the request of the Chilean side to the Study Team to examine whether hazardous materials are disposed in the municipal landfills or not, expressed at the Meeting of the Progress Report Explanation held from 10th to 14th March 1995, the Team conducted "The Leachate Quality Survey" in June 1995.

cb. Results of the Laboratory Analysis

Results of the laboratory analysis are shown in Table 3.1.4b.

Table 3.1.4b Comparison of Laboratory Analysis Data and Maximum Permissible Concentration

		Result of Survey (mean value)			Chile	
		Lepanto	Renca	Lo Errazuriz	CMP by MOH	STD** NCh 2280
pH		6.7	8.1	8.1	-	5.5 to 9.0
Temp.	C	17.3	16.1	18.8	-	35.0
BOD	mg/l	44,667	2,367	4,867	-	300
COD	mg/l	67,467	4,750	8,100	-	-
Cl	mg/l	3,563	4,217	3,990	-	
SO4	mg/l	1,127	82	57	-	1,000
T-KN	mg/l	1,598	930	2,310	-	(T-N) 80
Hazardous Substances						
CN	mg/l	ND	0.06	ND	20.00	1.00
Pb	mg/l	0.66	0.30	0.58	5.00	1.00
As	mg/l	0.033	0.014	0.022	5.000	0.500
Cd	mg/l	0.05	0.01	0.04	-	0.50
Cr+6	mg/l	0.30	0.27	1.09	(Cr) 5.0	0.50
Hg	mg/l	0.001	0.001	0.001	0.100	0.020
Cu	mg/l	0.52	0.06	0.44	100.00	3.00
Zn	mg/l	1.88	0.17	1.24	5.00	5.00

Note: CAMP* : Maximum Permissible Concentration (CAMP) for the application of the Leachate Toxicity Test.

STD**: Maximum limits for industrial liquid waste discharges into the public system of waste water collection.

cc. Conclusions

As far as the outcome of the laboratory data of this Leachate Quality Survey implies, the following may be concluded:

- ISW is possibly disposed in all 3 landfills. (The Team's factory survey also received information that quite a few factories send their ISW to those present municipal landfills.)
- Since concentration values of hazardous substances are relatively high compared to foreign examples, it might be evident that hazardous substances are included in the SW disposed in those landfills. It can not be concluded that those hazardous substances are solely attributed to ISW. Since the possibility of a significant amount of hazardous substances is included in municipal SW is small, it might be assumed that it is attributed

mainly to ISW disposed.

- Although hazardous substances are included in SW disposed in those 3 landfills, whose concentration do not exceed limits of maximum permissible concentration (CAMP) for the application of the Leachate Toxicity Test drafted by the Ministry of Health in Chile.
- Since those data of 3 landfills' leachate exceed "maximum limits for industrial liquid waste discharges into the public system of waste water collection" (draft) to be normalized as Standard NCH 2280, the leachate can not be discharged to the sewage line without treatment.

Meanwhile, as a matter of disposal site control after the operation of landfilling, it is important to maintain a weak alkaline condition (pH 8-10) inside the SW layers in landfill sites in order to restrain elution of heavy metals into leachate.

In this regard, the following measures are necessary:

- Clayey materials should be applied for final covering layer of landfills in order to maintain the anaerobic conditions inside the SW layers of the site.
- Re-excavation of disposal sites after the operation of landfilling should be refrained in order to shut the oxygen supply into SW layers of the site.
- Periodical sampling and laboratory analysis should at least be maintained in order to monitor the situation of decomposition inside the SW layers of the site.

d. Comments on the Regulations for the Sanitary Management of Hazardous Solid Waste (First Working Draft)

da. Background

"Regulations for the Sanitary Management of Hazardous Solid Waste - First Working Draft" was produced by the Department for Environmental Programs, Health Programs Division, Ministry of Health, Republic of Chile. The regulations consist of the following articles:

- General dispositions (Article 1-10)
- Production and internal storage (Article 11-20)
- Transportation of hazardous waste (Article 21-26)
- Security landfills (Article 27-40)
- Incineration of hazardous waste (Article 41-44)
- Declaration system and monitoring of hazardous waste (Article 45-53)

Responding to the Chilean counterpart's request for comments for this document, the Team summarized their comments and opinions as follows through integrating Team member's national/international experiences and comments from the JICA Advisory Committee.

db. Comments and Recommendations

The document reveals the intention to innovate or consolidate and generalize on a comprehensive national scale, various normative and legislative acts of the Ministry of Health. The intention is opportune and salutary. Hopefully it would expand, to the inclusion of normative and legislative acts from other Ministries about the same topic - which would result in greater clarity and effectiveness for all.

The mixed character of the document, legal and technical-normative, results in reduced effectiveness as far as obligations, deadlines and penalties are concerned, since it is detailed and too extensive as a "regulation" but sometimes too insufficient as a "technical norm." It must be considered that legal acts have a "conservative" (long-term) character, while technical norms are continually being actualized (medium-term). That is why it is undesirable that they are included in one same document.

The classification of hazardous waste (hereinafter HW) drafted by the Ministry of Health (hereinafter MS) in the document is basically corresponding to the classification adopted in the Bazel Convention. It is fairly understandable that a developing country employs it for its administration of HW. However, D.S. (Supreme Decree) No. 745/92 of the Ministry of Health uses the generic denomination "hazardous industrial waste" that includes solids, semi-solids, (semi-liquids) and liquids. It is recommendable to retain the term liquid waste because there are many hazardous wastes in liquid state.

It may be practical to adopt the methods of US-EPA as analytical standards for Chile under the present circumstances. Consolidation of analytical capacity is essential for Chile to manage HW. It may be recommended that the Chilean side should make most of CENMA (National Environment Center Project by JICA) to consolidate analytical capacity nationwide.

The overall aim of establishing a declaration system for the whole waste cycle is strongly supported. A Standard Declaration Document for general use in Chile should be developed as an integral part of the regulation.

The declaration system may be supplemented by a labelling system for the waste, to be applied in parallel to the Declaration Documents. The purpose of this would be to have an effective tool for action in emergency situations (accidents) and to secure the

proper treatment/disposal as foreseen in the Declaration Document.

The specific technical standards in the chapters regarding landfill construction and waste incineration should be limited to a description of issues to be considered by the authorities in each case of a plant construction.

It is further recommended that there should be specialist working groups established regarding these topics. These groups should have as their task to establish technical guidelines in relation to landfilling and waste incineration. In doing so, the working groups should take into consideration international conventions/agreements of which Chile is a signatory nation as well as the intrinsic conditions of hazardous waste management in Chile and the targeted level of environmental protection in the country. Besides, the guidelines should be developed with due consideration of the variation in requirements which should result from the variation in climate, land use, and population density in Chile.

As a conclusion, the edition of Regulations is recommendable, one which fixes obligations and penalties even more extensively than those in this document, and which establishes the legal bases for the administration of waste (and of its generators, transporters and receivers). Criteria and technical norms should be edited separately for each subject, progressively and in conformity with technical-administrative needs.

3.2 ISWM On-site (In-Factory)

Identification of the present condition of ISWM on-site is conducted based on the factory survey done by the Study Team for 199 ISW generators. Some results of the EWI's RISNOR Study is also incorporated.

3.2.1 Flue Gas and Waste Water Treatment

According to the Team's Factory survey, heat charging processes (HCP) such as boilers, furnaces, heating, incineration etc., are used by 82% (164) of the surveyed sample. From the sample of surveyed industries, 81% use water in its productive process. Flue gas treatment may be needed in factories with HCP while waste water treatment may be required in factories with watering processes (WP). Tables 3.2.1a and 3.2.1b show the results of the Team's factory survey.

Table 3.2.1a Present Flue Gas Treatment On-site

Industrial Category	Number of factories with HCP	Number of factories with FGT (existing)	Number of factories with FGT (planned)
Highly potential industry	75	30 (40%)	10 (13%)
Potential industry	68	24 (35%)	10 (15%)
Less potential industry	21	8 (38%)	5 (29%)
Total	164	62 (38%)	25 (15%)

About 38% of the factories having HCP are equipped with FGT (Flue Gas Treatment) and 15% have plans to install them. The remaining 47% neither have nor plan to install air emission control facilities at present. It indicates that a certain amount of dust and APC (air pollution control) products is emitted into the atmosphere without any pre-treatment.

Table 3.2.1b Present Conditions of Waste Water Treatment

Industrial category	Number of factories with WP	Number of factories with WWT (existing)	Number of factories with WWT (planned)
Highly potential industry	75	34 (45%)	14 (19%)
Potential industry	67	35 (52%)	20 (30%)
Less potential industry[1]	19	14 (74%)	10 (52%)
Total	161	83 (52%)	44 (27%)

Note : The reason why the sum of the number of factories with existing WWT and planned WWT exceeds the total number of factories with WP is that some of factories with no WP also have WWT or its plan.

Although the installation rate of the waste water treatment facilities is 52% (83 factories), only 5 factories generate C-3 (Inorganic sludge) and C-4 (Organic sludge) is produced by 21. The remaining 57 factories have only primary treatment facilities (e.g. simple ponds, screen, etc.) which do not generate sludge. Consequently the installation rate of waste water treatment facilities which generate sludge is 16% (26/161 x 100 = 16%). In addition, the Team's factory survey also indicated that 4.4% of the total generated waste are directly discharged into sewer or watercourse. For highly potential factories of generating hazardous wastes, the ratio reached as much as 12.4%. Such inappropriate practices may potentially increase the danger of water pollution. In-factory waste water treatment should be immediately enforced by establishing the related legal and regulatory frameworks. Moreover, it is also kept in mind that sludge handling will become another issue if waste water treatment is widely applied by factories.

3.2.2 In-factory Recycling of ISW

According to the result of the factory survey done by the Study Team, the ratio of in-factory recycling amount is approximately 10% (see Table C.5.1k of Annex C) of the total ISW generation of the 199 factories surveyed (however, according to the EWI's RISNOR study it was about 21% as shown in Table I.1.4b and I.1.4c of Annex I). According to the Team's survey in-factory recycling ratio is the highest in C-12 other liquid waste and C-24 other solid waste of 100%, which are followed by C-2 dust and APC products of about 70% and C-8 solvents and C-14 glass/ceramic wastes of 47%. However, it has to be taken into account that the Team concluded more than 50% in total (on-site and outside factories) of ISW generated are recycled at present based on the analysis of both the Team and EWI's RISNOR study (see Table 3.4.4a).

3.2.3 Treatment, Final Disposal and Long-term Storage On-site

a. In-factory Intermediate Treatment

In-factory intermediate treatment is one of the important parts of waste minimization by generators. According to the results of the Team's factory survey, most of ISW (82.6%) generated on-site are not treated. Among the treated ISW (17.4%), 10.1% of them are recycled on-site. Thus, only 7.3% of ISW generated are treated on-site (at generation). Popular treatment methods on-site are neutralization (2.8%), sorting (1.8%) and drying/evaporation (1.7%) in order and the other methods are negligible.

b. Final Disposal at Factory's Compound and/or its Property Land

According to the Team's survey results, only about 3% of the total generation amount is disposed of at factory's compound and/or its property. Such disposal is carried out by the factories of chemical, metal, non-metal mineral, and rubber products, and textile industries. As a whole, however, ISW final disposal on-site does not seem popular in MR.

c. Long-term Storage at Factory's Compound Awaiting External Treatment/disposal

Storage of ISW seems to be temporal for most of factories. According to the survey,

long-term storage is quite small (0.8%) and it can be found in small quantities in iron & steel, glass products', and metal products' factories. In future, however, storage facility will become necessary to temporarily store the increasing ISW generation (especially HW) mainly due to the installation of flue gas and waste treatment equipment in factories.

3.2.4 Consigned ISW Handling

The Team's factory survey indicates that a large amount of ISW generated is handled by the consigned ISW handling agents. The ratio of each consigned ISW handling to the total generation is given in Table 3.2.4a (see Table C.5.1q of Annex C).

Table 3.2.4a Ratio of Consigned Handling of ISW for Factories Sampled

Type of Industry	Consigned transport of ISW to municipal landfill	Consigned treatment and disposal of ISW (unknown treatment / disposal methods)	Reutilization by other parties (use at other factory's raw material, etc.)	Total consigned ISW handling
High Potential Industry	30.1%	9.4%	29.8%	69.3%
Potential Industry	32.4%	1.8%	53.8%	88.0%
Less Potential Industry	8.7%	1.1%	73.9%	83.7%
Total	22.6%	3.3%	56.2%	82.1%

3.2.5 Hazardous ISW Handling

Although the Team's survey targeted to investigate potential industries generating HW (i.e. more than 50% of targeted factories are estimated to use hazardous substances), answers to questionnaire saying they generate HW reached only 8 out of 199 interviewed. On the other hand, some interviewees answered without hesitation that they dispose of asbestos directly at municipal landfill site and some other answered that they practice to discharge waste acid, waste alkali, waste organic solvents directly into sewage line. It clearly indicates that factories consciousness regarding HW are very poor.

As for interviews regarding the organization of on-site management of hazardous substances and HW, great majority (80%) answered that they allocate responsible

manager for the control and they maintain distinct isolation (from other materials/ISW), marking and storage. On the other hand, 74% of factories interviewed answered that they do not have facilities on-site to treat HW.

49% of factories interviewed mentioned, with regard to problems of current HW control on-site, that they are in want of knowledge and information for identifying which ISW generated be HW. 45% mentioned that regulations and norms which specify what measures be taken for the control of HW are lacking in the present situation.

As implied above, for both waste generators and administrative authorities, on-site management of HW in the MR are just at a first step of their practices.

3.2.6 Other Findings from the Team's Factory Survey by Each Category of Industries

a. Highly Potential Hazardous Group

aa. Chemicals, insecticides and chemical fibers (3511 ~ 3513)

Neutralization of waste acid and alkali is applied in some of factories. But, mitigation of hazardous materials seems insufficient. Waste water treatment including chemical treatment of hazardous component is necessary for some factories.

Recycling of acid and other materials is advanced in some new and large industries.

An insecticides factory has a penetration well, in their premises, for disposing segregated hazardous liquid wastes. It should be stopped as soon as possible to avoid the groundwater and soil contamination.

ab. Paints, medicines, soaps and other chemical products (3521 ~3529)

Cleaner production including automatic filling and packing system is introduced in some of factories. Waste water is drained to municipal sewer, and a little quantity of plastics is sent to municipal landfill. Checking hazardousness of waste water should be required at each disposal point.

ac. Asphalt, rubber and plastic products (3540 ~ 3560)

Recycling of resources are highly performed in most of the observed factories. Some

of them are operating their original waste recovering appliances.

ad. Iron and steel industries (3710)

No blast furnaces are located in MR. There are some steelworks having electric furnaces to utilize steel ingot and scraps as raw materials, and hot strip mills producing steel shapes. Most of slags and inorganic sludges generated in these factories are utilized for paving in their premises first, and remainders are disposed through recyclers/transporters. Mostly they are sent to municipal landfill. However, some of them are observed to be disposed illegally to clay excavated holes for bricks, etc..

As for exhaust gas treatment, treatment of dust generated from electric furnace of the steel foundry visited should draw an attention of alert. Since the foundry smelts scrap steel contaminated with considerable amount of debris, ill working environment was observed. Immediate action should be taken for workers health.

ae. Metal products (3811 ~ 3819)

Waste acids and alkalis used for pickling are neutralized in some of factories. Zinc coating and lead coating by hot-dip method are applied. A metal products factory stated discharging CN included in inorganic sludge. 66.7% of metal scraps are recycled. 400 tons per month of inorganic chemicals are neutralized and disposed to public sewer. 143 tons per month of inorganic sludge is sent to municipal landfill.

b. Potential Hazardous Group

ba. Textile and leather industries (3211 ~ 3240)

There are many medium to small size old factories of these categories in densely populated areas. Most of them do not have any water treatment facilities for the waste water containing high BOD and SS load. The waste water is directly discharged to municipal sewer, like domestic waste water. If the regulation for industrial waste water disposal is strictly applied and the waste water is treated in these factories, considerable amount of organic sludge will be generated.

bb. Wood, paper and printing industries (3319, 3411 ~ 3420)

No virgin pulp producing factories from wood (having digesting and bleaching processes) are located in this region. However, there exist several factories that regenerate used papers and/or cartonboards, with pulpers, cleaners and de-inking

equipment. One older factory is discharging their waste water containing about 2,000ppm SS without any treatment to the river Maipo. One relatively newer factory discharges their treated waste water with 20ppm SS to the river Mapocho. These paper regeneration factories, having no waste water treatment facilities yet, will be the potential big generation sources of organic sludge.

Recycling and cleaner production system are partly applied in the downstream paper processing industries, such as carton box manufacturers, sanitary goods manufacturers, publishers, etc..

Recycle rate of waste paper in these industries group reaches high level of 85.7%.

A large scale used paper recycling company is effectively operating, having their branch offices at several locations in the region.

bc. Glass, non-metallic mineral products (3620, 3699)

Internal recycling is widely applied. 59% of waste glass is recycled within the industry.

bd. Gasoline filling station (6253)

Waste oil such as exchanged engine oil is taken out by recycler. Washing water of cars is drained after decanting. Sedimented sludge is sent to municipal landfill.

be. Laundries and dry cleaners (9520)

Washing water goes directly to municipal sewer. Dry cleaning sludge is sent to municipal landfill.

c. Less Potential Hazardous Group

ca. Food and Beverage manufacturing (311x, 313x)

No hazardous wastes are generated in these categories of industries. Modernization of production process, including cleaner production, automatic filling and packing, energy and resource saving, waste minimization, preparation of improved working environment, etc., is well achieved. 95.6% of waste food generated in these industries is recycled.

cb. Thermal electric power generation (4101)

Coal-firing 100MW steam turbine generator for peak shaving purpose is the only one power plant in the Metropolitan Region. Average operating time in these 5 years was only 915.3 hours per year (10.44%). Fuel conversion to gas is under planning. No possibility of becoming a big ISW generator is expected in future.

3.3 External ISWM (Outside of the Factories)

In order to identify the ISWM outside generation, factories' survey and survey on private enterprises were conducted by the Team. In addition, the Team examined EWI's RISNOR study.

3.3.1 Storage, Collection and Transportation

a. Storage

Source segregation is well established in general. Basically, wastes are separated in accordance with the following categories:

- waste to be recycled in the factory;
- waste to be reutilized outside the factory;
- ISW to be disposed of at municipal landfill;
- ISW to be consigned to private contractors; and
- municipal waste.

Generally, factories are well maintained with frequent cleaning. The wastes cleared up are transported from generation places to storage by carts and/or vehicles.

Specific storage areas are secured in factories; generally special yards are maintained for large factories and drums are used for smaller ones. The storage areas are maintained in good condition. According to the factories' survey, the rate of long-term storage at factory's compound awaiting external treatment/disposal is 0.8% of total generation amount. Thus, the amount of it is estimated at about 7,500 ton/year.

b. Collection and Transportation

Due to the difference of the questionnaire used in the two studies (i.e. JICA Factories' Survey and EWI's RISNOR Study) the rate of collection/transportation obtained by the studies is quite different. However, it is concluded that more than 25% of ISW generated, i.e. 240,000 ton/year, are collected, transported and disposed of at the municipal landfills.

On the other hand, most transporters registered in the manifest system, except for factories' own transporters, were contacted and major 21 transportation enterprises were interviewed by the Survey to the private enterprises. According to the survey results, the rate of ISW collection is shown below.

Table 3.3.1a Rate and Amount of Collection by Category of Waste

Type of Waste	Rate	Amount (ton/month)
Municipal SW	81.5%	102,000
ISW	16.2%	20,300
Medical SW	1.8%	2,300
Construction Waste	0.5%	600
Total	100%	125,300

From the table it can be said that business magnitude of collection /transportation of ISW is only 1/5 of municipal SW. This figure (20% of municipal SW) is considered quite small and the business of ISW collection/transportation is not well established. It is said that municipal SW collected is 157,000 ton/month. Based on the figure, it is estimated that ISW collection amount is 31,400 ton/month which is equivalent to 20% of municipal SW collected.

3.3.2 Treatment and Recycling

a. Treatment

There are no treatment facilities for ISW in the MR and at present ISW generated in factories is either recycled or disposed of at landfills including authorized ones. There are several plans, which aims at treatment and disposal of ISW including HW, being evaluated by CONAMA-RM. None of the plans are implemented.

b. Recycling

The recycling of ISW is very common in the MR and the rate of ISW recycled is quite high. Although surveyed items of JICA Team and EWI's RISNOR regarding waste generation and treatment/disposal were different, both studies reached the same conclusion that percentage of "recycling" of ISW is quite high. The proportion of "ISW recycled" are 56.2% in JICA Team's survey, and 54.1% in EWI's RISNOR study respectively. The outcome of both studies showed approximate values. In this regard, it might be assumed that the values are reliable.

It is concluded that more than 50% of ISW generated are recycled. However, "Survey on private SWM Enterprises" by the JICA Team and EWI's VIRS study pointed out that considerable amounts of ISW collected by recycling agents are treated and/or disposed inappropriately. Attention should be drawn that residues of recycling works are illegally dumped in many occasions.

3.3.3 Final Disposal

In order to identify the actual situation of final disposal in the MR, all solid wastes landfills registered in the CDSI database (10 sites), except for one, were visited. (The exact location of "Calera de Tango, parcela 15" could not be established). Furthermore, three additional sites were visited which, upon consultation with the Chilean counterpart, entailed some degree of uniqueness and interest. The classification of the visited sites was conducted in the following manner:

i.	Authorized:	(3)			
ii.	Unauthorized:	(9)	a.	Pure Landfills	(5)
			b.	Landfills with Recycling	(4)

Note: in parentheses, the number of visited sites for that category

Among the 12 landfills visited, 6 landfills gave information on disposal amount. According to the information given by the present landfills, only 17,870 ton/month of ISW are disposed of at three landfills (including an unauthorized landfill which receives 870 ton/month) and this is less than the disposal amount obtained by generators (more than 20,000 ton/month). However, upon consideration of disposal amount of 6 landfills which did not give information, it is concluded again that more than 20,000 ton/month of ISW are disposed of at present landfills including unauthorized ones. This, however,

indicates that some of ISW consigned to the private ISW collectors and deemed to be disposed at the 3 authorized landfills are in practice disposed of at unauthorized landfills.

Furthermore, it can be said that most of ISW are disposed of at the two authorized municipal landfills, i.e. Cerros de Renca and Lepanto, and the biggest authorized municipal landfill in the MR, Lo Errazuris, receives very little. This is because compared with prices of the other authorized landfills (in average 1,800 Peso/ton), tipping fees of Lo Errazuriz is much more expensive (6,000 Peso/ton).

3.3.4 Illegal Dumping

Today, there are no dedicated landfills or other major treatment options for ISW in the MR. Some of the non-hazardous ISW is accepted at the landfills as Municipal Solid Waste. Hazardous waste materials may be hidden among non-hazardous waste, but at least at the Lo Errázuriz landfill several supervisors are present at the tipping area during unloading.

According to the EWI's VIRS study, 101 illegal dumping sites with a total accumulated volume of about 10 million m^3 of waste have been identified in the Metropolitan Region. Approximate 45-50 of the sites receive ISW. The majority of the dumping grounds are situated in residential areas (50%), while 18% are located in industrial areas and 32% in remote areas. The surface area covered is approximate 7.2 million m^2. Construction waste is the most abundant type of illegally dumped waste. ISW is deemed to occupy only 2.2% or 224 thousand m^3.

3.4 Present ISW Generation

3.4.1 Previous Studies on ISW Generation

a. D&M's RISPEL Study

A study of generation ratios of ISWs was not carried out, therefore the ISW generation amounts of the year 1992 were estimated according to the CIIU Code by using the INVENT model and WHO model. The summary of estimation is shown below.

- Total generation amount of ISW by INVENT model:
  659,228 ton/month
- Total generation amount of ISW by WHO model:
  28,641 ton/month

b. EWI's RINSOR Study

Based on the survey result of 265 factories, the total **discharge amount of ISW** (No Aprovechados: Not Recycled Wastes) from the MR in 1994 was estimated at 26,105 ton/month, i.e. 313,260 ton/year.

The **discharge amount of ISW** (No Approvechados) in the year 2004 is estimated at 55,662 ton/month (667,944 ton/year) based on the number of employees and growth of GNP.

3.4.2 Classification of ISW

a. Classification of ISW Related with the Study

aa. Classification Related with the Study

Various investigations in relation with the Study have been carried out and various classifications of ISW, as listed below, were introduced:

- HW classification in the D&M's RISPEL study,
- ISW classification employed in the declaration system,
- ISW classification proposed in the EWI's RISNOR study,
- ISW classification the Team employed for their investigation,
- HW classification drafted by MS, and
- HW classification in the ISWM manual produced jointly by the Ministry of Economy Promotion and Reconstruction, and CONAMA by TESAM S.A..

Among various classifications mentioned above, the classification applied to the CDSI data base is the most relevant for the Study.

ab. Present Status and Future Adjustment to CDSI System

aba. Present Database System

In July 1994, Dames & Moore presented the Final Report of the Study on "Household and Industrial (Toxic and Hazardous) Solid Waste Management; Design and Implementation of a Hazardous Solid Waste Management Control System in the Metropolitan Region" (D&M's RISPEL study). This report included a "Scheme for the Identification and Classification of Hazardous Solid Waste". The scheme would enable to both identify hazardous solid waste and determine the degree of harmfulness on the basis of their chemical constituents. However, such classification procedure implies the need to implement chemical analysis and, therefore, the existence of certain analytical capability, not yet attained in Chile. For this reason, the proposal presented by the consultants was not for immediate implementation.

The short term proposal established by the report was the implementation of a declaration system where both producers and destinations of waste should declare the amounts generated and received respectively. One of the main results of the study was the design of the CDSI database (ISW Control System), created to store all the information received from producers and final receivers of waste.

The initial computer system included 25 categories of waste for classifying the different types of residues generated and declared by the industries.

However, during the first 4 months of independent operation by PROCEFF, the number of categories was increased to 50 on the basis of the new types of waste that were being declared.

At present (August, 1995), the computer system is still operating under the mentioned conditions, which result in various shortcomings.

abb. Improvement Plan

EWI's Study on "Diagnosis and Identification of Technologies and Strategies for Non Hazardous Solid Waste" (EWI's RISNOR study), Final Report (March 1995), proposed an improvement plan for the declaration system and the CDSI database. The plan can be summarized as follows:

- A new scheduled list of residues with 333 categories was compiled to be used in the CDSI system. Each waste was assigned a code which will be used at the time of completing the documents and recording the data in the

computer system.

- This general list of residues was used to compile a specific list titled "Types of Waste for Industrial Sector", where each industrial activity (ISIC code) was associated with all the different types of waste it is predisposed to generate.
- Both of these lists will be sent to the industries and will become the new guideline for filling out the declaration documents and also for recording the information in the database.
- The computer system will generate a specific list corresponding to each industry for each individual company in order to individualize the monitoring activities.
- Finally, the database will retain the capability of upgrading both lists if new information is received (e.g. adding new waste to the general list, assigning an existing waste a new ISIC code, etc.).

It is expected that these adjustments will provide a more accurate control over the industries, as well as a quantitative diagnosis regarding the need for treatment/disposal facilities. It is PROCEFF's intention to begin implementing the new system by January 1996.

b. ISW Classification Employed in the Team's Investigation

As mentioned above, several similar studies for ISWM were conducted prior to the Study and several ISW classification were examined and proposed. Among those ISW classifications proposed, it may be judged that the "333 classification" proposed in the EWI's RISNOR study and the one which SESMA-PROCEFF plans to adopt officially for their ISW monitoring and management (i.e. CDSI system) should be currently most suited to the present state of industries in the region.

As proved in the EWI's RISNOR study, the 333 classification is most suited for management of the declaration (and is advantageous especially in view that both waste generator and authority could identify ISW), however, diversity in the 333 classification is of great disadvantage and imposes a huge restraint when estimating total waste generation amount in the MR and for planning treatment/disposal plans based upon the estimated value. Therefore, for the formulation of the Master Plan as the Study requires, it is indispensable that the 333 classification should be divided into categories of wastes, similar in nature. Consequently, the Team proposed the 24 ISW classification, as shown in Table 3.4.2a, to be used for the Study that is compatible with and is a calibrated version of the 333 classification. The Team produced the matrix-table, as shown in Table I.1.2d in Annex I in order to maintain compatibility of

the two classifications. The matrix-table is determined for the Study in order to estimate ISW generation amount and formulate ISW treatment/disposal plans, finally after full and detailed examination of its compatibility by both the Team and the counterpart.

Table 3.4.2a Proposed 24 ISW Classification

Code	Type of Waste
C-1	Ash including from incinerator
C-2	Dust and APC products
C-3	Inorganic sludge
C-4	Organic sludge
C-5	Asbestos
C-6	Acids
C-7	Alkalis
C-8	Solvents
C-9	Oily waste
C-10	Inorganic chemical residues
C-11	Organic chemical residues
C-12	Other liquid waste
C-13	Waste from food production
C-14	Glass and ceramics
C-15	Metal and scrap
C-16	Paper and cardboard
C-17	Plastics
C-18	Rubber
C-19	Textile and leather
C-20	Waste similar to domestic waste
C-21	Wood
C-22	Slag from melting
C-23	Construction waste
C-24	Other solid waste

c. Proposed Classification of ISW

The classification of HW drafted by the MS in the document is basically corresponding to that sanctioned by the Bazel Convention. Therefore, in order to identify and control HW by the MS classification, establishment of "analysis methods and permissible limits" for HW and consolidation of analytical capability in industries are essential. Based on this issue, the Team summarized the relationship of three ISW classification, i.e. 44 classification of MS, 333 classification of PROCEFF and 24 classification of the Team, as illustrated in Figure 3.4.2a and described below.

i. Estimation of ISW generation and treatment/disposal planning

As EWI's RISNOR study proved that "estimation of ISW generation amount" and "planning of treatment/disposal based upon the generation estimation" in relation to the 333 classification are hardly possible in view of the "time allowed" and "available computer capacity" at present, in this regard, the Team proposed the 24 classification in order that ISW can be identifiable visually and the compatibility of waste classification with 333 classification can be maintained. Therefore, it is necessary for "estimation of ISW generation amount" and "planning of treatment/disposal based upon it" to adopt the 24 classification that the Team proposed.

ii. SESMA-PROCEFF 333 classification and MS 44 classification

While the HW classification MS proposed is for the purpose of identifying and controlling HW, it is indispensable to provide standard analysis methods for identification and to facilitate specialized analysis for HW. Under the present situation where analytical abilities are not gained, it is very difficult for industries to declare their waste through the declaration system according to the classification that MS proposed. On the contrary, the 333 classification of ISW has the list for HW identification and thus may be deemed as an effective tool to be employed for the declaration system and the management of HW, under the present situation of lacking provisions of standard analysis methods and specialized analysis facilities for HW. Therefore, as the Team's conclusion of ISW classifications, both classifications of SESMA-PROCEFF being adopted and MS drafted should co-exist.

iii. Coordination of two classifications

In order to formulate an efficacious HWM plan in Chile, coordination of both classification of SESMA-PROCEFF and MS (drafted) is indispensable. However, formulation (coordination) requires empirical support of analysis works, which shall take some time.

iv. Coordination work required

In order to formulate a compatible system between the 333 classification (being adopted for the declaration system) and the classification MS drafted, the Team proposes the following steps to be adopted by the Chilean side:

- For the time being, for those industries which are deemed to

generate HW and LW listed in the PROCEFF classification, (control system) unless the factory proves their waste is non-hazardous, the waste shall be deemed hazardous (i.e. the industry carries out the required analytical tests of their generated waste based upon the criteria of MS specified in the draft regulations.)

- At the same time, data of HW and LW should be continuously collected and compiled in accordance with the 333 classifications of PROCEFF as well as the 44 categories of MS.
- Factory inspections should be carried out in conjunction with laboratory analyses for processing the compiled data to make it more accurate and reliable.
- Along with the data compilation, the risk of ISW in accordance with the definition by MS should be easily identified by the data given in the declaration system.

v. Estimation of HW quantity

Based on the matrix table between the PROCEFF's 333 and the JICA's 24 classifications, the hazardousness of ISW can be identified to the extent as described below:

- The waste categorized as C-5 (Asbestos) is hazardous,
- The wastes categorized as C-13, -14, -15, -16, -17, -18, -19, -20, -21, -23, are all non-hazardous,
- Some portions (some between 0 and 100%) of the wastes categorized as C-1, -2, -3, -4, -6, -7, -8, -9, -10, -11, -12, -22, -24 may be hazardous.

In addition, based on the comparison of the available waste generation data by the 333 classifications, from the EWI's RISNOR Study, with the results of the factory survey by the Study Team, the portion of hazardous and liquid wastes for each of C-1, -2, -3, -4, -6, -7, -8, -9, -10, -11, -12, -22, -24 can be assumed because "one-to-one correspondence" (with a few exceptions) is maintained between the 24 classification and 333 classification.

Accordingly, the ISW treatment/disposal master plan is to be proposed based on the estimation of HW/LW generation with the method mentioned above. However, the Chilean experts may also refer and review the ISW based on the amount of HW generation in accordance with the 44 classification of MS as its compatibility with the PROCEFF's 333 classification is known to the Chilean side.

vi. Priority in HWM

Main HWM issues for the time being are: monitoring and controlling of "Highly Potential Industries" which may be liable to produce LW and HW for the ISW List (namely the 333 classification of PROCEFF). Factories are classified with their (high, medium, or low) liability of generating HW as shown in the Table I.1.2e in Annex I. Monitoring and controlling by regulation should be first reinforced and practiced toward those "high potential industries".

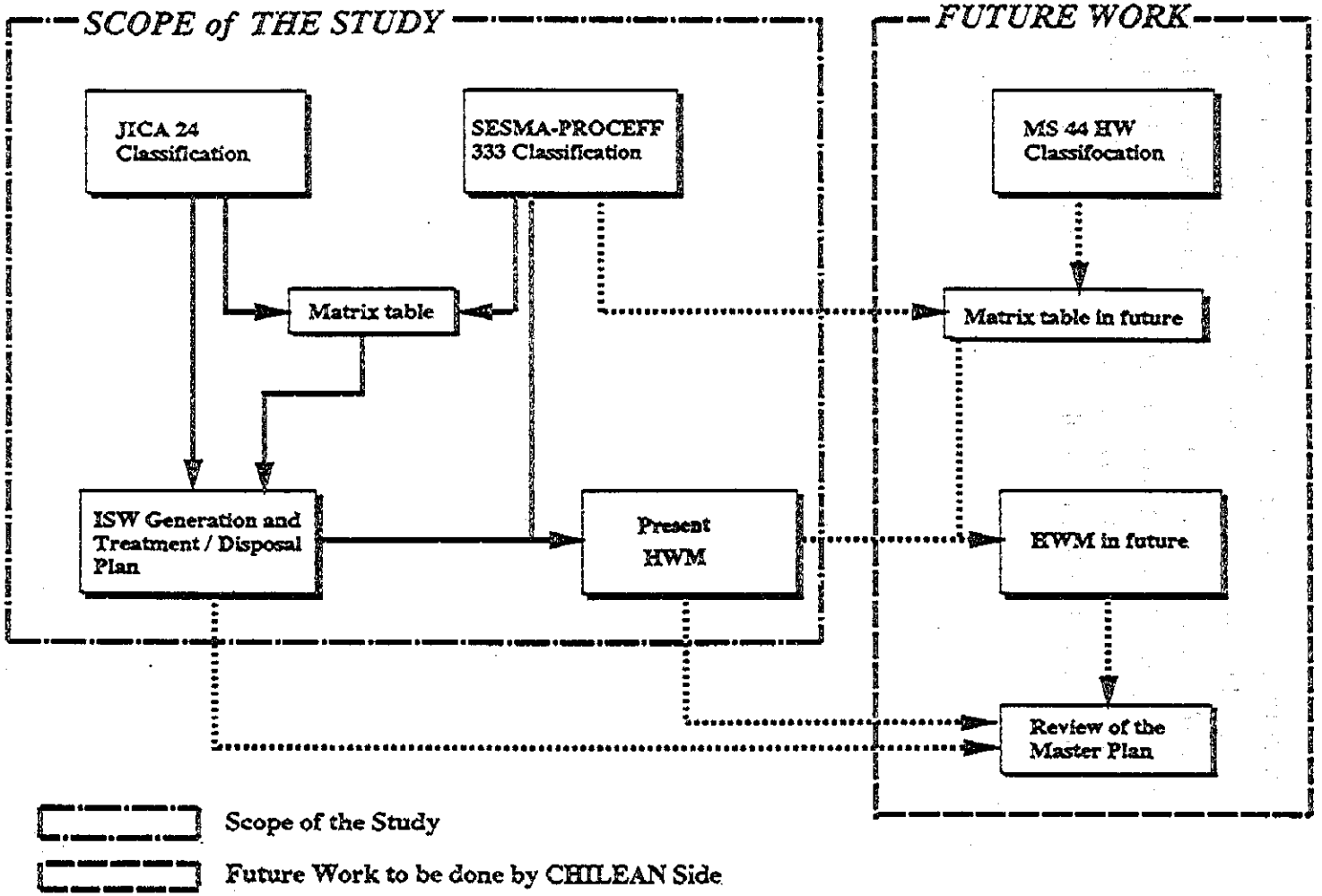

Figure 3.4.2a Relationship of three ISW classification

3.4.3 Present ISW Generation

a. Calculation of Generation-Ratio

Estimation of the present ISW generation amount is carried out by referring to the outcome of the Team's factory survey (189 factories: due to 10 factories out of 199 did not reply their number of employees) plus the data from the EWI's RISNOR study (236 factories: due to 29 factories out of 265 factories overlapped in the two studies) converted to the 24 waste classifications proposed by the Team. Based on the generation data of these 425 factories, generation-ratios (GR) of 24 ISW classification were calculated from the following formula.

$$GR = (TA(J) + TA(E) - OA) / (NE - NE(OA))$$
$$GA = (GR \times NE(INE)) / 1,000$$

GR	:	Generation-Ratio (kg/employee/year)
GA	:	Waste Generation Amount (ton/year)
TA(J)	:	Total Amount of Generation obtained by the Team's survey
TA(E)	:	Total Amount of Generation obtained by the EWI's RISNOR study
OA	:	Overlap Amount of generation between Team's survey and EWI's RISNOR study
NE	:	Number of Employees in total for all factories surveyed by the Team and EWI's RISNOR study
NE(OA)	:	Number of employees overlapped in the two studies
NE(INE)	:	Total number of employees in the Metropolitan Region from INE data

b. Numbers of Factories and Employees in the Metropolitan Region

Statistics available with regard to the industries and their employees are the data compiled by INE (Instituto Nacional de Estadisticas). The INE data regarding the industries in the MR shows only ranges of number of employees for respective industries as shown in Table 3.4.3a. The following assumptions are, therefore, made for the calculation of Industrial SW generation:

i. Data (numbers of factories and employees) of industries with less than 10 employees are not included in this estimation, since relevant data was not available and its overall contribution towards the total number of

employees in the industries within the MR is marginal.

ii. Number of employees referred in the calculation of GR is the total employees including employees in indirect/administrative sections.

iii. Number of employees (in industries with 10 or more employees) used in the calculation of the ISW amount generated are shown in the table below.

Table 3.4.3a Assumption for the Estimation of Waste Generation from Factories with 10 or more Employees

Range of Employees Number	Assumed Employees Number
10 -19	15
20 -49	35
50 - 99	75
100 - 199	150
200 - 499	350
500 - 999	750
> 1,000	1,500

c. Present ISW Generation Amount

A comparison table of EWI's RISNOR study and the JICA Team's survey is prepared as shown in Table 3.4.3c. As clearly presented in the table, there is very little difference between generation ratio of EWI's RISNOR (4,254.49 kg/annual/employee) and that of the JICA survey (3,473.71 kg/annual/employee). However, the generation ratio as well as amount of HW and LW in the JICA survey was much higher than in EWI's RISNOR study, because the JICA survey targeted to investigate industries which may generate more HW and LW than those industries targeted by EWI's RISNOR study. The two studies covers 84,380 employees in total which is equivalent to 30% of total employees of targeted industries in the MR. JICA study selected much larger industries than EWI's. (Average number of employees for JICA is 340 while that of the EWI's is 76.)

Present ISW generation amount in the MR is estimated in relation to 36 industrial group-wise classification and the 24 ISW classification. The outcome is summarized as shown in Tables 3.4.3d and 3.4.3e below. As for the mining industries (CIIU code

21001 to 29090), there are several in the MR and they produce considerable amount of ISW. However, all of the generated ISW in the mining industries are disposed of at their own landfills at present and in future (i.e. closed system). Therefore, ISW generated in mining industries are excluded from this table to avoid confusion due to the huge amount of slag from the industry. ISW Generation amount (in 1995) in total is about 939 thousand tons per year. The largest generation (amounts) of ISW and industry are C-13 Waste from Food Production (219,911 ton/year) and CIIU Code 311 Food Manufacturing (154,850 ton/year) respectively.

As for the ISW generation by the waste categories of non-HW, HW and LW, ISW generation amount in 1995 is calculated based on the EWI's RISNOR Study and JICA's Survey and summarized below. As clearly shown in the table present generations of HW and LW are very small (7.6% in total) due to mainly limited generation of sludge (C-3 and C-4) and dust (C-2).

Table 3.4.3b ISW Generation Amount in 1995 by Non-HW, HW and LW

Unit: ton/year

ISW Category	Generation Amount	Rate (%)
Non- Hazardous Waste	868,000	92.4
Hazardous Waste	26,000	2.8
Liquid Waste	45,000	4.8
Total	939,000	100.0

Table 3.4.3c ISW Generation Ratio (for Non-HW, HW and LW) in 1995 based on EWI's RISNOR Study and JICA's Survey

Unit: kg/year/employee

Industrial Category	CIIU A	Generation Ratio by EWTS RISNOR				Generation Ratio by JICA				Grand Total
		Non HW	HW	LW	Total EWI	Non HW	HW	LW	Total JICA	
Highly	351	3,066.67	82.05	-	3,148.72	215.15	-	1,931.01	2,146.15	2,294.07
Potential	352	1,611.46	879.35	0.03	2,490.84	304.36	1.45	809.66	1,115.47	1,198.35
Industries	354	-	-	-	-	561.26	-	-	561.26	561.26
	356	323.67	-	-	323.67	516.36	2.53	2.03	520.93	476.97
	371	3,596.60	475.51	2.38	4,074.49	7,531.07	2,420.17	-	9,951.23	7,391.28
	372	15,615.65	354.26	-	15,969.91	319.35	525.99	15.03	860.36	1,074.88
	381	1,051.94	31.88	1.65	1,085.47	2,196.99	96.55	796.87	3,090.41	2,699.67
Total Highly Potential Industries		1,793.22	234.18	1.32	2,028.73	1,521.40	250.83	600.82	2,373.05	2,314.00
Potential	3211	2,395.51	2.76	-	2,398.27	204.44	2.43	7.67	214.54	564.81
Industries	3231	8,167.27	8.08	-	8,175.35	3,252.14	208.70	-	3,460.83	4,879.49
	3319	8,392.76	-	-	8,392.76	5,075.00	-	-	5,075.00	6,217.18
	341	8,321.64	910.30	0.45	9,232.39	5,646.72	875.28	3.24	6,525.23	7,039.02
	3420	1,501.72	6.29	0.17	1,508.19	4,510.04	-	15.15	4,525.20	4,142.52
	355	1,621.50	0.70	0.28	1,622.47	4,304.71	-	-	4,304.71	3,437.44
	362	388.24	-	-	388.24	6,341.36	524.27	5.83	6,871.46	6,664.29
	3699	333.55	-	-	333.55	191.38	517.24	-	708.62	508.75
	382	267.33	-	-	267.33	486.71	52.94	5.62	545.27	542.18
	383	-	-	-	-	3,875.23	2.65	19.73	3,897.61	3,897.61
	384	1,362.86	2.86	-	1,365.71	343.35	-	0.06	343.41	381.39
	385	-	-	-	-	46,029.57	-	8.70	46,038.26	46,038.26
	390	353.04	8.87	0.08	361.99	438.10	-	-	438.10	395.87
	625	-	-	-	-	61.54	-	538.46	600.00	600.00
	952	-	-	-	-	401.66	1,492.23	4.35	1,898.24	1,898.24
Total Potential Industries		3,901.68	235.39	0.16	4,137.23	3,162.11	208.94	8.28	3,379.33	3,485.80
Less	311	4,186.52	14.43	324.82	4,525.77	3,102.47	-	3.31	3,105.78	3,744.23
Potential	312	1,376.50	8.65	39.68	1,424.82	-	-	-	-	1,424.82
Industries	313	2,213.51	-	-	2,213.51	20,343.31	-	95.53	20,438.84	16,475.65
	3212 - 3219	499.67	-	0.88	500.55	-	-	-	-	150.21
	322	180.93	0.13	-	181.06	270.68	-	20.95	291.63	270.05
	324	109.41	-	-	109.41	204.81	-	-	204.81	186.35
	3311 - 3315	13,382.42	0.37	-	13,382.79	-	-	-	-	13,382.79
	332	1,655.40	0.97	-	1,656.36	-	-	-	-	1,656.36
	361	29,374.16	-	-	29,374.16	-	-	-	-	29,374.16
	3691 - 3696	1,792.24	-	-	1,792.24	17,698.91	-	-	17,698.91	10,380.27
	410	-	-	-	-	3,157.89	1,578.95	-	4,736.84	4,736.84
Total Less Potential Industries		4,981.55	7.45	158.31	5,147.32	4,893.30	8.45	20.61	4,922.36	5,010.69
Grand Total		4,058.96	104.45	91.08	4,254.49	3,099.60	167.43	206.67	3,473.71	3,658.92

Table 3.4.3d Summary of ISW Generation Amount in 1995 by 24 ISW Categories

Unit: ton/year

Code	Type of Waste	ISW Generation
C-1	Ash including from incinerator	10,973
C-2	Dust and APC products	5,078
C-3	Inorganic sludge	47,035
C-4	Organic sludge	43,518
C-5	Asbestos	299
C-6	Acids	16,911
C-7	Alkalis	2,435
C-8	Solvents	485
C-9	Oily waste	3,824
C-10	Inorganic chemical residues	24,479
C-11	Organic chemical residues	7,927
C-12	Other liquid waste	4,044
C-13	Waste from food production	219,911
C-14	Glass and ceramics	129,240
C-15	Metal and scrap	55,028
C-16	Paper and cardboard	90,602
C-17	Plastics	24,858
C-18	Rubber	14,306
C-19	Textile and leather	10,158
C-20	Waste similar to domestic waste	47,984
C-21	Wood	117,359
C-22	Slag from melting	10,898
C-23	Construction waste	6,577
C-24	Other solid waste	45,209
Total		939,138

Table 3.4.3e Summary of ISW Generation Amount in 1995 by 36 Industrial Groups

Unit: ton/year

Potential	CIIU Code		Industrial Category	Nos. of Employee	TOTAL
Highly Potential Industries	351		Manufacture of industrial chemical products	1,962	4,500.97
	352		Manufacture of other chemical products	18,512	22,183.80
	354	3540	Oil and coal products	1,360	763.32
	356	3560	Other non-classified plastic products	15,931	7,598.57
	371	3710	Iron and steel industries	4,106	30,348.60
	372		Basic metal industries	2,355	2,531.35
	381		Manufacture of metal products except machinery & equipment	26,602	71,816.61
Potential Industries	3211	3211	Textile processing and materials manufacturing	19,717	11,136.32
	3231	3231	Leather tanning and finishing	1,868	9,114.89
	3232	3232	Fur dressing, dyeing and other fur and skin articles	14	68.31
	3319	3319	Other non-classified wooden products	770	4,787.23
	341		Paper, printing and publishing industries	9,655	67,961.71
	3420	3420	Printing, photoengraving, publishing and the likes	11,734	48,608.29
	355		Manufacture of rubber products	4,751	16,331.29
	362	3620	Glass and glass products	2,163	14,414.85
	3699	3699	Other non-metallic mineral products	1,211	616.10
	382		Manufacture of machinery except electrical	10,477	5,680.46
	383		Manufacture of electrical machinery	4,829	18,821.57
	384		Manufacture of transport equipment	7,402	2,823.04
	385		Manufacture of science, measuring, controlling equipment(inc.lens)	1,094	50,365.86
	390		Other manufacturing industries	2,598	1,028.48
	625	6253	Gasoline filling station	5,115	3,069.00
	952	9520	Laundries and dry cleaners	2,535	4,812.03
Less Potential Industries	311		Food manufacturing	41,357	154,850.18
	312		Other food manufacturing	4,595	6,547.06
	313		Beverage industries	7,696	126,796.61
	314	3140	Cigarettes, cigars and tobacco	167	1,494.69
	3212-3219		Textile industries	13,221	1,985.96
	322	3220	Garment industries	25,525	6,892.97
	3233	3233	Leather products (exc.footwears)	1,158	312.72
	324	3240	Leather footwears	14,785	2,755.23
	3311-3315		Wood and cork industry	3,745	50,118.56
	332	3320	Furniture, fixture and the likes	5,975	9,896.77
	361	3610	Potteries and ceramic products	3,591	105,482.60
	3691-3696		Manufacture of non-metallic mineral products	6,962	72,267.45
	410	4101	Generation, transmission and distribution of electric energy	75	355.26
			Total	285,613	939,138.70

3.4.4 Present ISW Flow

a. Factory Survey by JICA and EWI's RISNOR Study

The factories' survey by the Team carried out an investigation regarding waste generation, treatment/disposal by respective factories, in order to assume "present ISW flow". Although it is not presented in the report of EWI's RISNOR Study, the study also carried out an investigation regarding ISW generation and treatment/disposal at respective factories.

b. Analysis of the Outcome

Although surveyed items of JICA Team and EWI's RISNOR regarding waste generation and treatment/disposal were different, both studies reached the same conclusion that the percentage of "recycling" of ISW is quite high. Bearing this in mind, ISW is classified principally into "recycled" and "not-recycled"and summarized in Table 3.4.4a following the manner EWI employed.

According to the table proportion of "ISW recycled" and "ISW not-recycled"in both studies showed approximate values. In this regard, it might be assumed that the values are reliable.

According to the Team's survey on "on-site intermediate treatment", 1,366 ton/month, which counts for about 7% of the total generation amount of factories surveyed (18,632 ton/month) are internally treated on-site. Judging from the questionnaire format employed in the survey, it might be assumed that on-site intermediate treatment are realized in the range of this value (i.e. 7%) in the MR.

Table 3.4.4a Comparison of JICA Survey and EWI's RISNOR Study Results

Category of survey	JICA Survey		EWI's RISNOR Study	
	ISW amount	Rate	ISW amount	Rate
Disposal Method	ton/month	(%)	ton/month	(%)
1. Generation	18.632	100.0	10,386	100.0
2. Recycled	10,480	56.2	5,614	54.1
- On-site	NA	-	2,143	20.6
- Outside	NA	-	3,471	33.4
3. Not Recycled	8,152	43.8	4,772	45.9
3.1 Storage	145	0.8	21	0.2
3.2 Disposal	6,725	36.1	4,751	45.7
Disposal at municipal landfills	4,755	25.5	NA	-
On-site disposal	538	2.9	NA	-
Discharge to sewer, etc.	826	4.4	NA	-
Unknown disposal	606	3.3	NA	-
3.3 Others	1,282	6.9	NA	-

c. Present ISW Flow

ISW flow identified in the study is shown in the Table 3.4.4b.

Table 3.4.4b ISW Flow obtain by JICA Survey

	Amount (ton/month)	Share (%)
1. Generation	18,632	100
2. Recycling	10,480	56
3. Treatment	1,282	7
4. Storage	145	1
5. Final Disposal		
5-1 Disposal at municipal landfills	4,755	26
5-2 On-site disposal	538	3
5-3 Discharge to sewer, etc.	826	4
5-4 Unknown disposal	606	3
Final Disposal Total	6,725	36

The "Present ISW Flow" in the MR shown in Table 3.4.4c is calculated from "present ISW generation amount" multiplied by the "shares (%) obtained in Table 3.4.4b". Which is presented in a diagram of Figure 3.4.4a.

The flow indicates that more than 50% of ISW generated are recycled. However, "Survey on private SWM Enterprises"by JICA Team and EWI's VIRS study pointed out that considerable amounts of ISW collected by recycling agents are treated and/or disposed inappropriately. Attention should be drawn to that residues of recycling works are illegally dumped in many occasions.

Table 3.4.4c Present ISW Flow in the MR

	Share (%)	Amount (ton/year)
1. Generation	100	939,139
2. Recycling	56	525,918
3. Treatment	7	65,740
4. Storage	1	9,391
5. Final Disposal		
5-1 Disposal at municipal landfills	26	244,176
5-2 On-site disposal	3	28,174
5-3 Discharge to sewer, etc.	4	37,566
5-4 Unknown disposal	3	28,174
Final Disposal Total	36	338,090

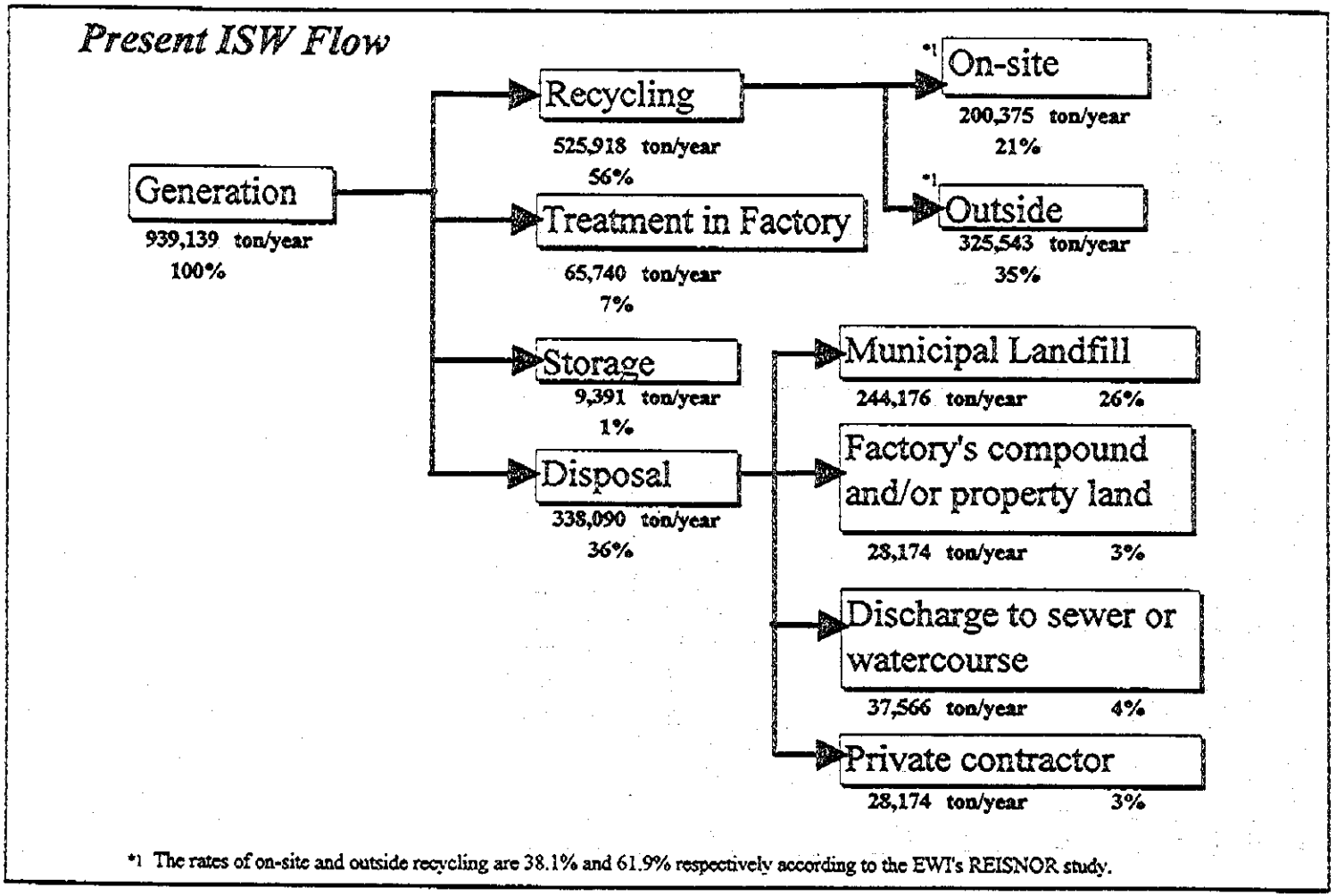

Figure 3.4.4a Present ISW Flow

CHAPTER 4

ISWM INSTITUTIONAL SYSTEM

CHAPTER 4 ISWM INSTITUTIONAL SYSTEM

4.1 Environmental Policy

4.1.1 Current Movement in Environmental Policy

"Free market economy" is thoroughly adopted and promoted as the national policy in Chile. The same policy is to be applied for the ISWM. Namely, based upon PPP (polluters pay principle), it is basically intended that public sector will be least concerned in operation of ISWM.

In 1990 CEDRM and CONAMA were established in succession, in order to cope with the pollution which was the start of strengthening the institutional system in environmental management.

In practice, the Environmental Basic Law was published in 1994. This law comprises 3 basic principles:

- establishment of environmental standards category-wise;
- requirements of EIA (Environmental Impact Study); and
- PPP (polluters pay principle).

These basic principles are to be recognized as prerequisites in promoting ISWM.

4.1.2 Air Pollution Control and ISWM

As for air pollution problems, where arsenic poisoning and respiratory diseases due to copper refineries have been outstanding nationwide, urban air pollution attributed mainly to automobile exhaust gas is worsening in the MR.

Under these circumstances, with aims of reducing the gross quantity of emissions of SOx, in 1992 it started to apply the D.S.N° 185 of the Minig Ministry, specifying the emission rate of tradable SOx (for facilities and factories related to the mining activity). On the other hand they were promulgated the D.S.N° 211, D.S.N° 82, D.S.N° 54 and D.S.N° 55 of the Transportation and Telecommunications Ministry, those which fix standard of emission of CO, THC (total hydrocarbons), NOx and particulate material

to the different vehicles that enter the country.

In the course of enforcement of air pollution control, where industrial air pollution prevention measures take place according to the emission rate stipulated in the Ordinance 185, dust derived from exhaust gas emission control facilities will be increasingly generated as ISW. However, it contains hazardous substances such as heavy metals. Administration for hazardous ISW and its treatment become indispensable.

4.1.3 Water Pollution Control and ISWM

Water pollution by waste water from ore dressing, fishery product processes, and pulp mill, including domestic waste water, is seriously worsening. Regulations for industrial waste water discharge are prepared to be enacted nationwide, corresponding to the situation.

At present, domestic waste water and industrial waste water are mostly discharged into public water courses through sewage lines in the MR. It is anticipated that soil contamination of agricultural land and sea bed contamination, etc. of fishery ground by industrial and domestic waste water are being aggravated.

Industries in the MR are not well aware nor conscious of the necessity of industrial waste water controls, small numbers of factories are voluntarily taking actions of waste water control. For national level enforcement of related regulations, it is planned that individual factories that do not comply with these norms should conduct pre-treatment to comply with the permissible discharge level of sewage. Public sewage treatment plants should cope with domestic waste water and the industrial waste water discharged after complying with the level stipulated.

In this regard, it is estimated that a large amount of "organic and inorganic sludge from individual industries" and "organic sludge from public sewage treatment plants" are generated. Special attention should be drawn to (there is a strongest possibility that) inorganic sludge from factories might include hazardous substances. The sludge quantity derived from the water pollution control facilities is relatively greater than the quantity of dust generated as ISW.

4.1.4 Municipal SWM and ISWM

Whereas Chile achieved high level of municipal SWM in view of international practices, ISWM in Chile is in it initial stages, that control is commenced alike that in other industrial pollution control.

It is envisaged that generation of sludge and dust contaminated with hazardous substances will be rapidly increased as air- and water- pollution prevention measures are enforced. The employment of exclusive treatment and disposal becomes an important issue for the dust and sludge together with other HW, in separation from non-hazardous ISW.

In general, control over hazardous substances from factories comprises:

- control over hazardous materials.
- control of waste water and gas emission, and
- control of HW.

However, most industries in the MR are not ready to practice appropriate control over HW so far.

Therefore, ISWM in the MR should be planned in full, relative to measures of air- and water- pollution prevention and hazardous material control.

4.1.5 EIA System

Substantial functioning of EIA system in Chile started voluntarily in 1994 and it will become obligatory when it is enforced in the corresponding regulation, probably in 1996.

The EIA system in the MR is: a promoting sector should carry out an EIA which should be submitted to CONAMA-RM, meanwhile the project should be made public and opportunity of public participation is given. Approval/disapproval of the assessment should be agreed by COREMA-RM within a certain period.

EIA is obligated to a promoting sector for a localization of SW treatment/disposal facilities as well. In evaluating the assessment (especially for final disposal sites), since it is stipulated in the Metropolitan Regulatory Plan that a buffer zone of more than 600

meters in length should be kept in all direction, localization of a final disposal facility in urban area becomes extremely difficult.

4.1.6 Land Use Policies

Attention should be drawn to the following land use policies in relation with ISWM.

a. Regulations for Localization of SWM Facilities

The Ministry of Housing and Urban Development is responsible for land use regulations. The Metropolitan Regulatory Plan permits localization of transfer stations, recycling facilities and incineration plants in the urban area. On the other hand it regulates that future municipal landfills and all types of ISW disposal sites should be located outside of the urban area. It is assumed that the regulatory plan will have a strong influence in developing the system for the ISW treatment/disposal in respect of facilities localization.

b. Land-use Capacity/Categories by Ministry of Agriculture

The Ministry of Agriculture had established 8 categories indicating the land use capacity, mentioned below. The installation of sanitary landfills is forbidden in the categories I, II and III. A description of the soil establishes its aptitude and the most suitable use it should receive.

I. Flat land without limitations for agricultural use; suitable for all types of cultures.
II. Similar to category I, but presenting slight limitations for agricultural aptitude.
III. Land with major limitations for all types of cultures (such as slopes, salinity, stones, etc.)
IV. Land with marginal aptitude for agricultural use with some degree of suitability for livestock raising.
V. Livestock raising land; it may change its category by undergoing some reconditioning process. This type is very rarely found (only in mountainous areas in the far south of Chile).
VI. Land for livestock raising and forestry.
VII. Land suited for forestry and wildlife.

VIII. Land exclusively suited for wildlife.

4.2 Administration and Organization

4.2.1 Organizations Related to Environmental Policy

Thirteen Regions constitute the Republic, divided into Provinces and Municipalities (Comunas), the smallest unit.

The National Executive Power, under the responsibility of the President, is distributed among 13 Ministries and 2 General Secretaries with the same status. Each Ministry plus the Republic General Secretary maintain a representative (Ministerial Regional Secretary) in each Region, and the 14 representatives compose the Ministerial Regional Secretary of that Region (SEREMI/Region). Each Region has an Intendente that is the chairman of the SEREMI, and together they constitute the Regional Government.

The Provincial Government has only coordinating functions.

The legal acts of a national level are: a Law originated in Congress (Legislative Power), a Decree-Law by the President, a Supreme Decree by a Ministry (also signed by the President), and Resolutions by the Ministries. At the Regional level, Resolutions should be promulgated by a Ministry or by a Regional Body. At the Municipal level, the highest legal acts are ordinances, promulgated by the mayor (Alcalde) or by a Regional Body.

Historically, each Ministry regulates its own specific activities that could have an impact on the environment or that have the purpose of protecting it. The Ministry of Health (MS: Ministerio de Salud) is responsible for all matters related to health and environmental aspects. Most recently, the National Environmental Committee (CONAMA: Comision Nacional de Medio Ambiente) was created under the Ministry of National Properties (Ministerio de Bienes Nacionales). Now CONAMA has been transferred to the General Secretary of the Presidency (Secretaria Nacional de la Presidencia). Composed by representatives of Ministries and other bodies, CONAMA should be the supreme council to dictate principles and policies for the environment. In the Metropolitan Area of Santiago and further in each Region, a Regional CONAMA constitutes a bridge between it and local environmental bodies, and promotes and supplies needs to their activities. CONAMA shall evaluate or coordinate the Environmental Impact Assessment enforced by Law Nº 19.300- General Basis for

the Environment.

Ministerio de Salud (MS) is the principal executive and normative body throughout a system of 13 regional components (SEREMI) of national health services (Servicios Nacionales de Salud), and the regulation departments (Depto. de Programas Ambientales). SEREMI Santiago includes 4 health services and the Metropolitan Health Service for the Environment (SESMA).

The Public Works Ministry (MOP: Ministerio de Obras Publicas) is responsible for the protection and maintenance of both natural and constructed water systems. Its Sanitary Services Superintendence (SSS: Superintendencia de Servicios Sanitarios) controls the industrial liquid effluents (RILES-Residuos Industriales Líquidos), including those from the mining industry.

The Mining Ministry (Ministerio de Mineria) regulates their specific environmental problems often based on MS and MOP directives.

The Transportation and Telecommunications Ministry (Ministerio de Transportes y Telecomunicaciones) regulates the transportation of dangerous goods, including hazardous waste.

Ministerio del Interior, as coordinator of municipal activities, regulates the collection and disposal of solid waste and other municipal sanitary obligations, as well as authorizing to charge for these services.

The Ministry of Housing and Urban Development (Ministerio de Vivienda y Urbanismo) provides directives and parameters for the municipal regulations of land occupations. The Regulatory Metropolitan Plan of Santiago (Plan Regulador Metropolitano de Santiago), published by the Metropolitan Regional Government (Gobierno Regional Metropolitano-Resolución N°20/94) delimits the urban area and its allowed occupation; establishes the waste disposal as part of the Metropolitan Sanitary Infrastructure; considers transfer stations, recycling plants and incinerators as industries allowed inside the urban area, but sanitary landfills and any final disposal site for industrial solid waste must be outside; the ISW must be "inert", and the pre-treatment may be allowed within the generators' area.

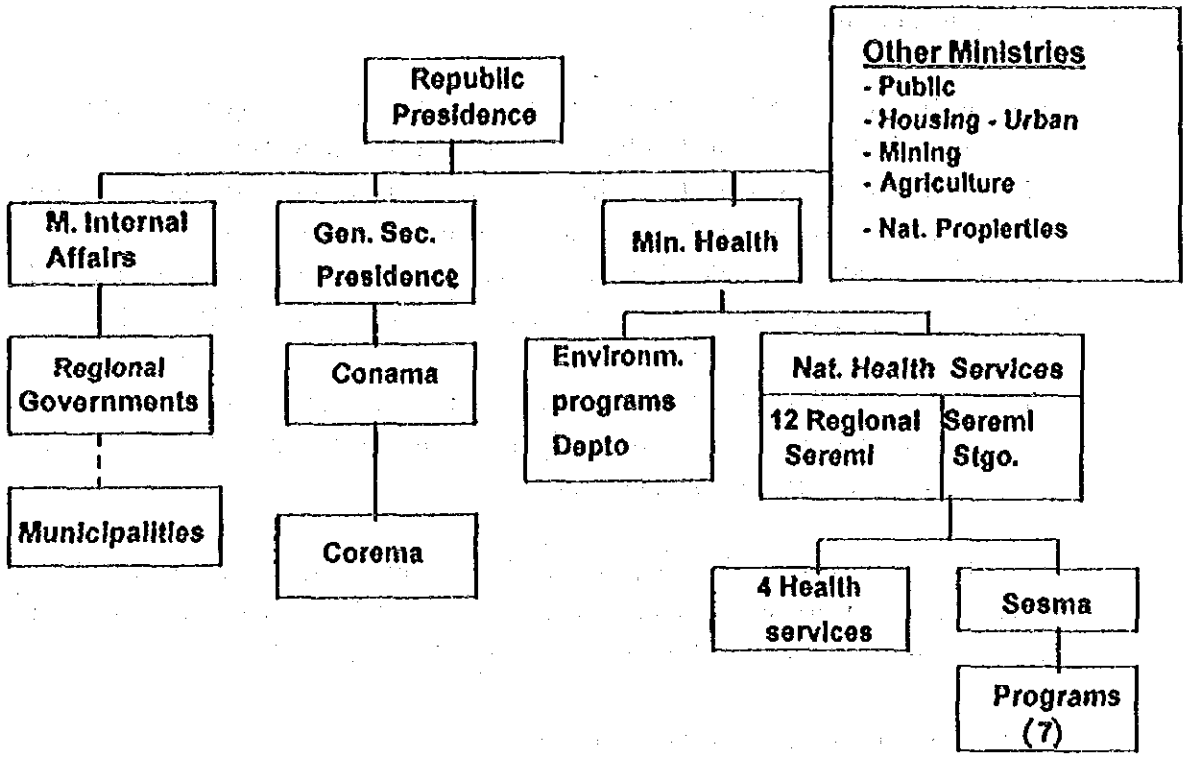

Figure 4.2.1a National and Regional Organizations which Regulate Environmental Matters

4.2.2 Organizations Related to Industrial and Medical SWM

Many other governmental and local bodies are presently involved in environmental administration. Presently, the most important ones are the Health Services (Servicios de Salud (SS)) which belong to the Ministry of Health (Ministerio de Salud) under an umbrella organization called National System of Health Services (Servicio Nacional de Servicios de Salud (SNSS)). There is one SS in each region. The SS have a medical and an environmental branch and are usually located in the main hospital of the region. The environmental branch of the SS is presently in charge of issuing environmental authorizations.

In the metropolitan area the environmental branch of the SS is named separately and is known as the Metropolitan Health Service for the Environment (Servicio de Salud Metropolitano del Ambiente (SESMA)). SESMA has under its jurisdiction several offices in charge of different environmental issues, for example one for industrial sewage (RILES), one for domestic waste, and one for air emissions and industrial solid waste (Programa de Control de Emisiones de Fuentes Fijas (PROCEFF).

SESMA has through PROCEFF initiated a thoroughly developed control system for industrial waste from manufacturing industries. This system includes a registration of the major waste generation industries.

SESMA is a very dynamic body, working in function of programs supported by a small permanent structure, composed by four technical departments. Each program has a coordinator, a technical team and a small Administrative Staff.

SESMA is now working on seven programs:

- Basic sanitation: drinking water, sewage, industrial liquid effluent, domestic solid waste, domestic pesticides, vectors, public areas control, and irrigation channels control (cholera);
- Air monitoring and control of the atmosphere;
- Health Education;
- Dietetics;
- Occupational health;
- Zoonosis;
- Stationary Emission Sources Control (PROCEFF): air emission and ISW.

SESMA and the Health Services attain, by means of issuing recommendations to their own units, some degree of control over the waste management of the residues resulting from medical and paramedical activities.

and paramedical activities.

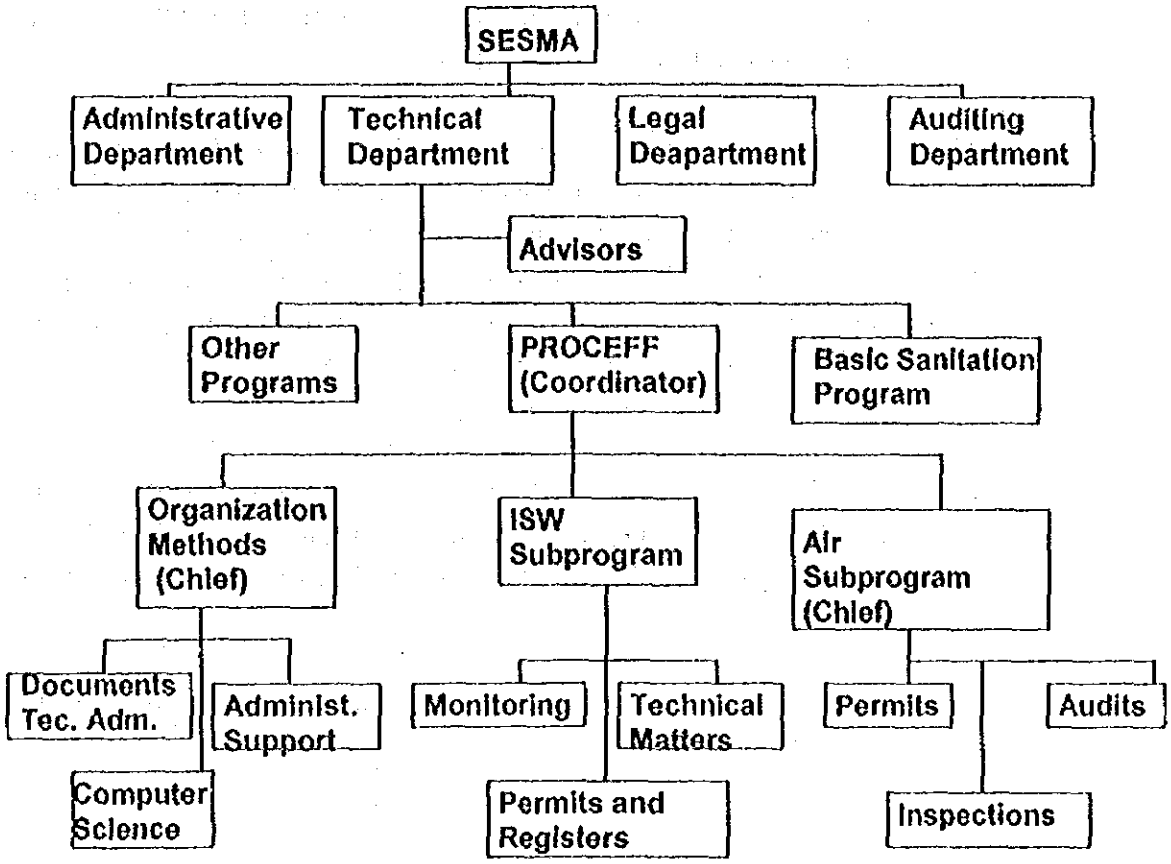

Figure 4.2.2a SESMA Organization Diagram

4.3 Legal System

4.3.1 Legislation and Enforcement

a. Basic Environmental Act and CONAMA

The environmental legislation in the Republic of Chile is at its very beginning. An environmental act was passed through Parliament in 1994

The above-mentioned act is known as the "Environment Basic Law" (Ley de Bases del Medio Ambiente) and the law is number 19,300.

The Environment Basic Law is in its form and content to a large extend directed towards regulating enterprises. Its main part is chapter II. The essential part of this chapter is applied to defining the conditions for and the content of Environmental Impact Studies (Estudios de Impacto Ambiental (EIA)) and of Environmental Impact Statements (Declaraciones de Impacto Ambiental (DIA)). However, in order that the system of Environmental Impact Study becomes obligatory, establishment of the regulation which regulates it is necessary.

Environmental protection issues are related to a National Comission for Environmental Protection (CONAMA). CONAMA has in general functions related to it being an administrative body responsible for the formulation of the overall environmental policy of Chile.

Article 10 of Chapter II indicates which projects for treatment or disposal of ISW must undergo an EIA.

b. Act 5081/93 from SESMA

This act establishes a declaration and monitoring system for ISW generated in the MR.

c. Law 3.133/16 and its Regulation from Decree 351/92

Decree 351 defines the concepts and the industrial activities affected (identified by CIIU code), whose effluents may not be discharged to any aquatic environment, whether natural or artificial, below or above ground level, without authorization. Such

authorization is always required when the effluent is harmful to the water for both irrigation and drinking purposes. The requirement is extended to discharges into the sewerage system that may damage the collection or treatment systems, or that infringe the quality standards in force.

d. Sanitary Code

The Sanitary Code contains several articles related to ISWM. Among these articles, it is important to mention the one indicating that any project related to the construction of facilities intended for the discharge, treatment or disposal of industrial and mining waste (regardless of the type) must be approved by the Health Service (Servicio de Salud). Furthermore, the Health Service must issue the pertinent permits prior to the start of any construction work.

e. Supreme Decree 745, from 1992, by the Ministry of Health

This decree contains the regulations for Basic Sanitary and Environmental Conditions at the Workplace. It makes some reference to industrial waste and establishes criteria for the on-site storage, treatment and disposal of waste within the industrial site.

4.3.2 ISW Control

SESMA has through PROCEFF initiated a thoroughly developed control system for industrial waste from manufacturing industries. This system includes a registration of the major waste generation industries. The waste from these industries is then controlled via a declaration system on which the waste generating plant informs PROCEFF about the monthly amounts of waste, the waste transporter and the final destination of the waste.

4.3.3 Permit for ISWM Facilities

Law 19.300, under the name Basic Environmental Law ("Ley de Bases del Medio Ambiente"), indicates which projects related with hazardous ISWM and treatment/disposal of ISW must clear an EIA. The acceptance of the project will then be accompanied by the environmental permits or notification that the government

bodies are able to issue at the time.

The following permits or notification will be necessary:

- Change in land use issued by the Agriculture and Livestock Service (Servicio Agrícola y Ganadero, SAG), which falls under the Ministry of Agriculture.
- Approval by SESMA, under the Ministry of Health;
- Patent obtained at the corresponding municipality where the activities are to be developed.
- Permit from the municipality for the construction of civil works for the facility; and
- Authorization by SESMA for beginning of activities.

4.4 Present Problems and Keys for Solution

The status-quo of ISWM in the MR implies series of problems foreseen. In consideration with the trend of e.g. enforcement of series of environmental policies, expansion of industrial activities in the MR, and in addition international trends of enforcing stringent environmental regulations for industrial activities, a set of issues which require the Republic's actions in medium- and long-term are foreseen. The Team's comment regarding those problems and issues to be solved are expressed below.

4.4.1 Problems regarding the Present ISWM

a. Non-HW (Non-Hazardous Waste)

Municipal landfills in the MR, where non-hazardous ISW are presently disposed, comply with high level standards of landfill management (i.e. entrance control, daily coverage of landfilling faces, impermeability control measures and recycling of leachate, etc.). The exceptionally small precipitation level in the region enables leachate treatment by recycling. As long as the ISW received in those municipal landfills are non-hazardous and subject to special handling within the landfills, no problems are foreseen technically.

However, under the circumstances, following issues and problems regarding non-HW

are implied:

i. Increase of landfill cost

Non-HW will still constitute the majority of total industrial waste generation, municipal landfill disposal sites to which these industrial non-HW are disposed will in short complete their service life. Since future municipal landfill sites will tend to be in remote areas, sitable and economical locations like present municipal landfill sites are not reserved for the future landfill development. It is envisaged that solid waste disposal cost may considerable be raised as a consequence.

ii. Lack of disposal sites for ISW

Furthermore, disposing of non-hazardous ISW into municipal landfill sites may not be allowed for long. If planning lacks consideration of establishing ISW final disposal facilities through utilization of private sectors, existing final disposal facilities would be in the near future congested and overloaded, resulting in facilities unable to contend with the waste influx.

iii. Increase of illegal dumping

Both the disposal fee of 3 to 6 US$/ton of present municipal landfill sites and their location being near the urban area (which enables lower transportation cost) leads to less illegal dumping of ISW. Meanwhile, since there are quite a lot of illegal dumping sites including locations nearby municipal landfill sites, environmental deterioration including underground water contamination is envisaged. If final disposal sites are to be constructed in remote places and disposal fees are raised, it may easily lead to a rapid increase in illegal dumping.

b. HW (Hazardous Waste) and LW (Liquid Waste)

Problems in relation to non-HW are comparatively simple as mentioned previously, thus countermeasures to be proposed might also be rather easy. However, problems foreseen in "HW and LW" are complicated and serious as described below.

i. Scarce generation

Generation of HW (26,000 ton/year) and LW (45,000 ton/year) in comparison to that of non-HW (868,000 ton/year) are small at present. It is understood from

its background that since standards for discharged water quality have not yet been enforced and regulations and guidelines for air pollution have just been introduced in Chile, the majority of industries have not commenced air/water pollution protection measures. For example, a survey of the Superintendency of Sanitary Services of the Ministry of Public Works in 1994 reported only 19 factories out of the surveyed 894 factories (it counts for only about 2%) was equipped with some waste water treatment facilities. Under such circumstances, many hazardous substances are, not emerging as ISW, dispersed into the air and water environment.

ii. Indifference to hazardous substances

As for ISW in general, majority of hazardous substances are mainly emitted as contaminant in dust, ash, sludge or liquid waste. However, at present most old, small and medium size factories are indifferent to particular movement of hazardous substances and therefore waste water, exhaust gas and ISW are equally disposed without making any distinctive segregation from other solid waste.

iii. Potential contamination

Under such circumstances, because of the following reasons, problems are not tangible nor eminent.

- Public water courses that receive considerable HW and LW in particular do not present evident problems yet since rivers to be discharged (Maipo river and Mapocho river) are rich in flow and they run straightly into the open sea without retarding in bays.
- ISW disposed at municipal landfill sites do not present prominent problems, since the quantity disposed is still small and the landfill facilities are equipped with high waterproof and leachate recycling suffices as its treatment.

On the other hand, it is reported that vegetables (such as lettuce) in those river basins are not edible uncooked, since they are contaminated with municipal sewage water. Which implies that soil contamination by heavy metals discharged from industrial sewage and consequently contamination of agricultural products are grave.

iv. Increase of ISW Quantity

However, it is evident that when air and water pollution prevention standards are

put into practice in future, generation of HW and LW, which is currently minimal, will rapidly increase and then these problems of ISW shall become more apparent.

4.4.2 Keys for Solution

In order to solve the problems foreseen above, the following keys for a solution may have to be considered.

i. Clarification of responsibility

It is necessary to clarify that waste generators are responsible for control and disposal of ISW. Meanwhile, the scope and division of administration (among national, local authorities, etc.) regarding ISWM should clearly be stipulated and operated within a legislative framework.

ii. Formulation of ISWM framework in relation with air and water pollution regulation

In order to establish management system of ISW at generation, it is essential that an ISWM framework closely connected with air and water pollution prevention should be established. It especially is indispensable to practice waste water regulations (i.e., pre-treatment before discharging into sewage).

iii. Identification of the status-quo of the ISWM and establishment of an information management system

It is the basic principle and the first step of ISWM to identify precisely the status-quo of individual waste generators' management, to understand current global situation of ISWM in the MR, and to establish an information management system in this regard. Fortunately, the Manifest System is already in operation by SESMA-PROCEFF. The Team's surveys further contribute to accumulation of data and information regarding the present situation of generation, control and treatment/disposal. It is necessary, in order to understand the status-quo, to establish a framework of information management system by starting with accumulation of data through factory visit surveys by SESMA-PROCEFF and reports submitted by factories.

iv. Establishment of administrative framework to promote ISWM policies

It is necessary to establish an integrated administrative system to formulate national level ISWM policies, and an organization (especially in local authorities) in charge of monitoring and guidance of ISW. Relative to this, legislative support should be realized (e.g. "report collection", "on-site investigation" should be allowed, and "illegal operations" should be prevented with empowerment of administrative orders and measures.). At the same time, in view of industries' air- and water- pollution control, on-site ISWM and control of hazardous materials being inter-linked, cooperation and collaboration among respective authorities related are indispensable. Furthermore, officers capable of monitoring and placing guidance should be trained.

v. Establishment of on-site ISWM

One of the basic principle of ISWM is that industries (as primary waste generators) should establish a system that copes with on-site ISW control and treatment, and entrusted disposal. In-house management and technology system responsible for ISWM should be established. Therefore industries need to allocate an engineer/manager capable of supervising water and air pollution control, as well as control of hazardous materials and ISW. Meanwhile, it is expected for authorities to take such actions that relative human resource development be promoted (system of training program and/or allocation of technical manager be obligated to industries.).

vi. Establishment of ISW treatment/disposal facilities

Majority of ISW is presently disposed at municipal landfills. It is envisaged that municipal landfills currently in operation will in short complete their service life and new ones will be located in remote areas. Whereas generation of ISW (especially HW) is estimated to rapidly increase in future. Consequently, it is judged that intermediate treatment and final disposal facilities for ISW are urgently needed. Especially among others, establishment of final disposal facilities for HW is an essential issue in formulating ISWM in the MR.

vii. Other Issues

In order to establish an appropriate control system for ISWM in the MR, it is necessary to formulate a system which enables:

- establishment of appropriate on-site ISWM by generators,

- formulation of market mechanism where generators can entrust treatment, disposal and resource recovery of ISW to agents, and
- elimination of illegal treatment/disposal and dumping.

In this context, in addition to the above, issues in variety mentioned below need to be solved:

- technical standards and guidelines which promote appropriate on-site ISWM by generators,
- permission procedure for siting of ISWM facilities,
- EIA system regarding facilities siting,
- promotion of laboratory analysis sectors and ISWM facilities manufacturers who are indispensable to realize analytical identification and monitoring of HW, etc.